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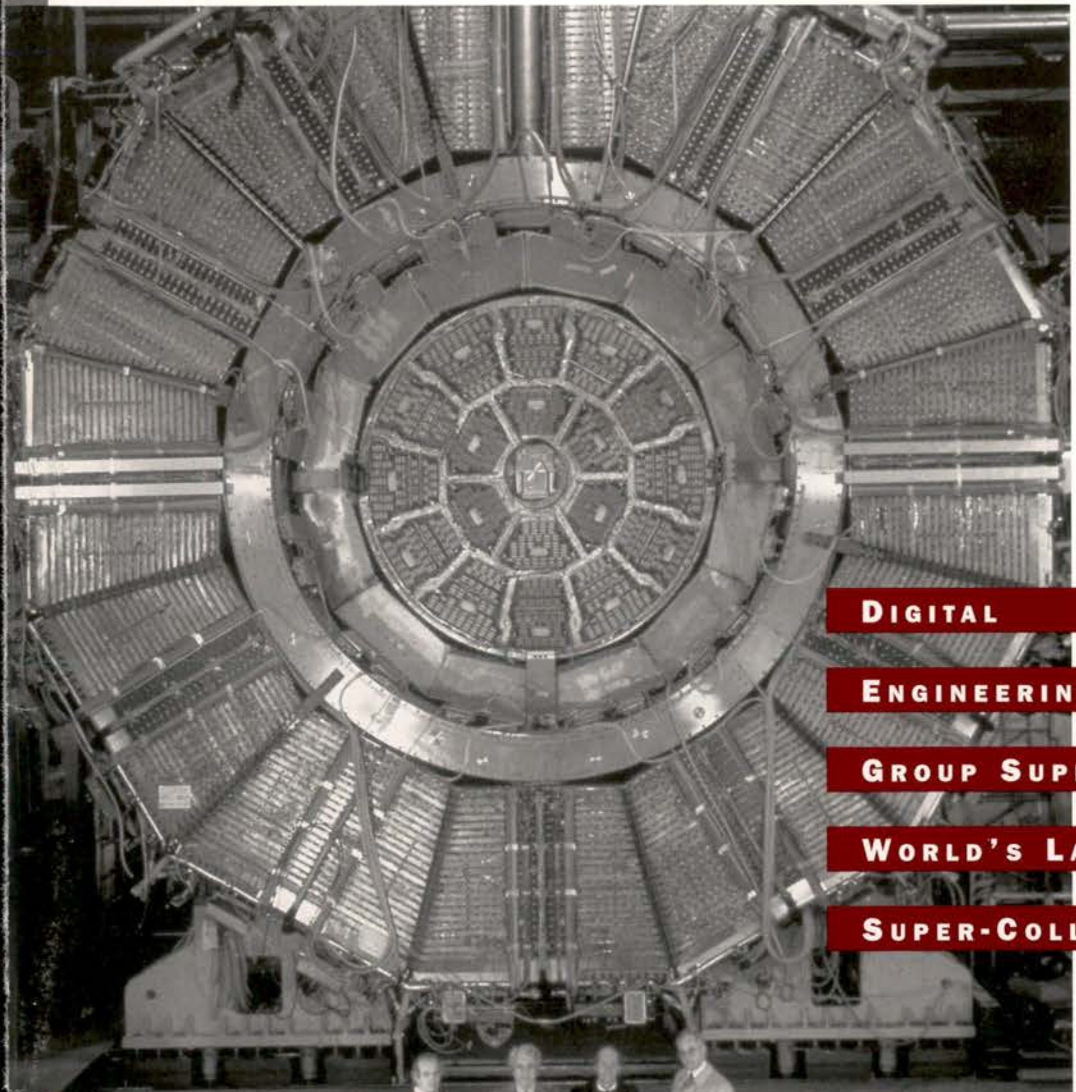
Forefront

A magazine for the technical community

Fall 1997



DIGITAL ENGINEERING GROUP SUPPORTS WORLD'S LARGEST SUPER-COLLIDERS

HIGHLIGHTS

- **UltraSCSI: A DIGITAL Technology Shared with the Industry**
- **Design of the AlphaServer 800**
- **Engineering Promotions**
- **Patent Awards**

Sam Fuller, Chief Scientist and Vice President of the Corporate Technology Strategy and Services Group

Message From Sam Fuller

CERN, located on the border of Switzerland and France, is the world's largest particle physics research center. Many of you are familiar with the laboratory's work in physics and its large underground collider and with the role the lab has played in the development of such technologies as the World Wide Web.

DIGITAL has benefited in a number of ways from working with the laboratory over the past decade, and as you'll learn from the feature article in this issue, we are now putting in place plans for future collaboration as CERN ramps up for its next phase of research.

While fundamental physics research is CERN's reason for being, the laboratory plays a vital role in spearheading the development of tomorrow's information technologies. DIGITAL's opportunity is to apply its expertise in high-performance technical computing to help solve the advanced technology issues presented by CERN scientists, whose experiments generate literally petabytes of data. As we resolve these problems, we gain significant new insights into the future computing needs of our customers.

A final word: Congratulations to the newly promoted Consulting Engineers and the latest patent award recipients who appear in the Promotions and Awards section of this issue. Those of you who are becoming involved with patentable work for the first time will want to look at the article in the Patent Program section that outlines two recently created awards for inventors.

Sam Fuller

forefront MAGAZINE

AKO2–3/B3

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Fall 1997 Issue

Forefront magazine is a forum for the worldwide DIGITAL technical community to share information, technology and strategic directions, and key accomplishments.

Forefront welcomes contributions of interest to the DIGITAL technical community. The submission deadline for the next edition is October 1, 1997. Contact Managing Editor Dick Willett for information.

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IN THIS ISSUE

Cover Photo

Four scientists are dwarfed by the CERN ALEPH detector, one of four experimental detectors positioned in the 27-kilometer-long accelerator tunnel. The detectors are located at the points where the counter-rotating beams of electrons and positrons collide, creating sprays of subatomic particles and debris. DIGITAL engineers aid physicists in the collection and analysis of the massive amounts of data that result from these experiments.

The DIGITAL Joint Project at CERN

Understanding CERN's computing needs—particularly in communications and data storage—helps DIGITAL anticipate the demands of more mainstream businesses, providing the competitive edge to forge ahead in many areas of high-performance technical computing.

By Geraldine Cotter, High Performance Computing, Galway, Ireland; CW Hobbs, Steve Carney, and members of the DIGITAL Joint Project at CERN—past and present

Photos courtesy of CERN

The DIGITAL Joint Project engineers gathered in front of the DIGITAL TL820 DLT tape robot for a quick portrait by CERN's Axis NetEye Web camera. From left: Stephen Carney, Jean-Pierre Thibonnier, Alberto Guglielmi, and CW Hobbs. Located in the CERN tape vault, the tape robot holds 1,320 cartridges and has a 3.2-terabyte capacity.

The DIGITAL Joint Project–CERN was established in 1987 to build relationships between the European Laboratory for Particle Physics (CERN) and DIGITAL engineering organizations. The formation of the Joint Project represented an extension and endorsement of several successful DIGITAL–CERN collaborations during the preceding years.

During these 10 years, the Joint Project advanced development group, located at the CERN campus on the Franco-Swiss border, has continued to reinforce the strong relationship between DIGITAL and CERN.

As a leading-edge research institution, CERN is always at or beyond the limits of current technology. The Joint Project provides an exciting opportunity for DIGITAL engineering to learn from CERN, in order to anticipate products that will be needed in the future.

About CERN

CERN stands for the French version of the lab's original name Conseil Européen pour la Recherche Nucléaire or European Council for Nuclear Research. It is known to many as the creator of HTML and the cradle of the World Wide Web. Today it is the world's largest high-energy physics (HEP) lab, devoted to the exploration of the structure of the basic building blocks of matter. Located in the vineyards between Geneva and the Jura Mountains, CERN provides a campus-like setting for about 3,600 staff members and 6,500 visiting scientists.

Most of CERN's experiments currently are carried out in the Large Electron-Positron Collider (LEP), a complex facility housed in a deep underground tunnel that is 27 kilometers in circumference. The instrument is so large that it requires chambers underground, each the size of a three-story building, to house the detectors. LEP even has its own monorail train for access to the magnets and equipment in the tunnel.

Within the next few years, LEP will have been fully exploited for research needs. As a result, CERN is now preparing for the next phase of its development—the replacement of LEP with a proton-proton collider called the Large Hadron Collider (LHC). The LHC will replace LEP in the same underground tunnel.

The LHC will be a particle accelerator based on high-power, superconducting magnets, each 24 meters long. Approximately 10 years will be needed to design and build one of the largest and most complex scientific instruments ever constructed. Whereas LEP was primarily a European venture, LHC is an international collaboration. When LHC begins operation, CERN will be the pre-eminent center for high-energy physics in the world.

Powered by Alpha Systems

The announcement of the VAX 8600, together with the introduction of the VAXcluster architecture in the early 1980s, made DIGITAL a serious contender for providing a scientific computer-center style of service. CERN was soon to have one of the largest VAXclusters in Europe, providing the time-sharing, development, and offline computational environments needed to design the LEP. The joint project Cluster Automated Operations Service developed software to automate systems management tasks for the cluster. Today this cluster is Alpha-based, with almost a hundred times more power than it had during LEP design.

Most of the online computing needs for LEP are built around OpenVMS systems. The combination of the soft real-time capabilities of OpenVMS and the closely coupled distributed computing of VAXclusters was ideal for LEP's needs. In particular, the depth of the LEP tunnel (less than 200 meters) was within the limits of an Ethernet connection. CERN was able to install several cluster nodes down near the detector, while the main cluster remained in the control room on the surface.

With the help of engineers at the Joint Project, these online clusters have migrated from OpenVMS VAX to OpenVMS Alpha systems.

The LEP monorail: a 27-kilometer circular ride

DIGITAL hardware continues to play a major role as CERN prepares for the LHC. The design of LHC relies on the most advanced supercomputing magnet technology ever employed—a detailed knowledge of the magnet's magnetic field is vital for success. This knowledge will be acquired by simulating the evolution of particles constrained in the magnetic field. Last year CERN purchased a 10-processor TurboLaser (AlphaServer 8400) to provide the power required for the magnet simulation in the Numerical Accelerator Project (NAP).

In addition, DIGITAL and the Joint Project are key players in the Alpha Magnetic Spectrometer (AMS) for the International Space Station Alpha. The AMS project is being managed and assembled by an international team of scientists, some of them at CERN and at the Massachusetts Institute of Technology. Charged particles from outer space will transit the detector, where signals are captured and then downloaded to DIGITAL Alpha systems at the AMS ground facility at the Johnson Space Center. DIGITAL will have major responsibility for ensuring that none of the data is lost (collected during 3 years at a rate of 1 megabyte/second). This will be a perfect showcase for DIGITAL TruCluster systems.

Phenomenal Amounts of Data

Some of the LHC challenges already have been successfully addressed by DIGITAL Joint Project engineers as part of work on LEP projects. As early as 1987, DIGITAL was involved in the development of EERP 200, a complete, real-time, data-acquisition operating system. Other LEP projects at the Joint Project included data-acquisition hardware and software for the VAXBI bus systems being used, and special high-speed communications links between the VAX systems and the main computer center.

The TURBOchannel to HiPPI hardware interface (and later PCI–HiPPI) was a significant data-acquisition project worked on jointly. The NA48 experiment uses this interface, in the final trigger stage, to transfer more than 70 megabytes/second from the detector directly into the memory of an Alpha workstation. When this interface was deployed in 1994, no other technology or vendor was capable of maintaining a similar transfer rate into a general-purpose workstation.

One of the major differences between LEP and LHC is the amount of data that will be produced. When fully operational, the LHC will be a much-higher-energy (14-TeV) collider than LEP. It will produce many more collisions per second, and each collision will contain much more information. From the moment LHC goes online, it will start to produce a veritable tsunami of data.

A LEP detector experiences a collision (an event) about every 10 microseconds, and each event generates about 100 kilobytes of data. Because many events are uninteresting, hardware triggers in the detector electronics filter this to a few events per second (equal to about 1 megabyte/second) to be saved on tape from the raw data rate of about 10 gigabytes/second.

LHC will produce a collision about every 10 nanoseconds—1,000 times more often than LEP. Each event also will be about 10 times larger—about 1 megabyte. This gives a raw data rate of 100 terabytes per second (or about 100 megabytes per microsecond!). Fortunately, this data also will be filtered by several layers of hardware and software triggers—but still about 100 megabytes/second of data must be processed and saved.

Each LHC experiment is expected to produce at least a petabyte (10^{15} bytes or 1,000 terabytes) of new data annually, resulting in between 2–5 petabytes of new data per year. A revolution in data-capture techniques and capabilities is required to deal with such massive data rates. Unlike the LEP, storing all the original data returned from the detectors is out of the question. A filtering process must be used to summarize or select the most interesting events.

At 10 gigabytes per cartridge, these tapes could hold the raw data from a half-second of LHC operation or the final data from 3 days of operation.

The filtered data will be stored in an object-oriented database (OODB). The RD45 Joint Project with CERN is investigating scalability and performance issues for OODB-based storage. An early phase of this project will construct a 1-terabyte OODB that will pave the way for LHC's multi-petabyte OODBs. Such large databases are at the limits of present technology—for both software and hardware. This project requires extensive cooperation between DIGITAL, CERN, and the OODB vendor, Objectivity.

"Just as the world is coming to grips with gigabytes and terabytes, CERN already is dealing with petabytes and beyond," says Steve Carney, the DIGITAL Joint Project engineer working on the RD45 project.

This quantity of data cannot be maintained reasonably in online disk farms; a hierarchical storage system automatically will migrate less frequently accessed data to and from tape robots. CERN and RD45 have determined that the High Performance Storage System (HPSS) project, sponsored by IBM Government Systems and five US Department of Energy labs, is the best solution for their needs. HPSS is a scalable, parallel storage system designed to manage data farms of many petabytes of storage. It has the ability to transfer data at hundreds of megabytes per second between disk and tape servers and the high-performance client systems. The DIGITAL engineers at the Joint Project, in collaboration with CERN and IBM, are about to embark on a project to port the HPSS client, disk, and tape servers to DIGITAL UNIX systems.

The point of the LHC research is to discover a model that explains the data being produced by the detectors and thereby to validate our understanding of the fundamental models of physics and matter.

An Insatiable Appetite for Compute-Power

Of course, the scientific process does not end when the LHC data is inserted into a database. The point of the research is to discover a model that explains the data being produced by the detectors and thereby to validate our understanding of the fundamental models of physics and matter.

Science at CERN consists of a process whereby the physicists

- collect raw data from the detector,
- reconstruct the events from the raw data,
- perform statistical analysis of a large number of events,
- refine the mathematical model according to the new data,
- simulate new events based on the new model, and
- compare simulated data with collected data.

The iterative steps—reconstruction, analysis and simulation—require enormous amounts of computing power.

Reconstruction refers to the process of taking the raw data and turning it into useful information for physicists. As the various particles created by a collision travel through the onion-like layers of the detector, their positions are recorded in a three-dimensional time-space array, indicating where a particle passed at a certain time. When the trigger systems in the detector decide that an event should be captured, the data from this array is compressed and fed to the online system as a raw event to be saved.

Reconstruction is followed by *analysis.* To be useful, this data needs to be interpreted as tracks of particles of a certain charge, velocity, and mass. The sparse hits in the array need to be transformed into the paths of particles. The mass, velocity, and charge of these particles need to be calculated. Various layers of the detector measure different physical properties—some detect charged particles, whereas others are sensitive to mass. The reconstruction process must use its knowledge of the detector structure to determine the nature of each particle and track. After the event has been reconstructed, it can be visualized as something intuitive—as a shower of debris from the site of the collision.

It is predicted that ATLAS, one of the LHC experiments, will take about 700 SPECint95-seconds to reconstruct each event—or about 45 CPU-seconds on a 600-MHz Alpha system. These events will be arriving from the detector at 100 events per second—which means that more than 4,000 of the fastest DIGITAL systems would be needed to keep up with the data generated by just one LHC experiment.

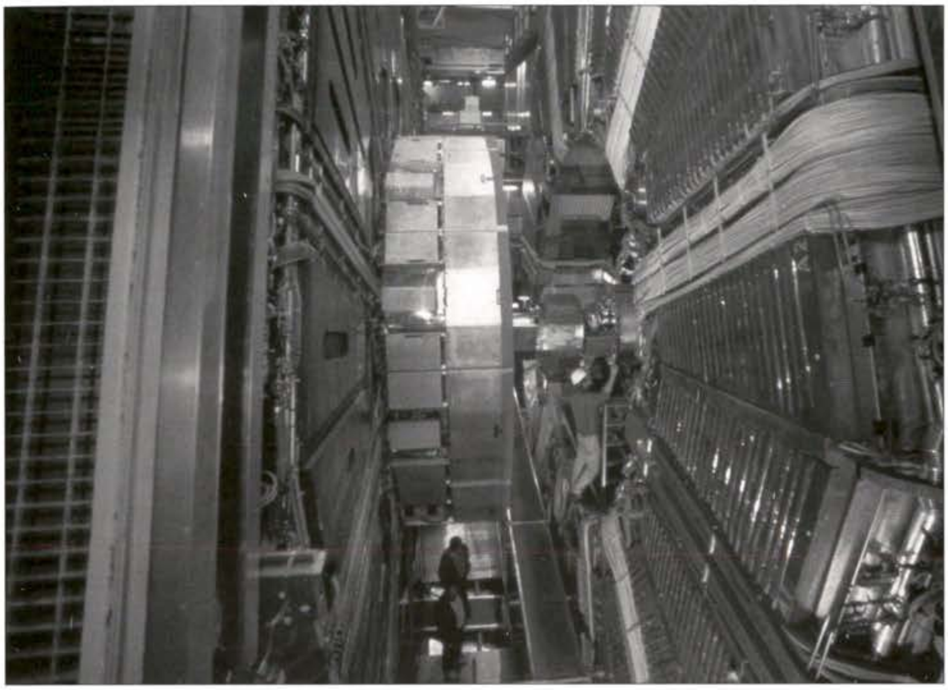
Event simulation is done via Monte Carlo techniques. It is slightly slower than reconstruction—about 750 SPECint95-seconds per event—but fewer events need to be simulated. For ATLAS, it is estimated that a total of 50,000 SPECint95 will be needed for Monte Carlo simulations. This can be satisfied with another 3,000 Alpha systems running at 600 MHz.

The analysis stages, however, will require somewhat more CPU power than the reconstruction and simulation combined. The reconstructed events from the detector will be analyzed for types of particles, energies, and other properties. The analyzed events will be stored in an object database for repeated access. Similarly, the Monte Carlo simulated events also will be subject to analysis before being compared to the real data.

The ATLAS collaboration estimates that it will need 130,000 SPECint95 for the analysis step—another 8,000 Alpha systems.

The computing power required for just one LHC experiment can be summarized as follows in this table:

Experiment phase	SPECint95	Equivalent in 600-MHz Alphas
Reconstruction	70,000	4,375
Simulation	50,000	3,125
Analysis	130,000	8,125
Total	250,000	15,625



One of CERN's four accelerator detectors opened for maintenance

Adoption of a vendor's technology by CERN can often be the key to market success.

Note that this estimate does not include the processing power needed for the hard real-time processing in the trigger and filtering components of the detectors themselves. One estimate from the CMS experiment is that the CMS detector will require 30,000 SPECint95 for this task.

When LHC begins operation in the year 2005, the available processors will be many times faster than today's CPUs. Even with the EV-7 and later chips, however, it will take a huge number of computers to cope with LHC's computing demands.

Learning from CERN

DIGITAL's involvement in CERN is not entirely altruistic. Over the years, it has become obvious that CERN's computing needs—particularly in relation to communications and data storage—are often a year or more ahead of other customers' demands. By listening to CERN, DIGITAL can anticipate the needs of more mainstream businesses.

"CERN's problems today will be experienced by other customers tomorrow," stresses Jean-Pierre Thibonnier, engineering project leader of the HPSS project at the Joint Project. "Learning from our experience at CERN can give us the competitive edge we need to forge ahead in many areas of high-performance technical computing."

The CERN "crucible" has provided many ideas that have been integrated into DIGITAL base products. For example, TruCluster Available Server, now a focal point of the TruCluster suite of products, began life in the Joint Project as a solution to a CERN need for shared–SCSI access from DECstations. A joint project to build an interface to feed an ULTRIX compute farm from the VMS systems evolved into DEC Distributed Computing Services, a product that was part of the initial wave of Alpha migration tools.

A Joint Project performance study on the migration of the central VMS timesharing service to Alpha systems was used to justify the product development of FDDI–based disk servers such as the StorageWorks Network Storage Array family. The study was done to demonstrate to CERN that Alpha systems connected by FDDI were comparable in I/O performance to the CI–based cluster. It also convinced DIGITAL that a similar system could be a profitable product.

Adoption of a vendor's technology by CERN can often be the key to market success. If a specific technology is good enough for CERN, it is likely to be adopted by many other HEP laboratories. This is especially important as CERN management is moving towards emphasizing solutions based on commercially available hardware and software, instead of building their own solutions.

If a specific technology is good enough for CERN, it is likely to be adopted by many other high-energy physics laboratories.

The Trigger Farm joint project is working with ATLAS on its event reconstruction environment, collaborating on the second-level trigger demonstration. The Trigger Farm is proving that DIGITAL commercial MEMORY CHANNEL technology is a viable solution for its event reconstruction switch—a high-bandwidth path for consolidating event data from different detector systems into individual events.

An Important Field Test Site

CERN has become one of the most important external field test sites in the world for DIGITAL. CERN was the only European field test site for the initial suite of DIGITAL FDDI hardware. Both the GIGAswitch and GIGAswitch/ATM were field-tested at CERN. The Joint Project has managed field tests for the DECsystem 5500, and the initial Alpha system prototypes for the Flamingo (DEC 3000/500) and Ruby/Laser (DEC 7000) were deployed at CERN long before the public announcement of Alpha. CERN is a perpetual software field-test site for OpenVMS and DIGITAL UNIX, DIGITAL Fortran and DIGITAL C/C++, networking, and many other products.

DIGITAL Gigabit Ethernet is an important field test being coordinated by the Joint Project. Alberto Guglielmi, the Joint Project engineer responsible for data acquisition and real-time processing, says: "Our good relationships with NA48 and the DIGITAL network group create an environment to test Gigabit Ethernet in a demanding production application."

An Invitation for Engineering Internships

Each year thousands of visiting scientists join CERN's staff to conduct a wide variety of experiments. One such experiment, UA-1, led to the discovery of the W and Z particles and earned the Nobel Prize in 1984 for Carlo Rubbia and Simon van der Meer. The prevailing atmosphere at the Joint Project, where scientists and engineers work side by side, is one of openness and university-like learning.

To capitalize on the unique growth opportunities at major customer sites, the DIGITAL High Performance Technical Computing group invites applications for 3- to 6-month engineering internships at the Joint Project. Mark Gantly, HPTC engineering manager, describes the internships as "an unrivaled opportunity to experience leading-edge customer problems first-hand and take an active role in their solution."

"Working at a customer site such as CERN can be a surprising reality check for an engineer," adds CW Hobbs, a senior engineer in the Joint Project. "Sometimes you find out that what seemed to be a sensible design decision, when you were sitting in your cubicle, simply doesn't make sense when you are with the customer trying to solve a problem."

Interested engineers, who have worked in a combination of UNIX, LINUX, and OpenVMS computing environments and have knowledge of ODBMS technology, should contact Mark Gantly at mark@ilo.dec.com. ✳

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The DIGITAL Joint Project at CERN

Delivering Relevant Information to Your Desktop

The 12 types of technical information most frequently used by the DIGITAL global technical community are accessible from the desktop via the WebLibrary.

By Joan O'Brien, Technical Information Program, Corporate Library Group, Acton, Massachusetts (AKO-2)

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Delivering information to the diverse DIGITAL technical community is a complex task. User feedback to the Corporate Library Group (CLG) is invaluable to this undertaking. In a recent survey of the technical community, respondents were asked to name the types of information needed for their work. They also were asked how frequently they use various types of information.

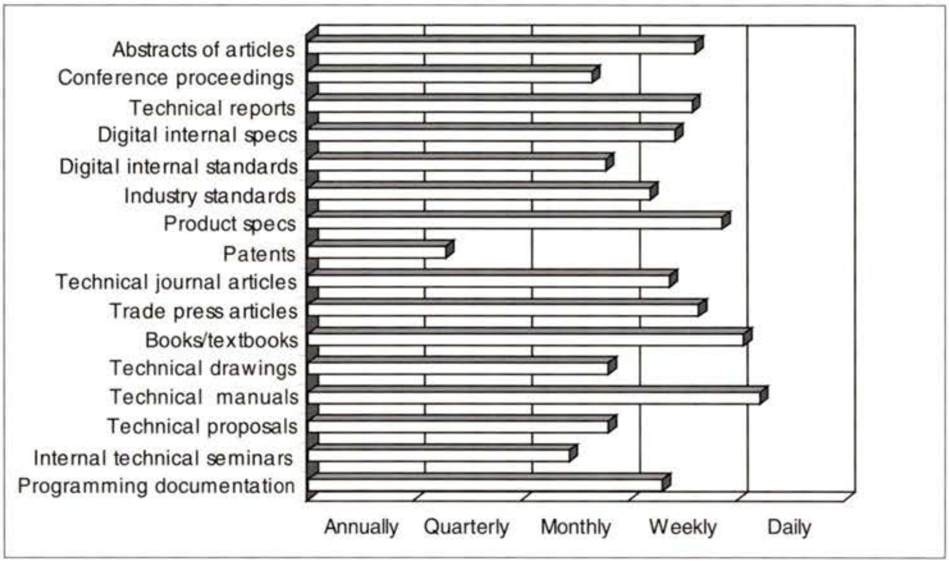

Figure. The technical community frequently requires many types of information.

As seen in the Figure, *technical manuals, books/textbooks,* and *product specs* are the three types of information used most frequently by the entire sample. *Abstracts of articles, technical reports,* and *trade press* are ranked close behind. Although the overall sample uses *patents* and *technical drawings* less frequently, a distinct number of users from every division and business unit *do* need them. The data differs somewhat when it is analyzed according to the respondents' areas of expertise. The heavy demand for technical manuals is influenced by the fact that 45% of survey participants work in the Services Division, where technical manuals are often used.

Regardless of how the data is analyzed, the results suggest a technical community that requires many types of information in the performance of their jobs. Whether you consider the entire sample or merely those in areas of expertise, 10 types of information are used by each group more frequently than monthly.

CLG WebLibrary

Produced in fiscal 1997, the CLG Technical Information Program's (TIP) "Technical Information Resource Page" on the CLG WebLibrary provides links to technical information resources that are evaluated and acquired specifically for the worldwide DIGITAL technical community. The evaluation process uses the criteria amassed during the user survey.

In fiscal 1998, TIP will be adding more technical resources to the WebLibrary, so visit the page often to find the resources you need.

You can find full-text versions of patents, trade press and industry articles, and technical reports. You can search article abstract databases and order full-text electronic delivery. Links to standards issuing bodies also are located on the WebLibrary as well as links to external and internal product specifications.

DIGITAL Library Catalog

The CLG works continually to make it easy for you to browse our collection and request books, technical reports, standards, and videos. Soon the DIGITAL Library Catalog will be accessible from the CLG WebLibrary page. You will no longer need to download software to access the catalog. The new Web-accessible catalog will be "rolled out" in two versions. CLG will run a pilot program for each version:

> **The CLG works continually to make it easy for you to browse our collection and request books, technical reports, standards, and videos.**

- The first version, due in late September, will allow you to browse, but not make requests. The old software will be used in parallel with this version, so you still can request documents electronically.
- The second version, due in December, will allow you to browse and make requests. It will have all the functionality of the present software, but will be accessible through the CLG WebLibrary.

The pilots for each version of the Web DIGITAL Library Catalog will be announced on the CLG WebLibrary home page. Try them out, and give us your opinions.

Please check the DIGITAL Library Catalog frequently for new materials. New technical books are being added continually. Don't forget that if you have requests for new items, you can always contact us. We will try to accommodate suggestions. ✳

web*sites*

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The Corporate Library Group's WebLibrary

intranet
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Technical Information Environment Report and Recommendations

ACM on the CLG WebLibrary. Let us know what you think!

During the summer, the Association for Computing Machinery (ACM) sponsored a free trial of the *ACM Digital Library*. ACM made many of their publications available in full-text form on the Web. TIP is considering acquiring ACM's service for the worldwide technical community. If you have used the *ACM Digital Library* during the trial period, please contact me and tell me what you think of it. Your comments and suggestions will be valuable during negotiations with the vendor. ✳

Technical Seminars: Heavy Attendance a Sign of Success

Customized technical seminars are a great way to keep up to date. During the past year, 2,200 DIGITAL employees have attended 2-hour seminars on the latest technology in their fields.

By Linda Hart, Technical Competency Development Group, Education and Training, Littleton, Massachusetts

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Two years ago, the Technical Competency Development Group began a technical seminar program for the engineering community that has become an integral part of the education process at DIGITAL. How did this come about?

We needed a way to bring new information to the technical community because breakthrough information can lead to breakthrough products. Yet, information about emerging technologies is not always available in an "off-the-shelf" course, and not everyone has the time or inclination to attend a 2- to 5-day training course. Therefore, we developed free, 1- to 2-hour seminars that cover an array of topics recommended by the engineering community.

An Expanding Seminar Program

In fiscal year 1997, the technical seminar program hosted 55 seminars—25 more than planned. Why? Because the technical community asked for them, and we knew they would be worthwhile. Seminars nurture ideas and provide a gathering place to build enthusiasm for and pride in our existing projects and products. At seminars, new ideas germinate, too.

From left, seminar technical host Shlomo Novotny, Workstations Engineering, introduces Fritz Gaensslen, an independent consultant and expert on MOS device technology and circuits.

Program Goals

The goals of the program are

- to create an environment of greater collaboration among engineers from different disciplines;
- to provide a vehicle for conveying information to all engineers who want it;
- to provide knowledge on business strategies, new technologies, and existing projects and processes; and
- to provide an awareness of trends in emerging, leading-edge, or current technologies that affect the corporation's overall core competencies and business strategies.

Location of the Seminars

In fiscal year 1997, in close collaboration with Networks Engineering and Workstations, we concentrated our efforts in Littleton (19 seminars at the King Street facility [LKG]) and Maynard, Massachusetts (11 seminars at the Parker Street facility [PKO]). The LKG facility hosted many seminars due to its central location among the New England facilities and the presence of a well-equipped amphitheater (the Harbor Conference Room).

We also hosted 8 seminars at the Spitbrook Road facility (ZKO) in Nashua, New Hampshire, and 1 each in Shrewsbury, Massachusetts, and Salem, New Hampshire. These seminars are of a formal nature: employees register online to attend and later fill out evaluation forms. Statistics gathered from these evaluations help us better understand the needs of the technical community.

Technical seminars are advertised through e-mail, on posters, or on our Web site.

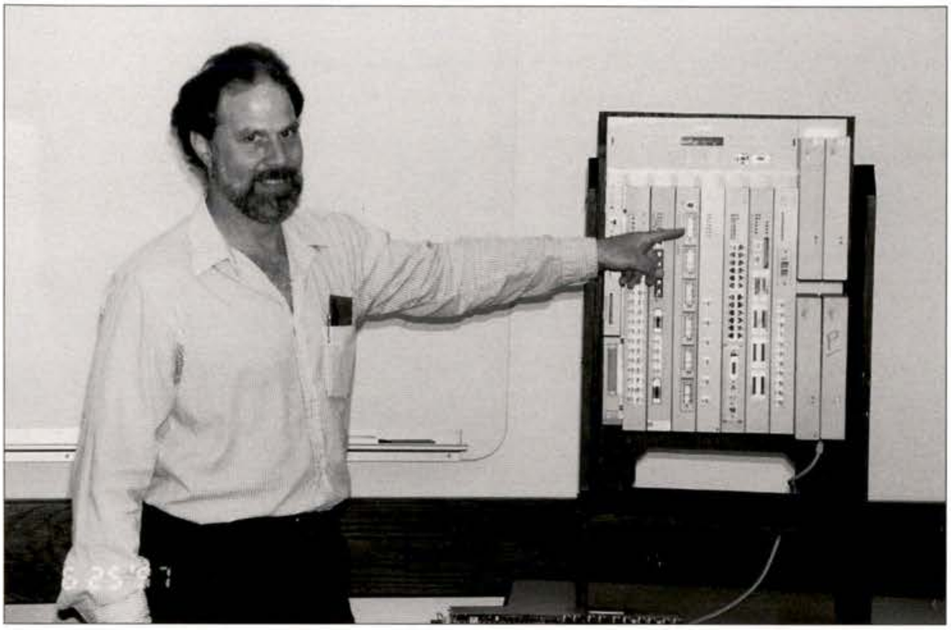
Lecturers from Inside and Outside DIGITAL

Seminar speakers come from academia, DIGITAL labs (for instance, the Cambridge Research Lab and the Systems Research Center), government labs (for example, the MIT Lincoln Laboratory), DIGITAL partners, and, most importantly, from among the ranks of the corporation itself. For example, Internet Protocol version 6 (IPv6) technical leader Jim Bound has spoken about IPv6 updates.

Academics who participated in the program during the past year included Raj Jain from Ohio State University speaking on performance and traffic management of IPs on ATM networks and Joe Jacobson, an MIT professor, who talked about electronic paper and electronic books.

From the DIGITAL research labs, we hosted Brian Reid from the Network Systems Laboratory and Hal Murray from the Systems Research Center (SRC). Hal spoke about evaluating the performance of ATM using TCP/UDP on DIGITAL UNIX.

We have been working closely with the MIT Lincoln Laboratory on a series of lectures related to the All-Optical Networking Consortium. Eric Swanson, assistant group leader of Lincoln Laboratory's Optical Communication Technology Group, broadcast a live, two-way video transmission from Lincoln Lab using fiber-optic technology. He presented an overview of the WDM AON program. In the future, we expect to use this technique again as a "long-distance learning" technology to present other lectures from MIT and Lincoln Laboratory.



Richard Graham, senior consulting engineer in Network Product Engineering, provides an overview of the DECHub 900 product set at a "Brown Bag Theatre" session.

A representative of the International Software Group, a DIGITAL Partner, spoke about Internet data access via a distributed OLE DB.

However, most of the technical seminar speakers come from DIGITAL. Here is a sampling.

- Jim Bound, IPv6 technical leader and consulting engineer, talked about IPv6 autoconfiguration.
- Jim Gettys of the Internet Business Group, who is a visiting scientist working with the World Wide Web Consortium at MIT, spoke about Hypertext Transport Protocol, version 1.1.
- Lynn Thorsen-Jensen, director of Graphics & Multimedia, Workstations Business Segment, discussed 3-D graphics.

Source of Ideas for Seminars

We find speakers for our technical seminars in many ways.

Members of our engineering community often recommend seminar speakers. For instance, Bob Stewart of Workstations suggested that Joel Emer speak about branch prediction of the EV6. Also, consulting engineer Don Dossa spearheaded inviting television weatherman Todd Gross to talk about using the Internet for out-forecasting computer models used in weather prediction.

While at seminars, engineers often suggest a speaker to us or volunteer to make a presentation themselves. In this way, we identified Charles Monia to speak for the Storage Architecture Group. His topic: "Fiber channels and CI—a comparison."

Seminar evaluation forms from attendees also solicit the names of speakers and possible topics. In addition, engineers contact us directly by telephone or e-mail.

'The Brown Bag Theatre'

During the fourth quarter of fiscal year 1997, a series of informal seminars was started in Network Product Engineering expressly for the Network group. Held weekly at lunchtime and dubbed "The Brown Bag Theatre," these seminars allow coworkers to meet, learn more about the group's numerous ongoing projects, and exchange information on topics specific to their business unit. Speakers receive a small honorarium.

Held at the King Street facility in Littleton, Massachusetts, this seminar series is proving to be an overwhelming success thanks to the technical and financial support of Jim Kuenzel, vice president of Network Product Engineering, and his staff. The presentations and discussions are lively. The atmosphere fosters sharing, questioning, and learning. Advanced registration is not necessary. Employees show up with their lunches, and we provide desserts and beverages. Sometimes, we conduct an impromptu raffle. To usher in summer, we raffled off a beach bag.

To date, the only problem has been an overcrowded room! When Rich Graham presented a talk on the DecHub 900, 65 people packed into a room that holds 28. ✳

George Varghese of Washington State University addresses a group about the principles of efficient protocol implementation.

Regular meetings with our client groups to report on the status of our programs often generate ideas. Recently, at a meeting with Henry Yang, technical director of Networks, we learned that Hal Murray from the SRL would be visiting. At Henry's suggestion, we contacted Hal and invited him to speak. Soon after, Bob Stewart of Workstations also suggested that we invite Hal to speak. As a result, we scheduled his talk at three facilities—at LKG and PKO in Massachusetts and at ZKO in New Hampshire.

Certain groups within DIGITAL must provide regular updates to the technical community. For 2 years, we have worked with the Corporate Regulatory Domains, Engineering and Test group to help organize the content and delivery of a seminar about the impact of regulatory requirements on product design and marketing. Subsequently, the seminar was scheduled at several New England sites and at three European sites.

Sometimes topics come to mind, but we don't have a speaker. Early in 1997, Craig Schomp of Networks asked specifically for a seminar on Java. The subsequent talk by senior consulting engineer Bill McKeeman was an overwhelming success. We scheduled it for PKO and LKG, and each time the session was oversubscribed. The PKO seminar had nearly 100 attendees!

The Role of Sponsors and Technical Hosts

Lecture ideas are usually referred to a potential sponsoring group. In some cases, we ask the person who requested a seminar to be its technical host. A technical host reviews the presentation's abstract to ensure that the content is at the appropriate technical level. The technical host often introduces the speaker, helping to set the tone for the lecture. Recently, consulting engineer Shlomo Novotny of Alpha Workstations Engineering asked us to invite Fritz Gaensslen, an expert on "chilled CMOS." Gaesslen's lecture on microelectronics at low temperatures was well received.

Using Your Ideas

If you have an idea for a seminar, or if you would like to be a presenter, please call or send e-mail to Linda Hart (DTN 226-7224; HartL@mail.dec.com) or Colleen Martin (DTN 381-2474; MartinCo@mail.dec.com). ✳

web *site*

intranet
http://www.tcdg.zko.dec.com
Technical Competency Development Group

Some Technical Seminar Stats

In fiscal year 1997, 55 seminars were offered. More than 2,200 persons attended these various technical seminars.

Seminars delivered:

- 19 seminars at the LKG facility in Littleton, Massachusetts
- 15 "Brown Bag Theatres" at LKG (see accompanying story on p. 12)
- 11 seminars at the PKO facility in Maynard, Massachusetts
- 8 seminars at the ZKO facility in Nashua, New Hampshire
- 1 seminar at the Shrewsbury, Massachusetts, facility
- 1 seminar at the Salem, New Hampshire, facility

Origin of the lecturer:

- 4 from universities
- 2 external experts
- 3 from DIGITAL research labs
- 1 from a government-sponsored lab
- 3 from DIGITAL partner
- 41 from within DIGITAL (i.e., engineers speaking to engineers) ✳

Announcing Two New Intellectual Property Awards

Enhancements to the Patent Program include an award for first-time inventors and the broadening of protections for DIGITAL intellectual property.

By Sharon M. Lipp, Corporate Patent Program, Corporate Technical and Information Services, Acton, Massachusetts (AKO-2)

On July 1, 1997, two new awards were added to the Corporate Patent Awards Program:

- the First Patent Application Award
- the Defensive Publication Award

On the same day, the method of calculating the monetary awards was changed for patent applications and for patents awarded.

The Corporate Patent Awards Program

Type of Award	Old Policy	Revised Policy
Individual Application and Issuance Awards	***Utility Patent Application*** Three inventors or fewer: • $500 each More than three inventors: • $1,500 is divided equally among the eligible inventors ***Design Patent Disclosure*** Three inventors or fewer: • $250 each More than three inventors: • $750 divided equally among eligible inventors	***Utility Patent Application*** Five inventors or fewer: • $500 each More than five inventors: • $2,500 is divided equally among all eligible inventors ***Design Patent Disclosure*** Five inventors or fewer: • $250 each More than five inventors: • $1,250 divided equally among eligible inventors
First Patent Application	Not applicable	***Utility patent application*** • $500 per eligible inventor ***Design patent application*** • $250 per eligible inventor
Defensive Publication	Not applicable	***Utility patent application*** • $250 per eligible inventor ***Design patent application*** • $125 per eligible inventor

First Patent Application Award

Inventors filing their *first* patent application as employees of DIGITAL will receive the First Patent Application Award plus the customary patent application award. The First Patent Application cash award is $500 for a *utility patent application* or $250 for a *design patent application*.

The inventor may receive this award one time for *either* a utility patent or a design patent—not for each type of patent. This award is not retroactive.

Defensive Publication Award

The Defensive Publication Award is intended to broaden the types of protection available for DIGITAL intellectual property and to reward the employee accordingly. The award will be given for inventions that the Invention Review Committee (IRC) judges as patentable but prefers to have published in the public domain to establish "prior art," an action that prevents others from patenting the innovations (see the accompanying brief discussion of the concept of prior art).

An inventor will be eligible for the award based on applicable current criteria for the patent award.

Awards are $250 per eligible inventor for a *utility disclosure* and $125 per eligible inventor for a *design disclosure*. These awards will not be considered in determining inventor eligibility for a cumulative patent award.

Change to the Patent Award Program

In an effort to bring the DIGITAL Patent Program in line with industry practices, changes were made in how the monetary awards are calculated.

The Utility Patents Application and Issuance award is now $500 per eligible inventor, if there are *five or fewer* inventors. When *more than five* eligible inventors, the amount of $2,500 is divided equally among them. The Design Patent Application and Issuance award is now $250, if there are *five or fewer* inventors. When *more than five eligible* inventors, the amount of $1,250 is divided equally among them.

Note that the existing criteria for award eligibility remain the same. No other changes to the Patent Award Policy have been made. ✻

web*sites*

intranet
http://www-server.mso.dec.com/IP/ip.htm
Corporate Patent Program

intranet
http://www-server.mso.dec.com/IP/awards/home.htm
Details of the DIGITAL Intellectual Property Awards

intranet
http://www-server.mso.dec.com/IP/awards/dp_process.htm
The next steps for a defensive publication

Defensive Publication

By Diane Drozenski, Patent Law Group, Maynard, Massachusetts (MSO-2)

Defensive publication establishes the concept of "prior art" related to an invention in order to prevent others from subsequently obtaining a patent on that subject. This course of action generally is taken whenever the Invention Review Committee (IRC) determines that it *is not* necessary to prevent others from using the invention, but it *is* necessary to ensure that DIGITAL may use it.

In addition, a defensive publication—made in parallel with the filing of the application—may provide additional protection when it is known that the subject matter of a patent application will not be considered later for protection as a trade secret.

Therefore, the IRC, with input from a member of the Patent Law Group, should evaluate each invention disclosure on a case-by-case basis, determining which, if any, is the most appropriate form of protection to pursue. ✻

Patent Awards

During Q4 FY97, 43 inventors from engineering groups in the US and DIGITAL subsidiaries were recognized for their significant contributions. As a result, the DIGITAL patent portfolio now surpasses 1,600 issued patents. These inventors received bonus payments of up to $500 for each patent granted by the US Patent and Trademark Office.

D. Willett

Patent Award Recipients from Massachusetts and New Hampshire
Front row, from left: William McCartay, Dan Wissell, Rich Watson, Kurt Thaller, Rubin Costelino, Bob Simcoe, and Kathleen Morse. Middle row, seated, from left: Michael Chautin, Servers and Workstations patent engineer; Burns Fisher; Dave Fenwick; John Kowaleski; Gil Wolrich; Dilip Bhavsar, and Barry Maskas. Standing, from left: Bob Reed, Patent Awards manager; Brian Croxon, vice president, AlphaServer Systems; Ricky Palmer; Larry Palmer; Steve Hobbs; Tim Fisher; Geoff Lowney; Don Scott, DIGITAL Semiconductor patent engineer; Bill Gist; Don Harbert, vice president, Internet Product Management and Development; Tom Gannon, director of Corporate Technical and Information Services; Sam Fuller, vice president of Corporate Technology Strategy and Services; and Harry Copperman, senior vice president and general manager, Products Division.

Patent Award Recipient from Scotland
Stoian Kableshkov

Patent Award Recipients from California
From left, Hal Murray; Jim Saxe; Bill Hamburgen; Bill Supnik, vice president of Research and Advanced Development; and Louis Monier. Not present: Mark Foster and Norm Jouppi.

Maintaining Product Safety: A Cooperative Endeavor

Managing product-safety risk—the charter of the Product Safety Incident Management group—is a key element in meeting the customer's needs and maintaining customer loyalty.

By Tom Wrenn; Product Safety Incident Management; Corporate Environment, Health & Safety; Maynard, Massachusetts

D. Willett

Members of the Product Safety Incident Management group. From left, Tom Wrenn, George Yender, Bob Brister, and Bill Henry.

Role of the Product Safety Incident Management Group

Since 1974 engineering has been an important partner of Product Safety Incident Management (PSIM). Originally part of the Field Service Engineering Group, more recently PSIM is a function within the Product Stewardship Technical Domain reporting to Corporate Environment, Health and Safety. Product-safety incidents are centrally monitored by PSIM to ensure that appropriate actions are taken to minimize the corporation's legal liability. Much has changed since 1974, but the key responsibility of PSIM has remained the same. The group is chartered to

- maintain a worldwide reporting process for safety-related product incidents,
- investigate all alleged product-safety incidents and determine appropriate action,
- retain hard and electronic copies of all case records,
- communicate with the appropriate business groups and functional organizations, and
- train personnel in matters related to product-safety reporting.

Reasons to manage safety risks

DIGITAL has an obligation to comply with the laws of independent regulatory agencies, such as the Consumer Product Safety Commission. These agencies are charged with reducing risks of injury associated with products—especially consumer products.

The Consumer Product Safety Commission has jurisdiction over approximately 15,000 types of consumer products used in and around the home, in schools, and in recreation areas. Section 15(b) of the Consumer Product Safety Act (CPSA), 15 U.S.C. #2064(b), defines the responsibilities of manufacturers, importers, distributors, and retailers of consumer products. Each is required to notify the commission if it believes a product fails to meet a consumer product-safety standard or banning regulation, or has a defect that could create a substantial hazard to consumers.

In Europe, the European Union has issued a directive on product safety (Directive 92/59/EEC). It stipulates that the producer must inform the consumer about the possible risks of his product so that consumers can make informed judgments and take the necessary measures to protect themselves against any danger during the use period, even if the risk is not immediately perceivable.

Product Safety Keywords

Please refer to Product Safety Incident Management (PSIM) any product incidents that involve the following keywords:

- Hazard
- Burned
- Injured
- Shock
- Fire
- Safety
- Toxicity
- Smoke
- Cut
- Irritation

The "24 × 7" hotline number for PSIM is DTN 276-9242 or 508-496-9242. ✳

Reporting product-safety incidents

A product-safety incident is considered to be any injury, property damage, or product damage involving a product manufactured, sold, or serviced by Digital. You should report any such incident to your local safety representative (LSR) within 24 hours. A worldwide list of LSRs can be found on the Product Safety Incident Management Home Page (www.aeo.dec.com/ehs/ps/prodsafe/prod-saf.htm). If no LSR is listed for your geographic area, call PSIM directly. The "24 × 7" hotline number for PSIM is DTN 276-9242 or (508) 496-9242.

Managing product-safety risk is responsible business practice. Limiting the corporation's exposure to potential liability requires attention to product safety. But, beyond legal requirements, Digital has a long-standing commitment to providing safe products to its customers. Therefore, managing product-safety risk is an element in satisfying the customer and maintaining customer loyalty.

Managing an incident

To effectively manage product-safety incidents, a worldwide reporting system of LSRs was established providing product-safety support to the field personnel servicing customers. LSRs are local resources who are available to answer many commonly asked questions. Inquiries needing further expertise are forwarded by the LSRs to PSIM. This strategy allows PSIM to resolve incidents at various levels on the basis of the risk posed to the corporation. The reporting network is maintained throughout Europe, the Asia/Pacific Rim region, and the Americas, with particular emphasis on the Asia/Pacific Rim region and Europe. It helps resolve issues involving different languages and local time differences.

Limiting the corporation's exposure to potential liability requires attention to product safety.

In recent years, Digital has engaged partners, resellers, and distributors to sell products. Product-safety support for such products is provided directly by PSIM. To ensure that Digital partners, resellers, and distributors communicate safety-related product incidents, PSIM has engaged the respective business units in specifying the incident-reporting procedure in the agreements signed with these channels. Service Level Agreements formalize the relationship between PSIM and the business units in the event that one of the partners receives a report of an alleged product-safety incident from a customer.

A Service Level Agreement assures PSIM that if an individual reports a problem with a Digital product to a business group and mentions during the phone call any of 10 predetermined keywords, PSIM will be notified. In such cases, the customer might not be reporting an actual product-safety problem. However, based on the initial call, PSIM will investigate the allegation and determine whether the customer's concern is one of product safety.

PSIM now has Service Level Agreements with the Office of the Chairman; Americas Multi-Vendor Desk Top Services; the Authorized Warranty Service Provider Program; and the Printer Systems Business in Valbonne, France.

PSIM and Engineering

As part of the incident-management program, PSIM performs risk analysis on reported safety incidents. When necessary, PSIM refers issues to the affected engineering groups and/or product management of the various business groups in order to determine appropriate action.

PSIM welcomes the involvement of engineering groups who are experienced in analyzing problems to determine their causes. However, product safety is not a regular function of engineering. PSIM has access to resources within Engineering Product Safety, Corporate Product Safety and Regulations, Corporate Risk Management, Corporate Public Relations, and the Corporate Legal Department. These groups are crucial to PSIM activities and are consulted on a monthly basis.

Benefits of PSIM Involvement

Managing corporate's legal risk is not the sole benefit achieved as a result of PSIM efforts. Service personnel benefit by being made aware of potential safety problems. They also ultimately end up servicing safer products. The business units benefit from the existence of a separate group that is solely dedicated to looking at potential product-safety issues. Only those issues that present a significant risk are forwarded to engineering groups or business units. When action is required, PSIM works with the engineering group responsible for the product until an agreed-upon resolution is reached. PSIM then tracks the resolution until all criteria have been satisfied.

To minimize risk and capitalize on the benefits, PSIM needs the cooperation of engineering. So, if you become aware of anything that might have product-safety implications, report it promptly. ✳

web*sites*

intranet

http://www.aeo.dec.com/ehs/ps/home.htm

The Product Stewardship Home Page where you can find

- discussions of product-related environmental issues;
- overviews of "eco-labels" (names, relevancy, and requirements);
- Environment, Health & Safety (EHS) specifications for DIGITAL products;
- policies, standards, and guidelines related to DIGITAL products;
- an overview of EHS experts available to business groups, and more.

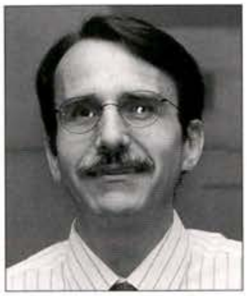
intranet

http://www.aeo.dec.com/ehs/ps/prodsafe/prod-saf.htm

The Product Safety Incident Management Home Page, where you can find a worldwide list of local safety representatives.

Engineering Promotions

Many thanks for the text and photo contributions of the supervisors and colleagues of the DIGITAL engineers whose collaborative and individual achievements earned them these promotions.



Gabriel Bischoff Promoted to Consulting Engineer

Gabriel Bischoff has been the project leader, a key architect, and developer of DIGITAL Semiconductor's Formal Logical Equivalence checking tool, BOVE. This state-of-the-art verification methodology and tool set was used extensively on the 21264 CBOX to compare RTL to schematics. During the course of CBOX development, BOVE uncovered over 500 mismatches in the design and the implementation, which previously would only have been detected through extensive and extremely resource-intensive simulation. These costly simulation runs also are pattern-dependent and thus do not "prove" that the two logic abstractions (the RTL model and the schematic implementation) are logically equivalent. BOVE is pattern-independent and proves logical equivalence or issues stimuli that the designer may easily use in the simulation to pinpoint where the mismatch exists. Gabriel successfully led the BOVE team of Karl Brace and Samir Jain in evolving DIGITAL Semiconductor's verification methods to the point where BOVE is now a vital part of the verification plans for future Alpha-processors.

In addition to his extensive BOVE contributions, Gabriel has been a key developer of the COSMOS three-state simulator used in virtually every DIGITAL Semiconductor chip for initialization testing. He remains the sole supporter of this simulator and its network abstraction path.

Gabriel received a PhD from Cornell University in 1985 and has been with DIGITAL for over 12 years.

Larry Blair Promoted to Consulting Engineer

Larry has been recognized for his leadership and technical contribution to the development of high-performance CMOS-6 transistors, which make possible very high-speed EV56 microprocessors. In addition, Larry played a key role as a technical liaison to Mitsubishi for the transfer of Alpha chips (LCA45) and has contributed to previous generations of DIGITAL CMOS technologies.

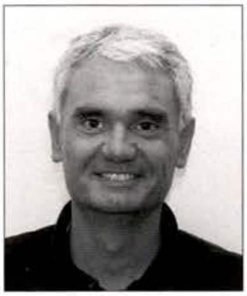
To enhance the performance of DIGITAL Semiconductor's CMOS-6 technology, and that of the Alpha microprocessors fabricated in CMOS-6, it was necessary to re-engineer the CMOS-6 transistor to be 20% faster than called for in the original aggressive target. Larry led the cross-functional team put in place to drive the transistor design and reliability assessments needed to meet product requirements. Transistor performance was boosted by reducing dimensions, while simultaneously increasing the power supply V_{DD}. This was a significant technical challenge both in terms of transistor design and transistor reliability. Larry spearheaded the evaluation and introduction of several necessary transistor design techniques such as retrograde channel profiles and halo implants.

Larry is presently the project leader for the Device Physics & Design team. He has principal responsibility for developing a detailed understanding of transistor physics and later incorporating this understanding into the design of transistors that meet the requirements of DIGITAL Semiconductor's products.

Previously, Larry worked on the development of DIGITAL Semiconductor's CMOS-5 process and played a key role in our partnership with Mitsubishi Electric Company. From December 1992 through September 1994, Larry represented DIGITAL Semiconductor Technology Development as technical liaison to Mitsubishi. This important role required familiarity with diverse aspects of the device and semiconductor manufacturing areas. He recruited cross-functional resources for second-source Alpha microprocessor evaluation and served as a focus for intercompany technical collaboration.

Larry also was instrumental in the design of test structures for CMOS process development. He led the design of the 0.5-μm CMOS development test chip, TM0025, including use of design verification tools on test chip structures, and contributed to every test chip design since then. In fact, Larry has become an international expert in microelectronic test structures. He has long been a member of the committee that reviews papers for acceptance at the IEEE International Conference on Microelectronic Test Structures (ICMTS). In recognition of his standing in the field, Larry has been appointed technical program chair for the 1997 ICMTS.

Larry joined DIGITAL in 1986 after earning an MS from MIT. He has five publications and holds one patent.



Mike Broomfield Promoted to Manufacturing Consulting Engineer

Mike Broomfield has been recognized for his outstanding contributions to the development of leading-edge CMOS processes at DIGITAL Semiconductor. His latest contributions were in the delivery of dielectric technologies for the DIGITAL 0.35-μm process (i.e., CMOS-6). Mike drove the CMOS-6 back-end dielectric deposition technologies which insulate the interconnects and give final passivation protection for the device. Mike introduced high-density plasma deposition technology to DIGITAL Semiconductor, allowing Fab 6 to move to 0.35-μm technology.

Mike joined DIGITAL in 1985 and has worked on etch, metal deposition, and inspection processes in addition to dielectric deposition. He spent time in South Queensferry assisting in process start-ups, then joined Fab 6 for the initial start-up in 1992, heading the Dielectric Equipment Selection Team and serving on the Metal Etch EST and the Gas and Chemical Material Selection Teams.

Mike is now in the Advanced Process and Tools Development Group. He evaluates and selects new state-of-the-art dielectric processes and tools suitable for each generation of CMOS technology. Currently he is evaluating tools to deposit low-dielectric-constant materials for CMOS-7 and CMOS-8. Mike also serves as the DIGITAL representative on the Sematech Dielectrics Project Technical Advisory Board.

Mike Callander Promoted to Consulting Engineer

Mike's promotion to consulting engineer recognizes his numerous contributions to computer architecture during the past 15 years. He has been a key technical contributor to product development starting with the VAX 8200 family of products. These products were based on the V11 processor chip set and the BI bus. Mike was a member of the team responsible for designing, verifying, debugging, and introducing the CPU board and the port controller chip set into manufacturing. Mike also played an important role in the system-level debugging.

Mike became the project leader on the VAX 6000 Model 300 (a.k.a. Rigel) REXMI chip set, which connected the processor to the XMI bus. In addition to his design work, he was responsible for hardware and software debugging, and the product's introduction into manufacturing.

Mike was the processor-board architect for the VAX 6000 Model 400 (a.k.a. Mariah). He did performance modeling, cache design, and was the main interface to the system, firmware, and operating system groups. He also provided technical direction to the group implementing the cache controller.

Mike was a key contributor on the NVAX+ CPU project. He provided the initial design of the external interface, defined the protocols, and provided the main interface to the systems and software groups using this processor.

Mike was the technical leader for the VAXstation 4000 Model 90 (a.k.a. Cougar). He defined the architecture, partitioned the system, and was responsible for a portion of the design. Mike was a key contributor to the debugging of both the hardware and software.

Mike helped DIGITAL Semiconductor explore and penetrate the external IC market for Alpha microprocessors. Mike traveled to several locations to proclaim the merits of the Alpha architecture. He enlightened, trained, and jointly developed both hardware and software products with DIGITAL customers. Mike set the standards and expectations for in-the-field and in-house application engineers.

Mike currently directs the development, deployment, and support of firmware, PALcode, Windows NT, and UNIX software on DIGITAL Semiconductor's Alpha motherboards. He is also responsible for Alpha software applications support to DIGITAL Semiconductor's external customers. He has been instrumental in defining architecture, setting performance standards, and supporting customers for more than five motherboards over the past 3 years.

Mike joined DIGITAL in August 1982 after graduating from the University of Massachusetts with a BSEE and a concentration in computer engineering. He has published several papers and holds six US patents directed at system design and cache memory architecture.

When not at DIGITAL, Mike can be found redesigning or rebuilding his race car in his garage or "in the fast lane" at one of the race tracks located along the East Coast.

John Dustin Promoted to Software Consulting Engineer

John's promotion acknowledges his role as technical leader of the DIGITAL UNIX IPv4 TCP/IP development team, which has produced a top-caliber IPv4 networking subsystem on DIGITAL UNIX.

Recently, John has been particularly focused on TCP/IP performance, and, under John's leadership, major improvements in TCP/IP performance have been achieved. This has brought DIGITAL UNIX into an industry leadership position in SPECweb96 price/performance. John recognized that the new modes of Internet operation today, such as frequent changes in World Wide Web (WWW) connections, have opened the door for TCP/IP tuning in new areas. John led the development of architectural changes, resulting in order-of-magnitude increases in metrics required by WWW servers such as IP aliases and connections-per-second. Working with other engineers on the team, John brought innovations in hashing, hint mechanisms, and other schemes to the product, resulting in tremendous improvements in TCP/IP performance. John also led the effort to make the TCP/IP subsystem tunable, so that the system can be modified by customers to accommodate various audiences such as Internet service providers (ISPs), database vendors, and traditional client/server users.

Customers, particularly ISPs, use TCP/IP performance as a key factor in their decision-making. One example is America Online, where John's leadership helped to leverage the sale of hundreds of AlphaServers. Nominated by the sales team, John received a Systems Business Unit achievement award for his efforts.

John also has been an innovator in bringing general enhancements to the global networking subsystem on DIGITAL UNIX, such as the Dynamic Host Configuration Protocol (DHCP) which was incorporated into the last major release of DIGITAL UNIX.

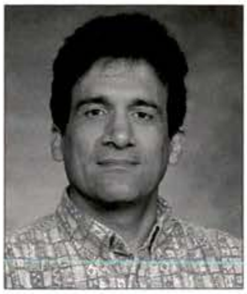
John holds a BSEE from the University of New Hampshire. He joined DIGITAL in 1983 and has worked on ULTRIX, DEC/OSF1, and DIGITAL UNIX, focusing on the networking subsystem in each of these products.

Norbert Eng Promoted to Hardware Consulting Engineer

Norbert received a well-deserved promotion to consulting engineer. He is a 15-year veteran of DIGITAL with over 20 years of engineering and simulation experience. He began his DIGITAL career as a senior hardware engineer in Mid-Range Systems, where he developed the simulation strategy for the Unibus and BI Adaptor. As a principal engineer, in 1983 he assembled and directed the Networks and Communications CAE group that developed the simulation strategy for LAN bridge designs. Later Norbert and his CAE team developed models and the verification process for the FDDI chip set with a simulation test bed.

Norbert's promotion acknowledges his expertise in static timing verification and the development and deployment of the Motive process within DIGITAL. In 1991, Norbert joined the ASIC center and developed the timing verification strategy for the DIGITAL ASIC verification process. He was the primary static-timing consultant on the Lynx, Gamma interface chips for EV4 and EV5 CPU–based servers. He returned to Networks in 1996, where he again leads the CAE simulation and modeling team. His timing expertise and Motive process have been instrumental in the recent sign-offs of the Network Product Business Unit's DART and SECAM ASICs.

Norbert holds a BSEE from the University of Massachusetts. He has published several white papers on simulation and static timing verification and presented numerous seminars and training sessions inside DIGITAL.



Nadim Khalil Promoted to Consulting Engineer

Nadim's promotion to consulting engineer was based on his contributions to DIGITAL Semiconductor's CMOS process as well as to transistor development and manufacturing, by providing state-of-the-art technology computer-aided design (TCAD) capabilities and tools. Throughout his 12-

year career at DIGITAL, Nadim has been a key player in developing software tools for the design and characterization of CMOS technologies.

This promotion recognizes Nadim's pioneering role in developing a new technique for determining the 2-D doping profiles of CMOS devices, a key factor in characterizing and optimizing the performance of submicron MOSFET transistors like those found in CMOS-6 technology. Such characterization is not possible otherwise. Nadim's novel approach uses inverse modeling to indirectly determine the doping profiles from electrical measurements. This methodology overcomes the limitations associated with direct measurement of the profile variation. In addition to originating this approach, Nadim implemented a complete methodology and software tools for this characterization. Nadim's technique is an essential first step in generating worst-case files for accurate circuit simulation (SPICE) which is of paramount importance in achieving chip functionality in first-pass silicon.

Nadim received a BSEE (with distinction) from the American University of Beirut in 1978, and an MSEE from Louisiana State University in 1979. He joined DIGITAL in 1985, and then, in 1995, received his PhD in electrical engineering from the Technical University of Vienna. He has authored or co-authored 18 technical papers and has been invited to give three special conference presentations.

Fred Kleinsorge Promoted to Software Consulting Engineer

Fred's promotion acknowledges his numerous and significant accomplishments during the past 3 years in the OpenVMS group as well as achievements during his previous 15 years with DIGITAL.

Fred joined DIGITAL in 1979 as a software specialist in the New York District office. After moving to engineering, he was responsible for the development of the VT200 terminal emulation for VWS (later used as the basis for the X11 dxterm), and he was the architect of the UISX product.

Fred is known widely and respected within DIGITAL as an expert in 2-D graphics and workstations, and he provided leadership in delivery of OpenVMS Alpha V1.0 graphics support and Alpha PC graphics.

More recently, Fred implemented a method for providing OpenVMS Alpha platform support independently of the operating system. This included support for booting third-party disk controllers and devising a common method for both user- and system-device configuration.

Fred is currently the technical director of the OpenVMS Systems group and a member of the development team for the Galaxy Software Architecture.

Rich Peterson Promoted to Software Consulting Engineer

Rich's promotion in the Core Technology Group recognizes his contributions to C compiler technology at DIGITAL. He was project manager for the initial release of the Visual C++ compiler for Alpha/NT, and for the past 3 years has been project leader for the DEC C compiler, which ships on DIGITAL UNIX, OpenVMS/Alpha, and OpenVMS/VAX. The Visual C++ compiler project combined technology from Microsoft and DIGITAL with development teams in Nashua, New Hampshire, and Seattle, Washington, to create a Microsoft-compatible compiler for building the NT operating system and NT applications for Alpha systems. During Rich's tenure as DEC C project leader, the first DEC C was shipped as the system and default compiler for DIGITAL UNIX, and the 64-bit support for OpenVMS/Alpha also was shipped. Rich is recognized widely for his skills in project management, timely delivery of robust products, and C language expertise.

Before coming to DIGITAL in 1992, Rich had spent 19 years developing compilers, tools, and runtime support for various languages and systems at Compass and Intermetrics. He holds a BS in English/Physics from the California Institute of Technology. In his spare time, he likes to jump out of airplanes.

Ron Preston Promoted to Hardware Consulting Engineer

Ron was promoted on the basis of his leadership role in the implementation of PCA56 and for his work on a series of Alpha microprocessors. Ron and the 35-person engineering team that he directed were responsible for organizing and executing all PCA56 design activities including logic design, schematic entry, CMOS circuit design, layout design, and electrical verification. The PCA56 design was completed in a record-breaking 11 months and met its initial circuit speed targets.

Before PCA56, Ron was a key contributor to the EV56 project for which he was the Ibox leader, as well as the engineer responsible for the EV56 global clocks, test logic, and pad-ring. Ron was instrumental in creating the EV56 input-clock duty-correction circuit, which cut the input clock frequency requirement to half of the previous Alpha microprocessor implementations.

Before pass 1 of EV56, Ron was the EV5 Ibox implementation leader. Ron's thorough engineering knowledge helped produce the flawless circuits and logic that enabled DIGITAL's first four-way issue Alpha microprocessor. After pass 1, Ron assumed project leadership of the entire EV5 Ibox.

Ron received BSEE and MSEE degrees from Renssalaer Polytechnic Institute in 1984 and 1988, respectively. He joined DIGITAL after receiving his MSEE degree.

Tim Reddin Promoted to Consulting Engineer

Since joining DIGITAL in 1994, Tim has worked on the design and implementation of high-speed interconnects for parallel scientific computing. Specifically, he has been responsible for providing direct access to MEMORY CHANNEL for scientific programmers. This has been crucial to the ability of DIGITAL to compete for and win opportunities at the high end of the scientific computing market such as at the national laboratories.

Before joining DIGITAL, Tim spent 7 years at ICL, Manchester, UK. His most significant achievement at ICL was the design of the I/O subsystems for the Goldrush Parallel Database Server, for which he holds a number of patents.

Larry Woodman Promoted to Consulting Engineer

Larry's promotion is in recognition of his work in the areas of virtual memory performance and virtual memory consumption under constrained resource conditions. He also is being recognized for his contributions in helping external groups enhance the performance of their very large memory (VLM) systems.

After joining DIGITAL in 1989, Larry worked as a software engineer in the VMS engineering group. In this capacity, he helped port the VMS operating system and several utilities to the Alpha architecture. In 1991, he joined the DIGITAL UNIX Base Operating System Engineering group, where he helped design the virtual memory management system and port DIGITAL UNIX to the Alpha architecture.

Larry holds a BS in mechanical engineering and a BS and MS in computer science. ✳

György Beck Receives 1997 John von Neumann Award

By Sándor Nacsa, Marketing Department, DIGITAL Hungary, Budapest

György Beck received the 1997 John von Neumann Award for his personal role in the advancement of computing in Hungary and for his work within the John von Neumann Computer Science Society and elsewhere to popularize computer science and engineering. György is the first Hungarian businessman employed by an international corporation to receive the award. This truly reflects the prominent role that DIGITAL and its subsidiary, Digital Equipment Hungary, Ltd., has played in this country.

György's association with DIGITAL began in 1982 when he worked for the Computer Application and Service Company. He has been a full-time DIGITAL employee since the establishment of the DIGITAL subsidiary in 1990, served as an account group manager from 1993 to 1994, and has been country manager since 1995. He has contributed greatly to DIGITAL Hungary's evolution into a $47 million company within its first 4 years.

György spoke strongly in favor of the so-called "small subsidiary model," which allowed DIGITAL Hungary to stay completely integrated. This has resulted in a 25% year-to-year growth rate and a leading position in the Hungarian information-technology (IT) market.

Since 1987, György has been involved in the design of the IT architecture for the large commercial banks in Hungary. These banks were established after the breakup of the centralized Hungarian bank that had been the sole body for commercial banking before 1987. György also is assisting with the IT architecture design of the newly established Hungarian Taxation Office, which replaces a centrally regulated payment system linked to the economy. From an IT perspective, the Taxation Office is another *big* success story.

As a result of his continuing leadership role in the IT design of Hungary's large banking and governmental establishments, nearly all Hungarian banks are relying on DIGITAL computers at least partially. Two of the four biggest banks in Hungary are relying solely on DIGITAL for their computing needs. One of these banks was able to continue its countrywide operations despite a sudden rush of private customers. The bank's computing systems tolerated about a 10-fold increase in processing demands for 3 days.

Under György's leadership, greater attention has been directed at manufacturing and trading industries, SAP R/3–based ERP solutions (close to 40% of the market has been captured in Hungary), and telecom solutions (from integrated mobile company solutions to TeMIP–based solutions for traditional telcos).

György Beck

In 1978, György received a master's degree from the University of Szeged Mathematics Faculty. In 1982, he earned a PhD for his study of the application of the Fast-Fourier Transform Algorithm to Toeplitz and Haenkel sets of linear equations. These algorithmic methods are important for many applications such as the design of digital filters, image processing, spectral analysis, signal processing, and time series analysis.

The Jon von Neumann Computer Science Society of Hungary was established in 1968 and represents the community of computing professionals in Hungary (more than 3,500 individual members and 200 institutional members). ✳

Global Computation

Computation over planet-wide structures is hindered by administrative, architectural, and physical constraints. These problems must be addressed by developing new models of programming and computation.

By Luca Cardelli, Systems Research Center, Palo Alto, California

Global Information Structures

The Internet communication protocols synthesize global information structures out of large collections of processors and networks. There are many kinds of such global structures. For example, the FTP protocol realizes a global file system, the Telnet protocol realizes a global multiprocessor, and the Hypertext Transfer Protocol (HTTP) realizes a global hypertext domain (the World Wide Web).[1] Naturally, we would like to have global information structures that are programmable. That is, we would like to use some global structures as global computers. A number of novel research issues arise if we want to program global computers.

Global Computers

The main characteristic of a global computer is its geographical distribution. Because of the slowness of light, a planet-wide computer cannot be regarded usefully as a localized computer. For example, a procedure call to the antipodes takes at least a noticeable 0.13 seconds; therefore, a widely dispersed program is easily distinguishable from a localized one. This physical limit has drastic consequences for programming. It implies that we need control over the locality, mobility, and distribution of computation. Latency and bandwidth, not CPU speed and memory size, become the limiting factors and must be directly addressed.

The Web is evolving rapidly towards programmability. A single global structure, however, will not satisfy all needs for global computation. Every large company will soon have its own internal global computer connecting its geographically distributed resources reliably and securely. The Web itself may be split into high-quality and low-quality services. Different global computers may be based on different instruction sets (virtual machines) and may be separated by administrative boundaries (firewalls). Therefore, we will have to think of how multiple global computers, each characterized by uniform guarantees of service, can interact effectively.

Models of Computation

What models of computation are appropriate for global structures? Traditionally, we have used sequential, functional, object-oriented, relational, concurrent, and distributed models. Although these models have been characterized formally, comparatively little formal work has been carried out on locality and other global computation issues. These issues are going to become central.

To program a global computer, we first need to understand its model of computation. For example, does computation on the Web correspond naturally to a traditional model? There are indications that it does not; a common experience exemplifies this point. When browsing, we actively observe the reliability and bandwidth of certain connections (including zero or time-varying bandwidth), and we take action on these dynamic quality-of-service observables. These observables are not part of traditional models of computation and are not handled by traditional languages. What models of computation and programming constructs can we develop to automate behavior based on such observables?

Programming Languages

Different global computers may provide different guarantees. Therefore, different programming languages may be appropriate in each case. As an example, consider the following programming languages that support mobile computation.

Telescript[2] is an agent-based language that explicitly deals with locality, mobility, and finiteness of resources. Telescript agents may migrate to new locations while active, but cannot engage in distributed communication. Telescript agents run only on a dedicated global computer that guarantees the integrity and security of agents.

Obliq[3] is an object-based language that encourages distribution and mobility. Mobile computations maintain distributed connections as they move. Obliq can run effectively on any single, reliable global computer, but does not deal with administrative domains or widespread unreliability.

Java[4] deals with security and multiple global computers. (Its programs are allowed to cross administrative domains.) Mobility, however, is restricted to transmitting program sources, in preprocessed form and not computations. Consequently, Java works satisfactorily in unreliably connected environments, since passive sources do not maintain connections. (Java is evolving to support active distributed computation and will confront the same problems as Telescript and Obliq.)

Each of these three languages is better suited than the others to a particular kind of global computer. However, none of them is particularly well suited to carrying out general computation over the World Wide Web. No language yet has the Web as its "run-time system": no language covers the full spectrum of Web behavior. Therefore, there is a need to develop more general semantic frameworks for global computation to understand the assumptions and requirement of various languages and to answer important questions such as "Who runs what, when, and where?" How do we reason about global programs?

Programming Issues

Programming issues acquire new facets in a global context, such as the following:

Typing

Global computation, being highly decentralized, needs to rely on some common notion of typing for the data that is exchanged. The Internet already has a rather sophisticated system of data types, called MIME; unfortunately, Web servers provide mostly HTML data that is poorly structured. CORBA defines a rich type system for distributed computation, but it is disjointed from that of the Web. To enable global programming, data will have to be transmitted over well-defined typed links. Moreover, link types will have to be mapped to (or identified with) program types.

Security

A model of security is critical for mobile computation. The cryptographic underpinnings of security are well understood. Unfortunately, it is not clear how to effectively and flexibly integrate security into programming languages and mobile computations. Currently, paranoia rules. What should be the syntax, static checking, semantics, and logic of security?

Reliability

It seems that certain global structures will always be unreliable. Unfortunately, like the World Wide Web itself, these also may be the most interesting global structures. Therefore, we need to find programming constructs and methodologies ("quality-of-service abstractions") that can increase the reliability of the substrate to tolerable levels.

Modularity

An appealing possibility, pursued by Java, is that software components will be fetched dynamically over the network, whenever the need arises. This approach requires modularity guarantees stronger than ever, as well as novel approaches to software production, distribution, and maintenance. It also suggests a notion of interfaces and modules as dynamic entities that is rarely found in current languages.

Resource Management

Time, space, bandwidth, and services need to be managed. Moreover, substantial new challenges are offered by the handling and transfer of money in locally minute and globally huge quantities within an open environment.

Directions

Today the standard computing infrastructure consists of locally networked personal computers with poor global connections. Gradually, this infrastructure will be complemented and replaced by network terminals that rely heavily and transparently on global resources. This transformation will be associated with the development of new computation and programming paradigms. ✱

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GLOBAL COMPUTATION

Mobile Computation

As the notion of mobile computation rapidly evolves, we can expect to see new forms of mobile computation emerge that challenge basic approaches to programming and system security.

By Luca Cardelli, Systems Research Center, Palo Alto, California

Moving Code, Off-line and On-line

Looking back a few years, we may notice that we finally abandoned assembly language programming in almost every domain. How did that happen? In part, improvements in compiler technology and hardware speed made high-level languages competitive. The main reason is that assembly code is inherently not portable: one cannot recompile it for a new architecture. Since recompilation is an off-line process, let us say that assembly code is not off-line portable and causes these main problems:

- It is difficult to automatically translate assembly code to new architectures (with reasonable performance).
- New architectures have been emerging faster than any feasible rate of manual recoding for legacy software.

New techniques can handle legacy assembly code, such as emulation and emulation-backed translation. However, the combination of the two problems above has overwhelmed any consideration based on absolute coding efficiency. As a result, new programs are now written in off-line portable languages: they are recompiled routinely for different architectures.

We can now draw an interesting analogy. Until recently no major language was on-line portable. That is, one could not take a running program and port it to a different architecture while the program was running. This, however, is precisely what must happen with network computations, because of the following:

- It is difficult to recompile source code on the fly for a new architecture (with reasonable performance).
- Connections to computers based on unknown architectures are established faster than the time it takes to recompile source code.

Techniques have emerged to get some of the advantages of both off-line and on-line portability, such as just-in-time compilation and run-time linking. However, the emphasis is now on mobility and quick compilation, not on optimized code generation.

Mobility poses a new basic question: what is the effect of taking a running computation and moving it to another network site? In most current languages, this makes little sense; the mechanisms for doing so are usually unavailable, and the effect would likely be unpredictable. To move computations, we need languages and models for which mobility makes sense; that is, on which the effects are well defined.

Traditional languages and traditional compiler technology are not well suited for the world of network computing. Languages that are not off-line portable already have been abandoned (effectively, except for legacy and specialized tasks). In a similar way, languages that are not on-line portable will be abandoned because they do not provide what is increasingly perceived as basic functionality: mobility.

Moving Computation, Not Just Code

The framework we are interested in is that of mobile computation; that is, the notion that a computation starting at some network node may continue execution at some other network node. This framework involves much more than just moving code. Pure code mobility is useful and has been used to great advantage in the form of Java applets, but it also is limiting. Fortunately, the other necessary components of mobile computation already have been widely studied and used.

The popular Remote Procedure Call (RPC) model is based on the notion of control mobility: a thread of control that originates at some network node continues execution at some other network node, and then comes back. No code is moved in this process, just control, so the question of on-line code mobility does not arise.

The RPC model also implements data mobility: data is exchanged over the network in the form of parameters and the results of RPC calls. This data must be on-line portable: data structures are marshalled (converted to portable form) at the originating side, sent over the network, and unmarshalled at the receiving site into corresponding data structures, possibly within a different computer architecture.

Some RPC systems also provide link mobility: the endpoint of a network connection can be sent over another network connection. The receiving party is then connected to the other endpoint.

Unlike RPC, mobile computation is based on the movement of code, not just the running of code that already exists in network nodes. All other components of RPC, however, also are important. In mobile computation, control must move as well: the code that is transferred must be run. Data also must move to preserve the state of mobile computations across moves. Network links also must move, since they are part of the state of the computation (at least, in models of mobility that support remote connections).

If code is represented as data (e.g., as the instruction stream of an interpreted virtual machine), then data mobility immediately implies code mobility. Therefore, mobile computation can be implemented rather easily over the RPC model by representing mobile code as mobile data and taking advantage of the other facilities already provided by RPC. In fact, mobile computation can be implemented on top of various transport mechanisms, although in each case it may acquire some peculiarities of the transport. RPC currently is the most convenient substrate on which to implement mobile computation. Hypertext Transfer Protocol (HTTP) also can be used, resulting in a more Web-oriented semantics of mobility. Thread and address space transport has been provided in the past by some operating systems and programming languages, but usually only within a single computer architecture.

How computation moves

I wish to compare three relatively well defined, distinct models of mobile computation. Other models certainly already exist, and more will be developed in the future. These three models differ in the kind of entities that can be transmitted over the network.

The most basic form of mobility consists in just moving code; this model is represented by Tcl[1] and Java[2] (pre-Remote Method Invocation). In these languages, an architecture-independent representation of program code (source text or bytecodes) is shipped over the network and interpreted remotely. When code moves, the current state of the computation (if any) is lost, and connections that the computation had at the originating site vanish. State and connectivity must be reestablished at the receiving site. Control is reestablished by dynamic binding or dynamic linking.

A computation, however, is more than just code: it is code plus the context of its execution. In this sense, a computation can be represented as a closure, which is the run-time description of a running procedure. Obliq takes the approach of moving closures: the code and the necessary context in which the code operates are transmitted.[3] The context may include data, active network connections that are preserved on transmission, and new connections that are created to keep the closure in touch with the site it leaves behind. In this approach, live, active computations can move, and their meaning is preserved upon transmission. Control is reestablished by running the closure at the receiving site, possibly supplying arguments that provide local information.

Telescript takes the approach of moving agents.[4] Agents are similar to closures in that they carry their context with them as they move from location to location and are reanimated at each location. Agents, however, are meant to be completely self-contained. They do not communicate remotely with other agents; rather they move to some location and communicate locally when they get there.

Obliq is in a sense the most general of these three models: a closure with no data is just code; a closure with no connections is an agent. On a local area network, this level of generality is convenient. However, the Obliq model is also the most fragile when used in full generality over the Web: the rich set of connections created by Obliq computation may be upset easily by network unreliability. In contrast, the pure code and pure agent models can at least survive intermittent connectivity failures. Even those models, though, are supplemented in practice with forms of remote connectivity, making them partially vulnerable to network instability. It is not clear yet how this tension between generality and reliability can be solved.

Fundamental issues

The very notion of mobile computation is evolving rapidly. We should expect to see the emergence of new forms of mobile computation and of new ways of using existing mechanisms. I conclude by listing some basic questions that should be asked of any present or future mobile computation scheme.

- What does a mobile computation do? This is the simple issue of meaning. It has been common to extend existing implementation models to network programming with little regard for clean and consistent semantics. What are the meaningful models for mobile computation?

- Where does computation happen? In any model of mobility, one must take the notion of multiple locations as fundamental. It should be possible to determine, in principle, where each piece of the computation happens. Location has an observable influence on behavior, on resource usage, and on the relative costs of computation versus communication. Knowing where computation happens is necessary in order to program mobile computations effectively.

- What is the programmer's view of mobility? There are many ready answers: distributed objects, closures, threads, continuations, agents, actors, etc. In fact, a programmer's model should be tested against the unusual realities of network programming (especially on the Web). In the long term, the prevalent models are unlikely to be exactly any of the above.

- How is security handled? The main obstacle to the acceptance of mobile computation for commercial applications is the issue of security, which is peculiar to code mobility. The basic technology of security is well understood, but it is not yet clear how to deploy that knowledge into languages and implementations, and how to check that security is truly respected. What are the syntax, static checking, semantics, and logic of security? ✻

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MOBILE
COMPUTATION

The Design of the AlphaServer 800

Better performance and additional features were combined to produce a well-balanced, low-priced server.

By Kurt Thaller, AlphaServers Engineering, Maynard, Massachusetts

D. Willett

Seated with the AlphaServer 800 Pedestal and Rack variants, from left: Adrianna Swartout, Leon Hesch, and Kurt Thaller. Standing, from left: John Linkel, Rich Braun, Jim Grillo, Bob DeRosa, Stan Stefanick, Nick Warchol, Ray Douillard, Harold Buckingham, Marco Ciaffi, Bob Astapovech, Bill Clemence, Frank Bomba, Oleg Klimowicz, Bryan Porter, Ann Coney, Bob Tillotson, Tom Thorp, Steve Boulay, Al Palmeri, Stu Erb, Wanda Hill, Mike Blaney, Shrey Shah, Ray Larson, Al Reddy, and Donna Korb.

Whenever a new platform is developed, efforts are made to improve upon earlier generations in one or more directions such as cost, performance, or product features. With any change, there is choice and associated risk. The design of the AlphaServer 800 was no exception. Opportunities for cost reductions with no impact on function were obvious. However, other possible changes required a different approach and had far greater associated risk. The ultimate goal is for a better product that meets the customer's requirements. The AlphaServer 800 has fulfilled this goal.

AlphaServer 800 (Corelle)

Alpha processor–based servers have a natural performance advantage in the high-performance market. However, the low-end market has different needs and cost goals. To gain entry into the under-$10,000 server market, the Low-End Server group had to develop a design that met the server requirements at the right price. In addition, product differentiation is crucial in the marketplace, so the design team looked for innovations that could be marketed as leadership features for this product.

Corelle was originally conceived as an AlphaServer 400 (Chinette) follow-on. The AlphaServer 400 was an AlphaStation 400 (Avanti), packaged and sold as a server. While achieving the desired target price, it lacked critical features necessary to be competitive in the server market: specifically, ECC-protected memory and hot-swap storage. As shown in the Table (see p. 32), the AlphaServer 800 addressed these issues and provided additional features and capabilities to make for a well-balanced, low-priced server.

During the design and architecture phases, difficult choices were made concerning enclosures and hot-swap disk implementation.

Enclosure Design

The design team started the project assuming that this product could use an existing enclosure. However, it quickly became clear that no suitable enclosure or power supply fully met the requirements. What was needed was the ability to support hot-swap disks, as well as the power and cooling requirements of a 500-MHz CPU and high-density, high-performance disks. In addition, the server was to be offered in both a pedestal and rack-mount version when the product was introduced. From a budgetary and scheduling perspective, a common enclosure that could be used for both pedestal and rack variants was desirable.

Corporate Photo Library

The AlphaServer 800

After it was determined that a new enclosure was needed, the design could be tailored to fully accommodate all the requirements of the server. The added flexibility allowed use of the following:

- an I/O bulkhead to support the complete set of connectors
- the correct number of removable storage bays
- hot-swap disks inside
- thermal and EMI management required for a 500-MHz Alpha chip
- the correct number and balance of PCI and EISA slot openings

Also in development at that time was a PC server product, Prioris MX 6000 (Skagit), with similar requirements. In order to share the costs of development and to take advantage of a joint design, the AlphaServer 800 team worked with the PC group for a few months to develop a common, shared enclosure. Unfortunately, the product requirements diverged, with no compromise seemingly possible, and the risk of not meeting the schedule increased as lack of agreement continued. The main issue was how to implement low-cost hot-swap disks.

Finally, each program went its own way. The AlphaServer 800 needed unique power and packaging development for the present project and for use in future AlphaServer generations. The design eventually implemented is shipping today. The resulting slick, well-balanced, compact server has been well received by both the field and customers.

Hot-Swap Disks

The remaining issue of debate was hot-swap disk storage. The AlphaServer needed hot-swap SCSI disks in the enclosure, instead of the fixed bricks used in the AlphaServer 400. This requirement directly affected the design of the enclosure, which had to provide for easy accessibility, cooling, and adequate storage quantity. For internal RAID, it was determined that the system required a minimum of four hot-swap disk bays.

The obvious first choice for implementation was to use the StorageWorks SBB disks, plugged into a four-slot backplane in the enclosure. The StorageWorks implementation is convenient and standard within the company, having been used in all other AlphaServer products with internal hot-swap disks. Unfortunately, there were unresolved issues:

- the size of the StorageWorks SBB
- the cooling of 9-GB disks (and beyond) in an SBB
- the cost of the SBB

The AlphaServer 800 had to be rack-mountable, which dictated certain

Table. Comparison of AlphaServer features and capabilities

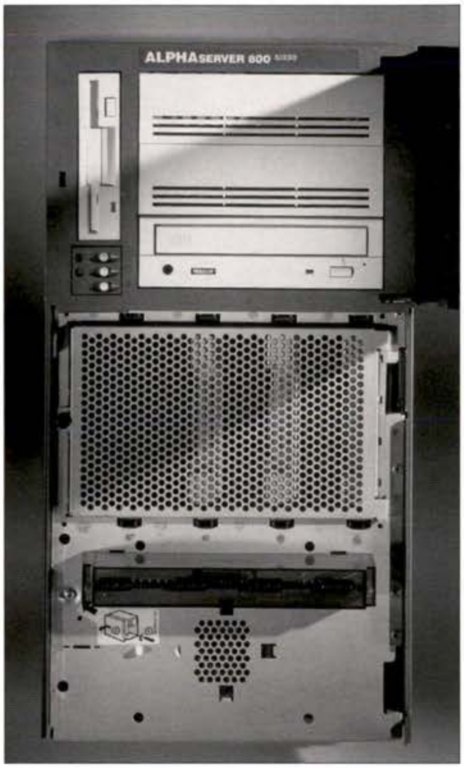
Feature	AlphaServer 800	AlphaServer 400	AlphaServer 1000A
CPU speed/cache	EV56-333 MHz/2 MB EV56-400 MHz/2 MB	EV45-233 MHz/512 KB	EV56-333 MHz/2 MB EV56-400 MHz/2 MB EV56-500 MHz/8 MB
Memory bus width	256-bit + ECC	64-bit + parity	128-bit + ECC
I/O slots	4 PCI (one 64-bit) 3 EISA (one shared)	3 PCI 4 ISA (one shared)	7 PCI 2 EISA
Memory (min/max)	32 MB/2 GB	32 MB/ 384 MB	32 MB/1 GB
Enclosure storage	3 removable + floppy 4 hot-swap	3 removable + floppy 1 fixed	2 removable + floppy 7 hot-swap
Integrated I/O	SVGA, SCSI-2 (FW)	SCSI (Fast)	SCSI-2 (FW)
Performance			
SPECint95	333 MHz: 10.1 400 MHz: 11.7	233 MHz: 4.28	333 MHz: 10.1 400 MHz: 11.5 500 MHz: 14.4
SPECfp95	333 MHz: 12.9 400 MHz: 13.7	233 MHz: 4.32	333 MHz: 10.6 400 MHz: 11.1 500 MHz: 17.8

maximum dimensions. The implementation used a pedestal mounted in a 90-degree-rotated orientation as a rack. This allowed a maximum width of 17 inches (standard EIA 310D RETMA). For a rack-mountable design, the server needed a depth less than about 25 inches to allow for sufficient cabling and access for the I/O at the back of the system. On the basis of the quantized unit height standard of 1.75 inches, the AlphaServer 800 needed a relatively optimal rack height of 5 units (a total of 8.75 inches).

But when trying to fit the StorageWorks SBB into the enclosure, the SBB plastic enclosure around the disk needed additional space; it was not possible to get an efficient implementation. In addition, the SBB requires that airflow be from front to back in the enclosure; thus the fan had to be in line with the storage shelf. These factors required an implementation 3 inches deeper than one using a plain disk brick, which meant not fitting into a standard rack.

Cooling issues also arose. Cooling of the SBB was less than optimal because when air flowed from front to back, it blew through the storage backplane. (Disk-cooling demands are even more rigorous for 9-GB and 18-GB disks—a concern for future generations of the product.) In contrast, cooling a plain disk brick is significantly easier because airflow can be across the disk rather than through the backplane. This was a second compelling reason to deviate from the StorageWorks disk strategy.

Compared to a fixed-disk solution, an implementation using StorageWorks was more costly. It required special EMI–treated plastic around the disk, internal flex cable, circuitry and connector, and a perforated backplane for increased airflow. With four disk drives, the total cost was considered to be significant in this low-end server market. Therefore, alternatives were considered.



The AlphaServer 800 5/333, the top door open/bottom off

Corporate Photo Library

The AlphaServer 800 abandoned the StorageWorks SBB in favor of a hot-swap disk drive that uses an interconnect known as SCA2 (an industry standard that major disk vendors currently ship on their SCSI disks). In fact, the latest StorageWorks SBB uses the same SCA2 disks. For the AlphaServer 800, the answer was to design a SCA2 backplane and an inexpensive (less than US$1.50) disk carrier. This met the product requirement of four low-cost, hot-swap disks. It also met the cooling requirements in that all system air can flow over the disks and the mechanical requirements of a small enclosure. Although this deviates from the corporate strategy that focuses on StorageWorks, it can be considered a more elegant implementation of the AlphaServer 400 fixed-disk bricks. In addition, it is an industry standard that is important to customers. The StorageWorks concept is supported on the AlphaServer 800 externally, but not in the enclosure. Figure 1 shows a view of the enclosure.

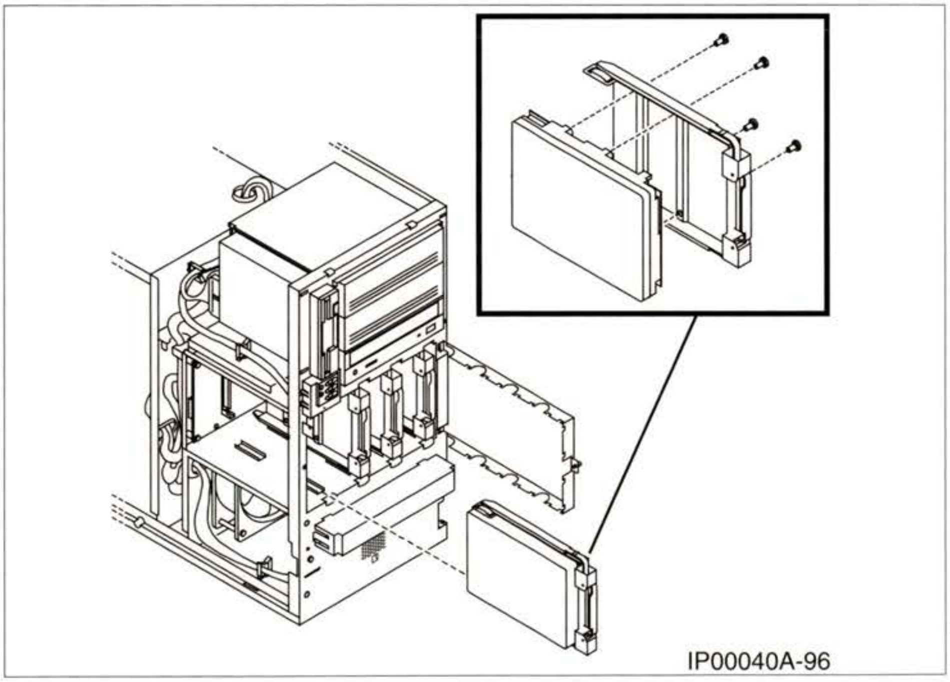


Figure 1. Low-cost storage implementation uses industry standard SCA2 disks.

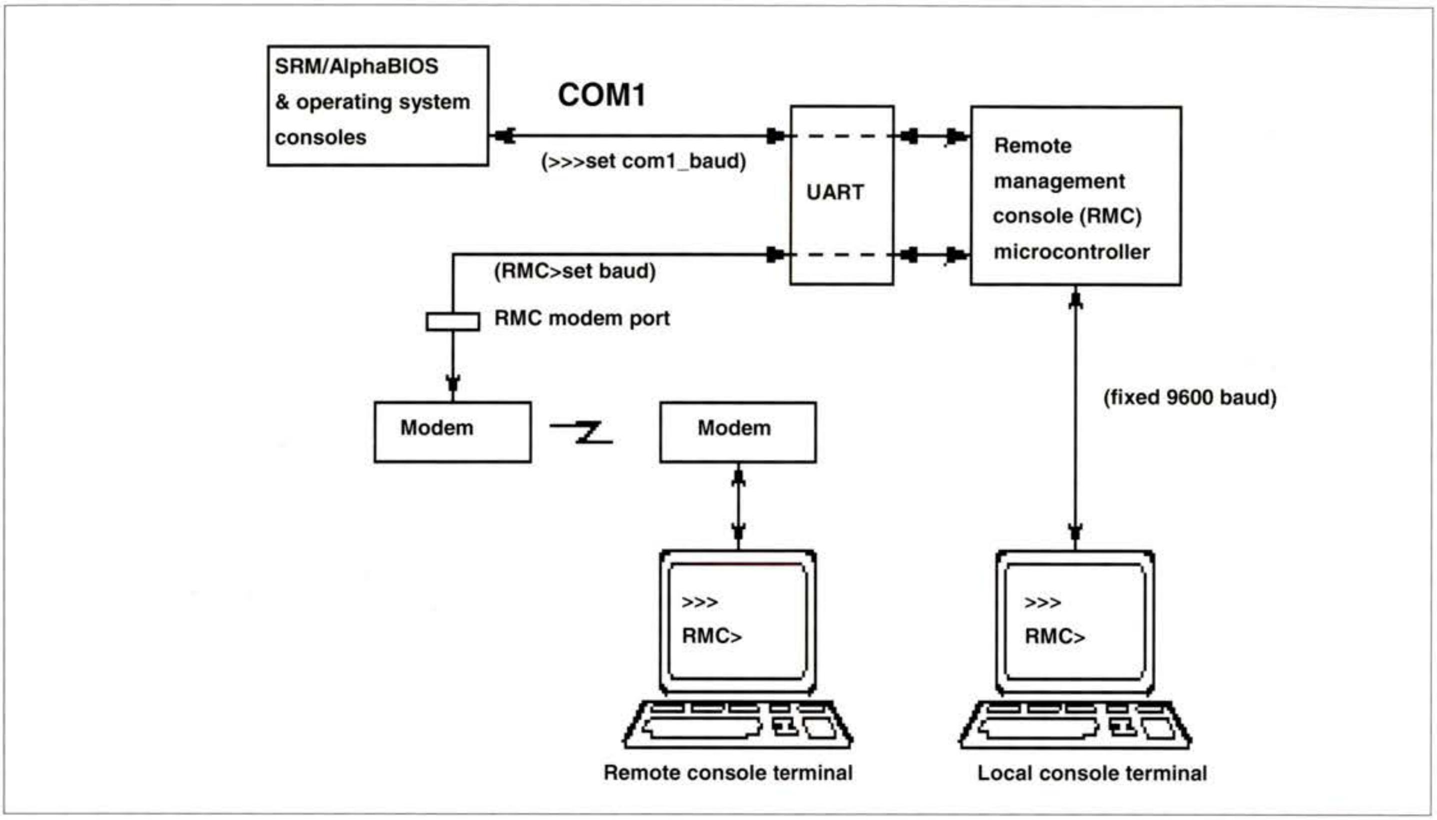


Figure 2. The remote server management console microcontroller integrates the normal console serial line with two console ports.

Remote Server Management

Remote server management is a relatively new feature found in servers and is available in the new AlphaServer 800. This capability is similar to that found in the KZRCM option used on other server platforms. However, for the AlphaServer 800, new features and capabilities were added, and the logic was embedded into the motherboard.

The remote server management console (RMC) enables the user to monitor and control the system remotely. The RMC allows a remote operator to connect to the system through a modem, using a serial terminal or emulator, and allows the system to access an external modem to page an operator in order to report a system alert condition. The AlphaServer 800 implementation uses an auxiliary 5-volt output of the power supply for the circuitry required for this function. In this way, the system can page an operator even if the system has shut down (for example, fan failure). Also an operator can dial-in via modem to query the status of the system after it has powered down. Figure 2 shows how the RMC microcontroller integrates the normal console serial line with the two console ports (the local console terminal and the remote console terminal).

The RMC can be accessed through one of two serial ports, the standard local console terminal (an MMJ connector) or the remote console modem port (a nine-pin DIN connector). Normally, the output of the system's COM1 port is passed through to the local console terminal. However, if an escape sequence is detected, the microcontroller intercepts and parses future characters as server management commands. The RMC commands allow an operator to remotely monitor power-supply status, system temperature, and fan status (see Figure 3). They also allow the remote operator to exercise control over the system equivalent of the operator control panel and to remotely power OFF/ON, RESET, and HALT (in/out).

The RMC logic can dial a preset telephone number when it detects system alarm conditions such as the following:

- a temperature warning
- a temperature failure (automatic power off)
- a power supply DC off (either failure or off switch hit)
- a fan failure
- a system watchdog timer expired (hung system)

```
PLATFORM

Firmware Revision: V 1.0
Server Power: On (Off)
Fanstate: OK (Fail)
System Halt: Deasserted (Asserted)
Temperature: 26.8°C (warnings at 46°C, power off at 52°C)
RMC Power Control: On (Off)
Escape Sequence: ^[^[RMC
Remote Access: Enabled and connected (Enabled, Disabled)
Alert Enable: Enabled (Disabled)
Alert Pending: No (Yes)
Init String: AT&F0E0V0X0S0=2
Dial String: ATXDT9, 15085551212
Alert String:,,,,,,,5085551234#;
Modem and COM1 Baud: 9600(19200, 38400)
Last Alert: (OverTemp Warning, Fan Fail, Power Fail, WD Time-out, RMC
   User Requested
Watchdog Timer: 60 seconds (00,10,20...90)
Autoreboot: Off (On)
```

Figure 3. Sample status from the remote server management console (RMC)

For example, a temperature warning might cause an operator to be paged. The operator could then remotely dial into the system, query for the status, and find out that the temperature is getting too high. The operator could then shut down the operating system and remotely power off the system.

Later, if the cause of the overheating were fixed (for example, a facility's air conditioning is restored), the operator could dial into the system remotely, power on the system, and reboot the operating system. All activities could be done remotely, without the need to be at the machine.

Market Acceptance

The AlphaServer 800 was announced in April and, to date, has been selling quite well. Customer feedback about the "volumetrics" of this server is positive. That is, it provides all the system-required components in a compact package, allowing for as many as six servers in a single rack. Feedback about storage implementation has been limited; however, very little has been negative or considered to be sales-inhibiting, and, in fact, customer response about the efficient size and implementation has been positive. There has also been some encouraging feedback on server-management features because many customers and, in particular, operators and system managers are excited about the level of system control that is possible from a remote location. ✳

UltraSCSI: A DIGITAL Technology Shared with the Industry

Bill Ham, manager of the Storage Bus Technical Office, discusses the development of UltraSCSI and its technical advantages.

By Lynn Berman, Corporate Storage Marketing, Marlboro, Massachusetts

The UltraSCSI technology development team. Front row, from left: Chuck Bagg (UltraSCSI interconnect test, physical configuration rules), Bill Ham (technical lead, SBTO manager), Ken Gulick (enclosure/power supervisor). Back row, from left: Fee Lee (DOC chip codesigner, UltraSCSI test equipment), Ed Neumyer (expander hardware designer), Jack Watson (interconnect components engineering), Doug Hagernan (UltraSCSI protocol architect), and Keith Childs (DOC chip codesigner). Not in the photo: Brian Herrick (hardware/power designer).

Q. What is UltraSCSI?
To the industry, the term UltraSCSI describes a SCSI device interface that goes twice as fast as today's Fast 20 SCSI. To DIGITAL, UltraSCSI also means a system package—composed of speed, interconnect, and expander technology—available across the entire StorageWorks product family.

Q. What is the origin of SCSI?
SCSI was a small computer interface made popular by Apple and its small computers. The name stuck even though SCSI doesn't mean small any more. It may have begun as a disk-attached technique for small computers, but it's been designed in a way that's provided tremendous growth potential to handle the needs of bigger systems without introducing complexity into the architecture.

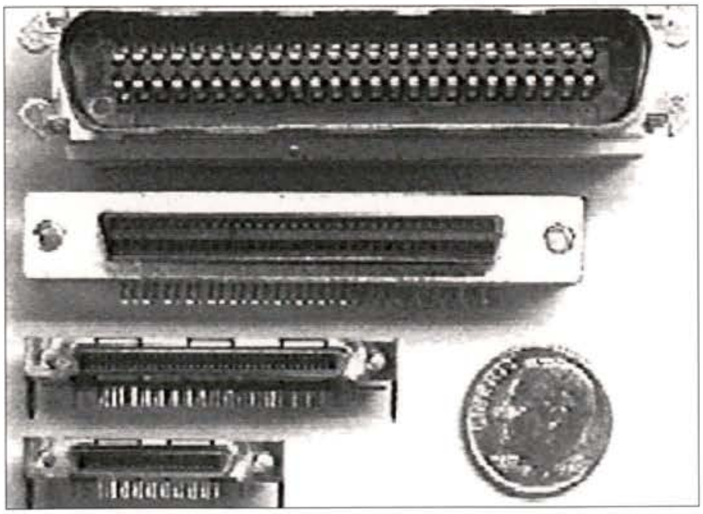
Q. How did DIGITAL contribute to the development of UltraSCSI?
In 1992 and 1993, the SCSI ANSI committee and the industry were struggling to get Fast SCSI to work. It wasn't a very pleasant experience, and many folks were beginning to think that we had seen the end of what SCSI could do. But DIGITAL came up with some fairly startling information on how to make SCSI go much faster than the current Fast Ten SCSI generation, where the opportunities were, and what to do to make that happen. We did it and without involving the protocol of SCSI. We didn't want people to have to rewrite their drivers, to redo their firmware. We wanted to enhance what was already there. We took that information to the SCSI Committee in the fall of 1993. This became Fast 20 SCSI, which is now a released standard. We took exactly that same approach with the Very High Density Cable Interconnect (VHDCI) connector and still are using this approach with the expander technology—making the details available to the industry.

Q. What are the components of UltraSCSI?
The building blocks of SCSI have not changed; we're still using the same disks, controllers, adapters, cables, and terminators.

The first component is greater speed, 40 megabytes per second. Silicon transmits the bits twice as fast and receives them twice as fast. To make this happen, we used the latest chip technology and more careful specification in the timing standard and signal requirements for SCSI.

The second component is a physical interconnect, based on the new VHDCI technology, which is an 0.8 millimeter connector technology. VHDCI is one-third the size of the old SCSI-3 wide connector, and its pins are fixed in a wafer, so there are none to bend or break. The cable is flexible, not nearly as stiff as the old wide cable; it can bend around a corner so well that right-angle connectors aren't even needed.

It's a much smaller interconnect, allowing us to get into places we couldn't go before, opening up a number of applications! The VHDCI connector also is capable of producing four SCSI ports out of the same PCI slot—four times as much connectivity from the slot as previously possible.



The shrinking size of external SCSI connectors. From top: SCSI-1 low-density, narrow (50 pins); SCSI-3 high-density, wide or narrow (68 pins); VHDCI wide or narrow (68 pins); and VHDCI narrow (36–40 pins) micro SCSI. (The coin's actual diameter is about 1.7 cm, slightly smaller than shown here.)

The third component is based on a technology called expanders. It contains a chip—developed jointly by Digital and Simbios Logic—that enables us to connect a physical SCSI bus to another physical SCSI bus making one logical bus, thereby increasing the length and number of devices in a single SCSI domain. We also can use multiple chips to create multiple SCSI bus connections into a cluster-like configuration.

I like to use this analogy for expanders: it's like we've given the plumbing industry a T-connector for the first time. Imagine your plumbing options now compared to your limitations before the T-connector!

Q. How does UltraSCSI protect the investor?

SCSI has been designed from Day 1—and continues to be designed —with the idea that backwards compatibility is a primary requirement. That's defined in terms of a person, a user, or even a company not finding their equipment obsolete before it's worn out. It simply protects their investment by not making their present equipment prematurely obsolete. You can grow UltraSCSI incrementally, a piece at a time, starting wherever it makes sense for your application—at the controller, adapter, or disk level. You can retire Fast 20 SCSI incrementally, a piece at a time. You get the value out of your investment. It's simply StorageWorks.

SCSI has been designed from Day 1 with the idea that backward compatibility is a primary requirement.

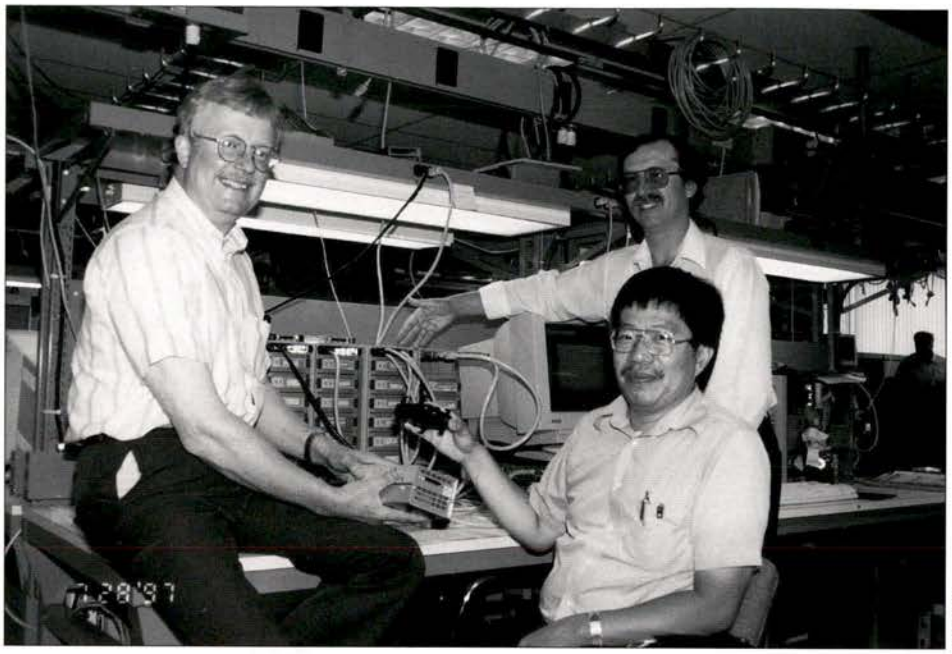
Q. How does UltraSCSI grow?

The growth picture for SCSI has many aspects to it, and it's a much larger space than it used to be because of UltraSCSI. UltraSCSI grows in several ways. We have a doubling of the delivered throughput in bandwidth-intensive applications. Through the use of expander technology, we're increasing the cable length from 1.5 meters to more than 60 meters, about 40 times in length. We haven't had to change one letter of code to do this because it is strictly a physical interconnect change.

The complexity offered by the interconnect also is growing. We now can offer radial wiring—SCSI hubs—which brings devices into a central point and then out from there. These are software-invisible components, like pieces of cable.

We are growing the volume and flexibility of SCSI in terms of the things it can do, the different kinds of applications it can solve. From high availability to high speed, from low speed to long distance, to mixing technologies, mixing single-ended differential and even, in the next generation, the voltage differential—doing all of these things in a way that doesn't require software changes.

You can grow UltraSCSI incrementally, a piece at a time, starting wherever it makes sense for your application—at the controller, adapter, or disk level.



D. Willett

Bill Ham holds the old, fast SCSI single-ended–to–differential expander (the large "box") while Fee Lee holds the new UltraSCSI equivalent product. Keith Childs points out the dramatic difference in size and connectivity in the new UltraSCSI connectors and cables (to the left of his hand) and the older SCSI version (to the right of his hand).

D. Willett

Ed Neumyer attaches the tenth UltraSCSI cable to a 10-port SCSI hub. This is a network-like interconnect capability for SCSI made possible by the DOC chip.

Q. Would you explain about shrinking?

SCSI is an interesting technology, because it's staying the same, shrinking, and growing simultaneously. Two SCSI architecture "planks" are staying the same as we progress—the physical interconnect (in the sense that virtually any physical interconnect specified for SCSI can work for all SCSI versions that exist) and the basic protocol for arbitration and selection. This means all SCSI devices can talk to each other and negotiate the next level of detail concerning how they want to communicate. With these two planks not changing, our software investment and our interconnect investment don't have to change.

And how is it shrinking? Well, sometimes it grows by shrinking. Thanks to silicon technology, we now can put four ports of SCSI on a single PC slot in a server or other system. Our new class of interconnect expanders went out in one chip about the size of a nickel; previous generations were on a printed circuit board 4 × 6 inches in size. These are dramatic reductions in the physical area! A four- to eight-channel board, a threefold change in the connectors, a doubling in the diameter of the interconnect. It translates into a lot more power, a lot more flexibility, and virtually no more cost per function than before.

Q. What is the complexity-to-flexibility ratio concept?

Generally, in technology and life, making something more flexible usually makes it more complicated. For example, if you want your car to have power windows, you've got to design fuses, wires, and switches, instead of just a handle. SCSI, though, is different: as it gets more flexible, it doesn't necessarily get more complicated.

Through the use of the new VHDCI connectors, the expanders, and the continuing use of the same basic interface and protocol, we're not changing the foundation on which SCSI was built—but we're adding a tremendous amount of flexibility. Sure, there's a little increase in complexity, but we get much more flexibility. Our complexity-to-flexibility ratio is improving fairly dramatically.

Q. Why is UltraSCSI so flexible?
SCSI actually will do the storage job at all levels of the computer business, all the way from your lowest-end PC up to mainframe storage. Technically, it can do this because of the wires in the SCSI—a cable doing multiple duty. In a sense, the wires are used to talk to each other—to see who's there and what kind of mode they support. Once they've figured that out, the same wires are used to transmit the high-performance data.

So UltraSCSI was really designed well. All the wires aren't used for the same kind of thing all the time; they have multiple uses. It fits into so many places because it's got a lot of programmability and more flexibility. It's able to handle tasks from the simplest to the most complex.

Q. What drove your research?
We've been managing a small laboratory here for a number of years, which has two purposes. First, we like to see what reality is in real hardware. We like numbers, data and instruments that actually measure things. It's amazing what happens when a little data is put on the table, because the truth starts to come out.

Second, when looking at the data, we find what has been overspecified. Maybe we could use that margin a little differently than at present. I call it "looking for the hidden margin."

With SCSI and other technologies, we're trying to make the whole technology perform optimally with a balanced margin among the pieces, so that we get the maximum performance with an acceptable risk load.

Q. Did DIGITAL do the right thing in sharing its technology advancements?
DIGITAL donated this information to the industry both to expand the knowledge base of the industry and to encourage people building SCSI components to keep making investments in SCSI. We want the industry to see market opportunities in their own businesses. We will take advantage of that in our business as system integrators, helping our customers with the lowest cost, highest reliability set of components in any technology for storage.

Yes, DIGITAL did the right thing. It was a strategic decision to help ourselves by helping the industry. There are no losers in this, just a family of winners. ✳

Editor's note: Look for a full technical paper on UltraSCSI in an upcoming issue of the *Digital Technical Journal.*

web*site*

internet
http://www.storage.digital.com

Maintaining Competitiveness While Coping with High Order Skew

A progressive assembly-line pilot program at the Salem, New Hampshire, plant reduced overall throughput time by 20%, corresponding to a 40% reduction in the build-to-stock time standards.

By Pete Lison, Systems Manufacturing Technology, Maynard, Massachusetts

During the past 6 months, one of Manufacturing Technology's assignments has been to identify and demonstrate a 20% reduction in systems manufacturing time standards for the Systems Business Unit (SBU) desktop product set (Figure 1). But before explaining how we actually met our goals, a review of the existing desktop process will be useful to establish a frame of reference.

When the project began, the desktop systems assembly process at the Salem, New Hampshire, plant consisted of two steps:

1. The first step, "build-to-stock" (BTS), is a manufacturing strategy that involves producing predefined basic units ahead of customer demand and holding each unit (referred to as a BTS kernel) in stock temporarily. Standard desktop BTS kernel configurations are built, partially tested, and then temporarily stocked in the warehouse.

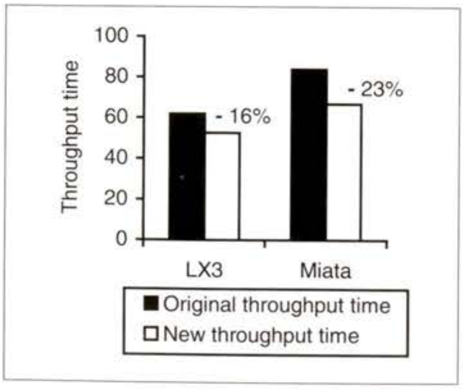


Figure 1. New desktop production line and throughput times

2. The second step, "configure to order" (CTO), is a manufacturing strategy that involves converting a basic building block (a BTS kernel) into a configured system by installing customer-specified options. A CTO is executed when customer orders are released to manufacturing. Upon receipt of the order, the prebuilt stock unit is pulled from inventory; options are kitted, installed, and tested; and then the unit is sent to packaging.

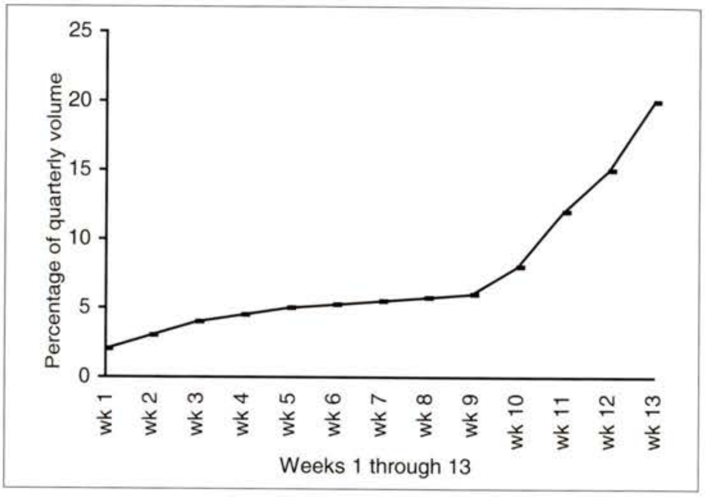


Figure 2. Typical order skew within a fiscal year quarter

Because of the high order skew experienced in the plant, BTS units are primarily produced early in the quarter when the customer load is lowest (Figure 2). This practice facilitates level loading operations. As the volume of customer orders increases, the direct labor workforce switches from building mostly BTS units to CTO units.

Although the BTS/CTO strategy helps manufacturing cope with high order skew, material shortages, and reduced customer-order cycle times, the lot size of one prevented Systems Manufacturing from taking advantage of opportunities associated with batch production using a progressive assembly line.

During a brainstorming session, we began to discuss developing a new BTS assembly line that could reduce BTS time standards and therefore the combined BTS/CTO time standards.

Using our collective ideas, we conducted a pilot test during the third quarter of fiscal year 1997.

Implementing a Pilot Line

In Q3, we began observing and evaluating several progressive assembly lines to begin formulating ideas for the new "FAST-BTS" line (Figure 3). We reviewed production lines used in Taiwan by the Personal Computer Business Unit (PCBU), as well as other progressive lines at several local electronics-manufacturing firms.

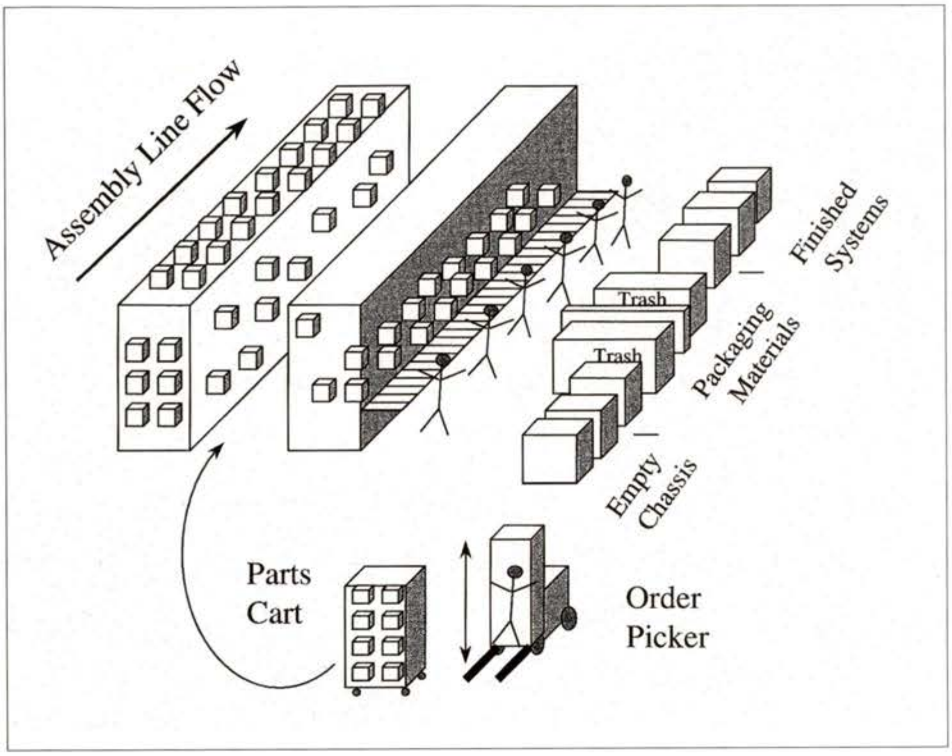


Figure 3. The FAST-BTS progressive assembly line

The existing process was analyzed on a step-by-step basis to improve productivity. If parts within the process had to be moved, we looked for ways to avoid the move or to move more units simultaneously in order to improve efficiency.

In this pilot program, we wanted to try to change some of the most critical processes:

- material controls
- progressive assembly (without benches)
- easily reachable components (within 2–3 feet [60–90 cm] of the assembler)
- packaging time (a reduction)
- scheduling (greater efficiency)
- process documents (greater efficiency)

In the plant, we built a prototype progressive assembly line in borrowed space (courtesy of Engineering Prototype Manufacturing) and staffed it during the first few days with experienced assemblers to balance the line. A few days later, we hired inexperienced contract workers who had never built a computer. Workers received training to produce each day's model. Quality checks were done at the beginning and end of each step in the process. The progressive assembly process comprised six assemblers, each responsible for a 2- to 3-minute portion of the assembly process.

After the first day of production, it became obvious that the progressive line could help us build products more quickly and improve how we design, build, test, and pack our products in the future.

FAST-BTS Line Advantages

The FAST-BTS line demonstrated several benefits.

New Product 'Design for Assembly'

The new-product engineers and "design for assembly" (DFA) engineers joined us for "Engineers Day" on the line. A day or two later, product engineers worked on the line building products, noting design changes for that product or possibly the next product. Observations on the progressive line allowed us to easily highlight wasted effort and steps in the process that might increase the standard deviation within each step. DFA engineers are beginning to incorporate solutions to some of the more challenging assembly operations in subsequent new-product designs.

Setting Time Standards

About 2 years ago, the SBU switched from a loosely defined standards-setting process to a rigid process using MTM–UAS[1] standard elements. To regenerate time standards for the BTS line, we enhanced the MTM–UAS process by videotaping each step of the process in order to create customized work elements that reflect the exact process.

Line Balancing

The key to any smoothly operating progressive assembly line is balancing the time it takes to complete each step of the process. Videotape was an excellent source of data for line balancing. Steps that could not be repeated many times within a few seconds implied a possible product-design problem. We attempted to identify these steps and group them at the beginning of the process into a step called "material preparation."

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[1] *A method for setting standards based on motion.*

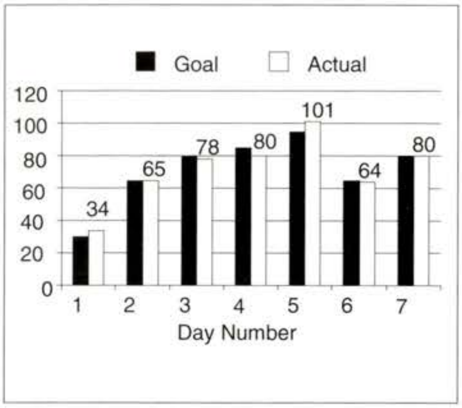


Figure 4. Output from the Miata progressive assembly line

Assembly Process

The assembly process was designed as a progressive assembly line with six operators standing side-by-side in front of an 18-inch-wide conveyer. Each operator is assigned a 2- to 3-minute task depending on the product being built. The materials for each operation are prepared and "detrashed" (removed from its original packaging) by the "prep" operator who receives the materials from the warehouse. This work is done in an area adjacent to the assembly line, called the material prep area. A product enters the assembly line on the left and flows down the conveyer attached to the front of the flow racks. The conveyer is the most critical component of the system for improving productivity. Before assembling, each operator verifies that the previous step has been completed correctly. Computers, tools, and other small fastening hardware are within arm's length in front of the operator or attached to the conveyer.

Training

Progressive lines offer the flexibility to employ either experienced or temporary assemblers. Process documents are generated in color with many visual aids. Progressive lines work best when each operator has a unit to work on. Thus, it was important to train the assembly team to leave a unit at each station ready for the next shift. This change minimizes start-up or changeover delays.

Productivity

Initial indications are that the FAST-BTS line improved BTS productivity by 25%. Progressive assembly processes are inherently easier to measure due to factors such as larger lot sizes. Figure 4 shows both daily goals and productivity achieved during the first 7 days. There clearly is marked improvement during that period resulting from slight modifications to the process. The output trend for the first 7 days of production is evident. Additional line balancing and implementation of other assembly-team suggestions are expected to yield an additional 20% increase in productivity in the near future.

As we look ahead, it is important to reduce set-up times for line changes. To minimize assembly-line down-time, it has been suggested that six units be partially built to ensure that each operator has work immediately after the line changes from one product to the next.

Temporary Storage

To avoid congestion, completed BTS units are transferred to the warehouse as soon as possible. To facilitate moving and storing BTS kernels efficiently, a special temporary packaging tray and sleeve were designed to store 16 or 24 systems on a pallet (Figure 5), allowing a reduction in the number of trips to the warehouse. This lightweight, reusable packaging protects the BTS units during transit to and from the warehouse. The pallet is designed to hold 4 or 8 systems per layer, depending on the enclosure design. The back of the CPU box faces outward to allow the possibility to test the systems 16 to 24 at a time in the future. Adequate space between the systems allows us to insert media.

Conclusions

The progressive assembly-line pilot program was successful. We achieved 40% reduction in the BTS time standards, which resulted in a 20% reduction in the overall throughput time.

Project success was due to the cooperation of many people in the Salem plant, where the installation of the first phase of the progressive desktop BTS process is being completed. The production version of the process will include FIFO inventory controls and high-bay material buffer storage locations to increase the flexibility of the line and to improve the use of vertical space.

Approximately 30 people helped in the brainstorming, design, fabrication, staffing, and debugging of the assembly line. At least one idea from each person was implemented on the line, so we can truly say that a team effort contributed to the overall success of the project. ✱

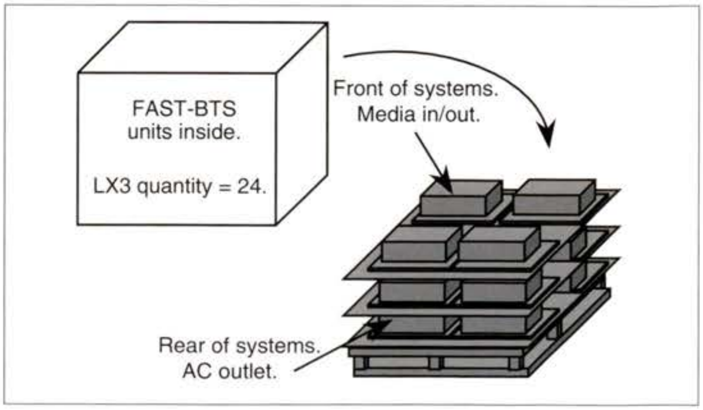


Figure 5. Build-to-stock unit reusable packaging/test pallet

Global Processes Key to Year 2000 Readiness

DIGITAL takes a systematic approach to dealing with its internal Year 2000 issues.

By Joe Quigley, Information Systems Year 2000 Program, Internet/Intranet Deployment Office, Littleton, Massachusetts

A few members of the Year 2000 team: From left, John Harrison, Bob Leonard, Joe Quigley, Gordon McAdams, and Ray Locke.

"DIGITAL systems will correctly process, calculate, compare, and sequence date data within and between the twentieth and twenty-first centuries, as well as leap year calculations."

This is the mission of the Information Services (IS) Year 2000 (Y2K) Program Office, which has been chartered to lead the DIGITAL effort to ensure that all its internal systems, operating systems, layered products, and applications are Y2K–ready.

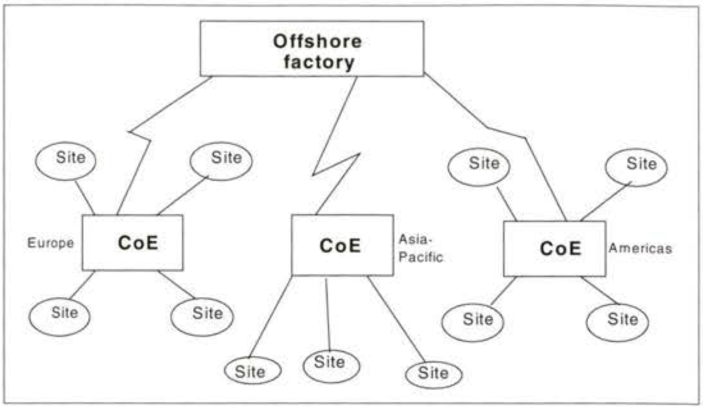
To meet the global Y2K challenge, the IS Y2K Program is employing strict processes that use "Centers of Expertise" (CoEs). These CoEs, located around the world, are the sites that assess, convert (if necessary), and test the hundreds of applications that DIGITAL uses daily to run its business. The CoEs are equipped with the necessary systems and personnel to deal with the Y2K issues on a large scale. According to Bob Leonard, technical consultant for the IS Y2K Program, "Program complexity and scope dictate high program office visibility and control of the Y2K conversion process. Accordingly, the program objective is to maximize the use of the CoEs. Y2K assessment, conversion, and testing at the development sites will be the exception, not the rule."

The War Room

The "war room" is the IS Y2K Program Office's Planning and Control Center, located in Maynard, Massachusetts. Here the Y2K team drives the strategy and scheduling for moving applications in and out of the worldwide CoEs. Sound preparation for entry into the Y2K conversion process is key to the program's success. This preparation actually began in May when the Y2K Program Office, in close cooperation with the business units, developed a database to catalog the DIGITAL application portfolio. At over 1,900 worldwide applications, this database helped highlight the immensity of the Y2K effort. But, as Dick Scarborough, vice president of the IS Y2K Program, points out, "We are implementing the most effective and efficient Year 2000 conversion processes for DIGITAL. The Y2K Program is a catalyst for other business-unit global processes that will reduce the size of our application portfolio and actually save DIGITAL money in the long run. These efforts also will offer our customers a simplified and more consistent interface into our business systems."

Offshore Factory

The offshore factory in Bangalore, India, is a key component in the IS Y2K global process. This site works with each of the worldwide CoEs and performs code assessment, Y2K code fixes, and unit testing for application packages. "The idea behind the CoE is not to be restricted to a physical location," Scarborough emphasizes. "Because of our networking sophistication and well-defined processes, we can include the India site as an important element in our virtual CoEs. It makes perfect sense to use the talent pool in India to help deal with our Y2K issues."



The Year 2000 conversion process. The offshore factory in India works with each Center of Expertise (CoE) to perform code assessment, Year 2000 code fixes, and unit testing for application packages.

Application Shepherds: Caretakers for the Future

The "shepherd" is the application expert who collects the code from the business unit and introduces a clearly defined package into the CoE. The shepherd must be available to assist in steps during the conversion process as well as to redeploy the well-tested application back into the business unit. As John Harrison, Y2K Program Manager for Europe, explains, "The term shepherd is really quite appropriate for the role. We have entrusted these people with ensuring that the vital business applications make it through the CoE process and back into the businesses, ready for the Year 2000."

Team Effort

The DIGITAL Network and Systems Integration Services (NSIS) organization is taking advantage of enormous revenue opportunities by selling Year 2000 services to external customers. The Y2K program and NSIS are working together closely to implement worldwide practices that share the same methods, tools, and training. Customers will see that DIGITAL clearly knows how to meet the Y2K challenge.

Opportunities

The Y2K program is critical to future business at DIGITAL. The program continues to seek talented individuals for critical worldwide positions. For information on these positions, see the DIGITAL intranet home page, Career Opportunities, or contact Steve Zabek (Zabek@mail.dec.com) or Lon Bassage (Bassage@mail.dec.com).

For the latest detailed information, visit the Y2K Web site, which is accessible from the corporate intranet home page or directly from the URL listed here. ✻

web *site*

intranet
http://rcwiii.ogo.dec.com/year2000

Information Services Year 2000 Program Office

Dick Scarborough, vice president

Lon Bassage, operations manager

Bob Leonard, technical consultant

Judie Groezinger, executive assistant

Ray Locke, testing manager

Frank McNealy, WW Y2K Product Sales Guide manager

Roger Peil, WW Y2K Connectivity and Computing Services manager

Bob Naismith, Americas manager

John Harrison, European manager

Georgiana Wong, acting Asia-Pacific manager

George Newton, Products Division

Sara Ann Gephart, MultiVendor Customer Services

Gordon McAdams, Vendor manager

Frank Forte, Marketing/sales

Russell Tahmoush, Network and Systems Integration Services

Brian Salloway, Corporate Functions

Ed Williams, Y2K India manager

Ken Wadoski, Planning and Control

Rick Gasparoni, Finance

Joe Quigley, Communications ✻

Claflin Greets Open House Guests

The Corporate Customer Center, which is located at corporate headquarters in Maynard, Massachusetts, marked the start of the new DIGITAL fiscal year with an open house on July 8. Bruce Claflin, senior vice president and general manager of Worldwide Sales and Marketing, kicked off the event, which was attended by more than 200 customers and employees. Executives from Boston College, Monsanto, TRW, SAS Institute, Raytheon, and Parametric joined DIGITAL employees for the open house.

Claflin noted that he was celebrating his first official week on the job in Worldwide Sales and Marketing and that the event was his first official act in this new capacity. He referred to the center as a first-class facility.

Attendees had a chance to take a glimpse into the future of DIGITAL products through three new demonstration areas featured at the center:

- Future Visions Kiosk
- Interactive Internet Theater
- Software Partners Kiosk

These new displays were added to the existing DIGITAL product solutions showcase, which features the latest DIGITAL products. ✳

D. Willett

Bruce Claflin, senior vice president and general manager of Worldwide Sales and Marketing, greets guests at the Corporate Customer Center open house in Maynard, Massachusetts.

D. Willett

Special Interest

Second Anniversary of India Development Center, Bangalore

By Philip Lynn

Courtesy of K. Shenoy, DIGITAL IDC Bangalore

Members of the IDC software development team gather for a presentation at the Bangalore site.

Bangalore, the "Garden City" in the south of India, is renowned for its pleasant climate and charming people. For many years, these factors have attracted people from far and wide who now call it home.

In the 1990s, Bangalore has emerged as the "Software Capital of the East," boasting quality software engineering talent and resources. In July 1995, the India Development Center (IDC) was set up in Bangalore with a mission to bring a share of these resources to DIGITAL engineering organizations. At that time, the IDC employed four engineers, with K. Parameswaran at the helm. Now, after 2 years as a successful software enterprise, the IDC has 70 engineers working on numerous and varied software projects.

Wide Range of Skills and Expertise

IDC began with one project—UNIX shells and utilities. Having quickly established a reputation for high-quality performance and output, IDC now handles more than 15 projects. The projects encompass support and development of UNIX and OpenVMS products, including TeamLinks, PATHWORKS, and ACMSxp on some platforms, as well as products on Windows, MacOS, and DOS platforms. In addition, IDC engineers support software such as TeMIP, WebMAPI, DECforms, ACMS, ALL-IN-1, Ladebug, Alpha C compiler, DEC FUSE, SVE, OOTB, Motif, and PDMS. For these diverse projects, engineers are using C, C++, Visual Basic, and Visual C++ tools.

Courtesy of K. Shenoy, DIGITAL IDC Bangalore

Members of DIGITAL India Development Center in Bangalore, India. The Center is currently marking its second successful year as a software development site.

IDC Management and Infrastructure

Each project manager at IDC reports to a manager in a DIGITAL engineering organization and a manager in India. IDC is host-managed by DIGITAL Equipment (India) Limited, headquartered in Bangalore. All facilities and staff are provided by the Indian subsidiary. Managing Director Som Mittal is proud of IDC's successful efforts. Glenn Johnson, director of UNIX Strategic Alliances, and Sas Durvasula, director of Software Partners Engineering, represent the interests of DIGITAL engineering organizations. The IDC continues to be managed by Parameswaran.

The IDC infrastructure comprises a sophisticated computing network with a DEChub 900 Multiswitch at its heart, dedicated links to other DIGITAL centers, AlphaServer and AlphaStation systems, and DIGITAL desktops.

Making DIGITAL Proud

Key to IDC's success is a flow of projects that are delivered on time and at the high levels of quality for which DIGITAL engineering is known throughout the world. On its second anniversary, the IDC looks back on a positive record of achievement and looks forward to meeting the high standards in software development that it has set for itself. ✳

Commemorating 40 Years of DIGITAL Engineering Excellence

In celebration of the company's 40th year, the Corporate Library Group has assembled an interactive timeline of DIGITAL computing milestones, which is accessible via the corporate intranet.

Selecting any year in the timeline will bring you to a series of photos and a description of events for that year; selecting individual photos or highlighted text in the "year" pages will bring you to more information about the history of DIGITAL products and technology.

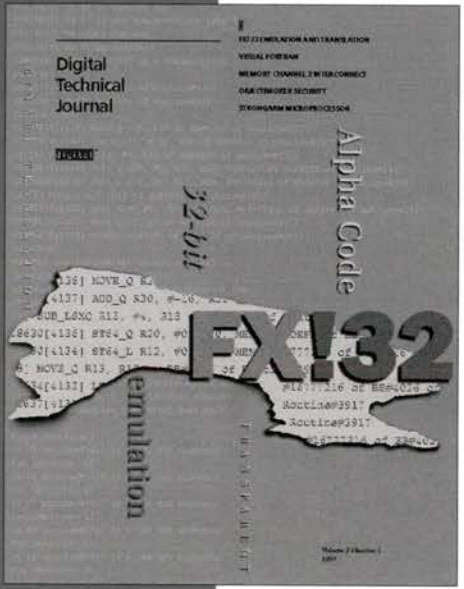
To order photos from the timeline, contact Nancy Strader (nancy.strader@digital.com) in the Corporate Photo Library. To provide feedback or information, contact Craig St. Clair (craig.stclair@digital.com) in the Corporate Archives. ✳

web *site*

intranet
http://weblib.ako.dec.com/clg/cc/tmlnhome.htm
A Timeline of DIGITAL Computing History

Digital Technical Journal Preview

Volume 9, Number 1



Pick your favorites from a wide-ranging set of timely topics...

- ✓ The award-winning FX!32 software that enables 32-bit applications running on Intel x86 to run on Alpha
- ✓ DIGITAL's Visual Fortran that's selling like hot cakes!
- ✓ The interconnect that makes clusters sing — MEMORY CHANNEL 2
- ✓ State-of-the-art security functions integrated with ObjectBroker
- ✓ The StrongARM microprocessor that balances high performance and low power for products of the future

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Engineering Profiles Update: Mary Payne

Mathematician Mary Payne, who was profiled in the Summer 1997 issue of *Forefront* (p. 20), died on June 14, 9 days after the death of her husband William. Both had contracted pneumonia while recovering from bone fractures. ✳

***Forefront* Welcomes Your Contributions!**

Article submission deadlines for upcoming *Forefront* issues are as follows:

Winter issue: October 1, 1997

Spring issue: January 1, 1998

Summer issue: April 1, 1998

Fall issue: July 1, 1998

Article Submission Deadlines

If you're planning to contribute an article to *Forefront*, keep the following submission deadlines in mind.

Winter issue: October 1, 1997

Spring issue: January 1, 1998

Summer issue: April 1, 1998

Fall issue: July 1, 1998

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Forefront

A magazine for the technical community

Winter 1997–98

HIGHLIGHTS

- **Collaborative Ventures to Locate New Technology**
- **Delivering a Shrink-Wrap Software Product**
- **Fall '97 Hot Iron Award Triumphs**
- **Engineering Promotions**
- **Patent Awards**

Meet the Finalists

DIGITAL Technical Excellence Awards

Digital Internal Use Only

Sam Fuller, Chief Scientist and Vice President of the Corporate Technology Strategy and Services Group

Message from Sam Fuller

This issue of *Forefront* features profiles of the finalists for the Chairman's Award for Technical Achievement and the Engineering Team Award. These awards recognize outstanding individual accomplishment and technical excellence through teamwork and collaboration. Both awards were established to recognize significant achievements and contributions made by members of DIGITAL's technical community in support of the corporation's strategic and business directions.

This year 18 individuals were nominated for the Chairman's Award for Technical Achievement, and 13 teams were nominated for the Engineering Team Award. From among these, five finalists for each award were chosen, totaling 180 individuals from our technical community. Each of the finalists has made outstanding technical contributions which have led to positive business results for the company and significant value for our customers.

This winter a banquet will be held to honor the finalists and announce the winners of both awards. At the same event, the recipients of the Cumulative Patent Awards will be recognized. The next issue of *Forefront* will feature the recipients of all of these prestigious awards.

Winning awards is one way to market DIGITAL's technical leadership. DIGITAL took first-place honors in the fall 1997 AIM Technology Hot Iron Awards competition. An article on the winners appears in the Promotions and Awards section. Congratulations to all of you who made this happen.

I also would like to call your attention to an article in the Standards section by the Industry Standards and Consortia Group (ISAC). In October, the group hosted a 3-day workshop titled "The Web is the Platform," which featured speakers from inside and outside of the corporation who spoke about various technologies, standards, and governmental policies that will enable the growth of the Web. From within the ranks of the DIGITAL technical community, enthusiasm was so great that the workshop could not accommodate all those who volunteered to make presentations.

A new section premieres in this issue, External Technology, and includes an overview of the External Technology Group (ETG), a sampling of ongoing projects, and a related article on a recent $1.5 million equipment grant to the MIT Laboratory for Computer Science. We wish to acquaint you with the work of ETG in order to familiarize you with how they can assist you in dealing with outside sources of technology and applications expertise.

Finally, congratulations to the newly promoted consulting engineers and to the latest patent award recipients who appear in the Promotions and Awards and Patent Program sections.

Sam Fuller

Winter 1997–98 Issue

Forefront magazine is a forum for the worldwide DIGITAL technical community to share information, technology and strategic directions, and key accomplishments.

Forefront welcomes contributions of interest to the DIGITAL technical community. The submission deadline for the Q398 edition is January 1, 1998. Contact Managing Editor Dick Willett for information.

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Ireland—Pat Costello
Network Product Business—Jim Kuenzel
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Windows NT Systems Software Segment—
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IN THIS ISSUE

On the Cover
For projects undertaken in FY97, 31 individuals or teams were nominated for the Chairman's Award for Technical Achievement and the Engineering Team Award. The 10 finalists, announced in October, are profiled in this issue of *Forefront* beginning on p. 2.

Meet the Finalists for DIGITAL's Most Prestigious Technical Awards

Facing challenges and overcoming them is characteristic of the finalists for this year's Technical Excellence Awards. These honors focus on the individuals and teams whose endeavors have enabled DIGITAL to offer superior products, technologies, and services or have created entirely new markets for DIGITAL.

Photos: D. Willett

Darrel D. Donaldson, hardware engineering senior consultant and Rawhide system architect

The Rawhide program would not have achieved its goal and objectives had it not been for Darrel Donaldson's vision, dedication, perseverance, and hard work.

Darrel D. Donaldson challenged conventions at every level to deliver a server system at midrange cost with high-end capabilities.

Darrel Donaldson, a 14-year veteran of DIGITAL, has made outstanding technical contributions in the areas of protocols, signal integrity, chip transceiver design for multiprocessor systems, and nonvolatile memory chip design. Then, when the AlphaServer group initiated a third generation of Alpha-based servers, management sought out Darrel to become the system architect and then project leader. But Darrel recognized that to develop an outstanding server system in terms of its capabilities, performance, and cost, he would have to contribute even more than technical expertise and leadership. He consequently took on the role of champion for Rawhide's innovative design and an unconventional approach to development.

As a result of Darrel's creativity, technical astuteness, and perseverance—not to mention his contributions as engineering manager for the platform—a new family of midrange servers, commercially known as the AlphaServer 4100 and 4000 family of products, is acclaimed by customers for its flexibility and competitive performance.

Masood Heydari, vice president of AlphaServer Platform Development, said: "Though no single individual can be credited with the implementation of a computer system such as Rawhide, I am certain that the Rawhide program would not have achieved its goal and objectives without Darrel's vision, dedication, perseverance, and hard work."

The Rawhide platform's widely acclaimed flexibility is exhibited in a number of ways. First, a single building block (drawer) can be rack mounted or configured as a pedestal. Further, the system is capable of accepting many microprocessor speed variants and memory technologies, providing system capacities ranging from 64 MB to 8 GB. The 8-GB capacity brought very large memory (VLM) capability to midrange systems for the first time. Its 64-bit PCI I/O subsystem provides 8 or 16 PCI slots, and the system supports three operating systems: DIGITAL UNIX, OpenVMS, and Windows NT.

The high performance that Darrel and his team strived to attain is exemplified in the chart-topping benchmarks achieved by the AlphaServer 4100 server family.

Bob Supnik, vice president of Research and Advanced Development, has called Darrel "an invaluable resource to the server organization, to engineering, and to DIGITAL." ✳

Rawhide

individual achievement

Microsoft Exchange

Stan Foster, Information Systems consultant and messaging architect

Stan Foster's advocacy for a modern messaging system within DIGITAL has resulted in the world's largest geographically distributed Microsoft Exchange system.

Few tools are more important to DIGITAL employees than electronic mail. Changing DIGITAL's worldwide mail environment is not only a formidable technical task, but one that puts at risk a foundation of productivity for the company. Earlier than most, Stan Foster recognized that future productivity would, in fact, depend on making a change and moving the company away from multiple, soon-to-be-obsolete messaging systems. He therefore became a strong proponent of a single Windows NT computing environment and a single Exchange messaging service.

As a result of Stan's technical expertise and insight, the deployment of DIGITAL's Exchange system succeeded in increasing productivity through easy sharing of binary files and a state-of-the-art interface. More than 61,000 users are part of the largest geographically distributed Exchange system in the world and one of the world's two largest Exchange systems in terms of mailboxes.

The success of the project was not assured, however, and the challenges to deployment existed on many fronts: technical, business, and operational. For example, the system software, which had not been tested at the scale required by DIGITAL, was initially implemented using beta software. "Stan's inventiveness kept the project on track," said Rick Fricchione, vice president of Advanced Information Technology. Stan proposed to use a "franchise model" that became both a technical and a business model for the company-wide implementation.

More than 61,000 users at DIGITAL are today part of the largest geographically distributed Exchange system in the world and one of the world's two largest Exchange systems in terms of mailboxes.

In describing the franchise model, Stan characteristically makes the concept easy to understand: "Think of McDonald's.... The Exchange implementation allows autonomy where appropriate without compromising the integrity of the system or confusing employees with different implementation standards.... Just as McDonald's has standards for store design as well as the shape and quality of buns and burgers, we have standards for the directory structure, routing topology, quality of service, and problem escalation." The inclusive approach of the franchise model has enabled a higher level of participation across the corporation. Stan's ability to communicate innovative ideas such as the franchise and his technical expertise have made him a key technical interface with Microsoft.

The project's success now extends beyond DIGITAL's own messaging system to customers interested in moving to an Exchange environment. These customers look to DIGITAL as an acknowledged leader in enterprise messaging systems and a supplier that can assure a successful outcome for their implementations. ✳

High Performance Computing

Richard Kaufmann, technical director, High Performance Technical Computing

Supporting DIGITAL's reemergence in the High Performance Technical Computing business is Richard Kaufmann's technical vision and leadership.

The excitement around DIGITAL's return to the High Performance Technical Computing (HPTC) space is fueled not only by the opportunity for significant revenue but by an opportunity to stretch and demonstrate the real capabilities of Alpha 64-bit computing. Scientific laboratories worldwide are seeking huge machines—some exceeding thousands of processors—with the ability to perform demanding numerical computations such as simulations of nuclear explosions. DIGITAL has the computing know-how to meet these customer requirements and then translate that work into competitive advantage for DIGITAL'S future commercial systems.

HPTC customers operate in a milieu of extremely high computation and I/O rates delivered in the largest system configurations built with interconnects supporting very high throughput and low-latency operations. Richard Kaufmann understood early the software approach that would meet these system demands. He led a team in Galway, Ireland, in the development of "a thin layer of parallel software" that took the form of very high performance message passing libraries designed to extract the maximum capability of systems connected by MEMORY CHANNEL.

Richard Kaufman is DIGITAL's key technical emissary to the scientific and technical computing community.

Richard's knowledge of high-performance technical computing, combined with his vision, has earned him the respect of laboratory scientists. He recently translated that vision into a DIGITAL proposal for the US Government's ASCI Pathforward Program, a multi-year, multi-million-dollar, high-performance interconnect advanced development effort.

Bill Blake, director of HPTC Product Management and Development, said: "Richard is in demand around the world to present his view of the direction of high-performance technical computing. He is DIGITAL's key technical emissary to the scientific and technical computing community." ✳

VNswitch 900


Hugh Wilkinson, consulting software engineer and VNswitch product architect

The force behind a unique and powerful switching system, the VNswitch 900, was Hugh Wilkinson's depth and breadth of technical expertise.

As the VNswitch product architect, Hugh Wilkinson, a software consulting engineer, used his outstanding technical depth and breadth in software and in hardware/software interface to provide the technical leadership to the entire VNswitch development team. Hugh has been the "agent of continuity" throughout the project, serving as a continuous resource for the hardware designers, the software engineers, and the ASIC development team. Accommodating Ethernet, FDDI, and ATM in the same switching architecture required exceptional technology expertise. Hugh was able to span this wide knowledge base and provide technical direction for system-wide issues.

The VNswitch is a design for a family of packet switches that implements DIGITAL's enVISN strategy for switched networks. The VNswitch provides easy-to-use, any-to-any LAN switching and IP routing either standalone or installed in a DIGITAL MultiSwitch 900 chassis. By adding LAN switching to the MS900 platform, the VNswitch has provided an exceptional level of investment protection for DIGITAL's networking customers. The VNswitch provides a unique level of "plug-and-play" extensible LAN switching across multiple LAN technologies. The unique hardware/software architecture remains extensible to new technologies such as QOS, RSVP, IP Multicase, and enhanced VLANs.

Accommodating Ethernet, FDDI, and ATM in the same switching architecture required exceptional technology expertise. Hugh Wilkinson was able to span this wide knowledge base and provide technical direction for system-wide issues.

"Besides providing customers with easy-to-use LAN switching, the VNswitch extends the life of the customer's existing MultiSwitch 900 chassis, providing a level of investment protection previously unknown in the chassis-based networking market," said Michael Paquette, HPN engineering manager.

In a recent independent switch performance test, the VNswitch outperformed similar Fast Ethernet switching configurations such as the Cisco catalyst 5000 and the 3Com Corebuilder 5000 platforms. The extremely high performance achieved by the VNswitch is the result of tight integration between software that executes on two distinct processors and custom ASIC hardware.

Since early 1997, DIGITAL has sold more than 10,000 VNswitches, generating nearly US$100 million in revenue for the corporation. *Network World* (June 9, 1997) called the VNswitch a "mixed-port ace" and listed its plug-and-play ability as a significant advantage. ✻

individual achievement

StrongARM

Rich Witek, senior corporate consulting engineer and StrongARM Architecture Team leader

> **StrongARM was Rich Witek's inspired idea. In 1994, he saw the need for additional processing power in network and consumer appliances....**

With StrongARM, Rich Witek adds another computer industry first to an impressive professional history.

StrongARM isn't just another microprocessor. StrongARM has established a new industry record by addressing three interdependent areas that are key to developing sophisticated network-based and consumer appliances: high processor performance, very low power consumption, and low cost. *Microprocessor Report*, the most influential publication in the semiconductor industry, called the processor "the pick of the litter" among the new generation of high-performance, low-power processors with the "best combination of price/performance and MIPS/watt of any integrated CPU in the market."

StrongARM was Rich Witek's inspired idea. In 1994, he saw the need for additional processing power in network and consumer appliances that would enable new functionality, new applications, and improve the performance of existing applications. The challenge was to improve performance significantly without consuming additional power—and, of course, to achieve all of this at low cost.

From a technical perspective, Rich saw the possibilities of combining performance techniques from the Alpha 64-bit RISC architecture with new ideas about low-power processors. Rather than define a whole new architecture, he combined his ideas with an existing one—the low-power, low-cost Advanced RISC Machines, Ltd., (ARM) architecture. Rich is a finalist for the Chairman's Award for Technical Achievement not only for conceiving of the idea for StrongARM but for taking on numerous roles to ensure the processor's success. He led the architecture team, recruited highly talented engineers, collaborated with ARM on the architecture specification, wrote code, and helped debug final silicon.

Rich is no stranger to taking on a leadership role and digging in to get the job done. Nor is he new to industry breakthroughs such as StrongARM. He was co-architect of the Alpha 64-bit RISC architecture, an architecture that anticipates computing needs well into the next millenium. In addition, he was lead architect on the first Alpha microprocessor and was one of the lead designers on the MicroVAX II microprocessor, the first single-chip VAX processor.

Rich's vision for the future of a high-performance, low-power, low-cost processor is already becoming a reality. StrongARM is today being designed into network appliances, Web phones, global positioning navigation systems, "smart" cellular telephones, and hand-held-, wallet-, and subnotebook personal computers. ✳

The DIGITAL HiNote Ultra 2000 team. Front row, from left: Martin Shan, Michele Bovio, Jay Kanjiram, Nat Alderman, and Rob Frame. Second row, from left: Kathy Walsh-Dingelhoff, Scott Baucom, Mike Martell, Mike Maddix, Scott Giordano, Sajiv Sarin, Rick Hennessy, Steve Paul, and Frank Ai. Third row, from left: George Yacubovich, Scott Pirdy, Fred Williams, John Riley, Bruce Wahler, and Chris Dunigan. Back row, from left: Tom Jeleniewski, Premanand Sakarda, and Bill Holden.

'DIGITAL redefines both the ultraportable and the desktop-replacement categories with its HiNote Ultra 2000....' [C/Net]

HiNote Ultra 2000

The DIGITAL HiNote Ultra 2000 team built 'a technological masterpiece.'

"Digital Ultra 2000 is a technological masterpiece that provides more computing per inch of thickness than competing units...." [*Mobile Computing*]

"Digital redefines both the ultraportable and the desktop-replacement categories with its HiNote Ultra 2000. The system offers a stunning, 14.1-inch LCD (the first we've seen), top of the line power, and a modular drive bay—all within the tight confines of a thin and wide design." [C/Net]

"Until now, laptop users have been forced to make compromises to satisfy their desires for both high performance and light-weight portability. The new Digital computers deliver high-performance in a light-weight package." [Analyst Mike McGuire of Dataquest, *Boston Globe*]

The huge success of the DIGITAL HiNote Ultra 2000 began 18 months ago in Acton, Massachusetts, when the 32-member DIGITAL HiNote Ultra 2000 team challenged the premium notebook market. Until the Ultra 2000, products such as the IBM Thinkpad 760 series, the Compaq Armada 7700 series, and the Toshiba Tecra 730 series defined this market. (IBM, Compaq, and Toshiba currently have over 80% of the premium market.)

To compete, the team set aggressive goals, resulting in a highly complex project. Each area of the project pushed the established boundaries to new extremes, resulting in a number of breakthroughs employed in the design of the Ultra 2000. These include state-of-the-art plastics—allowing the thinnest wall construction in the industry, a 14.1-inch LCD display and mounting system, the densest layout ever attempted by a PCB fabrication company, a state-of-the-art docking strategy, power-sharing architecture, true hot docking under both Win95 and WinNT, and the ability to swap the CD and floppy while the system is turned on. To date, these efforts have resulted in six patent applications with more forthcoming.

The result of this effort is a thinner—1.2 inches thick (slightly less than its cousin, the Ultra II which is 1.35 inches thick)—and a faster ultraportable laptop (using the latest 166-MHz Pentium processor with plans to move to 233 MHz and beyond).

Stephan Godevais, vice president and general manager, Mobile Business Segment, NTSBU, remarked: "The

DIGITAL HiNote Ultra 2000 team has delivered the only premium notebook with a 14.1-inch screen and desktop performance that is between 6 months to a year ahead of the top-tier notebook vendors. I have never seen a team of people willing to devote such extraordinary effort and dedication to bringing a product to market."

The DIGITAL HiNote Ultra 2000 Team

Francis Ai
Nat Alderman
Allan S. Baucom
James E. Bay
John F. Borg
Michele Bovio
Matthew E. Campanella
Bradford G. Chapin
Kalman S. Csigi
Christopher M. Dunigan
Robert T. Faranda
Robert C. Frame
Scott A. Giordano
Richard D. Hennessy
William Holden
Thomas E. Jeleniewski
Jitender Kanjiram
Michael D. Maddix
Michael E. Martell
Sergio Parise
Stephen M. Paul
Eugene Penszynski
Jeffrey A. Peterson
Scott L. Pirdy
John Riley
Premanand Sakarda
Sajiv Sarin
Martin S. Shan
Bruce A. Wahler
Sean M. Wall
Kathleen Walsh-Dinglehoff
Freddy Williams
George R. Yacubovich
Jikang Zhou

*

team achievement

If you know that DIGITAL invented clusters, the record-breaking performance of TruCluster comes as no surprise. True to DIGITAL's concept of clusters as highly available, extensible, high-performance multicomputer systems, the TruCluster Engineering Team set out to build a high-performance cluster for the DIGITAL UNIX environment. To the delight of Oracle Corporation and its leader Larry Ellison, the team delivered a UNIX environment that broke supercomputer performance records. The TruCluster version 1, running Oracle Parallel Server on a four-node AlphaServer 8400 cluster, was audited at 30,390 tpmC, beating out the record held by Tandem's Himalaya at 20,918 tpmC. Ellison summed up the accomplishment: "This means that our customers' mission-critical applications can now run faster, more reliably, and more economically."

The team's achievement is both commercial and technological. From the architecture through cluster components, engineers focused on delivering the availability, scalability, and performance characteristics of clusters. The

Tru

To the delight of Oracle Corporation and its leader Larry Ellison, the TruCluster team delivered a UNIX environment that broke supercomputer performance records.

The DIGITAL UNIX TruCluster Version 1 team. Front row, from left: Sandy Snaman, Jane Lawler, Brian Stevens, Larry Cohen, Dave Winchell, and Fred Glover. Back row, from left: John Williams, Wayne Cardoza, Hai Huang, Dick Buttlar, Joe Amato, Mitch Condylis, and Mark Longo.

Distributed Remote Disk ensures continued I/O access in the event of node failure; new Connection Manager assures scalability; and a newly designed Distributed Lock Manager enables parallelized applications. The TruCluster team also fully exploited the performance characteristics of the MEMORY CHANNEL interconnect for the cluster by working closely with the MEMORY CHANNEL Engineering Team on the design.

"A significant factor in the success of this major undertaking was the team's ability to work across organizational and company boundaries," explained Kent Ferson, vice president of DIGITAL UNIX Engineering.

In addition to the MEMORY CHANNEL team, TruCluster engineers worked jointly with Oracle Corporation engineers to understand system dependencies on database performance and scalability. Such collaboration has made possible technological leaps that place TruCluster ahead of the competition in the UNIX commercial and scientific/technical markets.

The introduction of TruCluster is only a beginning for the engineering team. The team will continue to evolve the TruCluster product toward an even more scalable, more general computing environment. In particular, the distributed file system, configuration flexibility, management tools, and single-system view for both internal and client applications will be emphasized. With this team, DIGITAL's place as a leader in UNIX is assured.

The DIGITAL UNIX TruCluster Version 1 Team

Joseph A. Amato
David L. Ballenger
Richard J. Buttlar
Wayne M Cardoza
Raymond A. Chibbaro
Lawrence S. Cohen
Mitchell P. Condylis
Maria C. Dicenso Vella
Frederick S. Glover
Hai Huang
Jane M. Lawler
Mark Longo
Joseph A. Pepicelli
Douglas J. Shakshober
William E. Snaman
Brian M. Stevens
John H. Williams
David F. Winchell

*

Cluster

Visual Fortran

By combining technologies from Microsoft and DIGITAL, the Visual Fortran team has excited the interest of the worldwide scientific and technical community.

The DIGITAL Visual Fortran team. Front row, from left: Leo Treggiari, Caroline Davidson, Cindy Huang, Terry Grieb, Mike Etzel, and Pierre Calixte. Middle row, from left: Lucy Hamnett, Robyn Sampson, Tom Lavigne, Peter Karam, Regina Bolduc, Neil Johnson, William Conrad, and Dave McClure, and Steve Lionel. Back row, from left: Steve Rose, Stan Whitlock, Bill Hilliard, Chris Bord, Bob Hanek, and William Youngs.

DIGITAL Visual Fortran is among the company's top-selling, layered software products. Within only 10 weeks of its release in April 1997, the Visual Fortran product group sold an amazing 6,000 licenses and has continued to sell at that rate ever since. Proud of the team and its selection as a finalist for the DIGITAL Engineering Team Award, manager William Youngs said: "Key to the success of DIGITAL Visual Fortran has been the willingness of team members to work outside their traditional roles and do 'whatever it takes' to get the job done."

As soon as Microsoft turned over its Fortran business, the DIGITAL team set out to create an integrated development environment that combines technologies from both companies.

Among the DIGITAL-developed technologies in the product are the compiler and run-time libraries that support the DIGITAL Fortran 90 language on all DIGITAL-supported platforms. Through the efforts of the code-generation team, Visual Fortran now supports Windows NT on both the Alpha RISC and the Intel x86 architectures. The company has applied for four patents on the code-generation technology. The DIGITAL team also added new Fortran tools, including the innovative Fortran Module Wizard. The Wizard aids developers by simplifying the interface to services available to clients through dynamic link libraries and to servers based on Microsoft's Component Object Model. Beyond developing new technologies and adding functions, the DIGITAL team has ensured that users of the Microsoft Fortran product can easily migrate to the new DIGITAL product. Microsoft's contribution to DIGITAL Visual Fortran is its integrated development environment, called Microsoft Developer Studio, which is also used by Microsoft Visual C++ and Microsoft Visual J++.

The final proof of the team's success lies with Fortran language users. Developed in the 1950s, the language has evolved over the years to serve a tenacious user base; Fortran is the language of choice for the scientific and technical community. Bill Blake, director of HPTC Product Management and Development, said: "Now scientists and engineers can rely on a single, 'industrial-strength' Fortran supported on systems ranging from their laptops to their largest teraFLOP machines. The DIGITAL Visual Fortran theme is 'write once, run fastest.'"

The DIGITAL Visual Fortran Team

Deborah Belcher
Regina Bolduc
Christopher L. Bord
Pierre Calixte
William Conrad
Caroline S. Davidson
Karen L. Dickinson
Michael J. Etzel
Henry N. Grieb
Lucinda M. Hamnett
Robert N. Hanek
William C. Hilliard
Cynthia H. Huang
Neil W. Johnson
Peter M. Karam
Thomas F. Lavigne
Steven B. Lionel
Lorraine W. Menard
John Panella
Stephen A. Rose
Robyn A. Sampson
Leo Treggiari
Stanley J. Whitlock
Paul S. Winalski

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FX!32 is a unique way of increasing software availability. The team that made it happen is among the finalists for the Engineering Team Award.

The capabilities of FX!32 software are remarkable and the technology complex. No less than nine patents have been filed on the FX!32 design. Nevertheless, its operation is transparent to users and the performance benefits are evident.

FX!32 combines software emulation and advanced binary translation techniques to enable 32-bit applications that run on Intel machines with Windows NT to also run on 64-bit RISC Alpha machines with Windows NT. More simply put, FX!32 makes available to users of Alpha machines hundreds of applications written for Intel machines. For DIGITAL's customers who run Alpha Windows NT workstations, this is a tremendous boon in productivity as well as in cost savings. Although most customers purchase Alpha Windows NT systems for the performance these systems bring to specific native applications, customers also greatly value the ability to run other applications that are not part of a core application set.

The FX!32 Development team. From left: Anton Chernoff, John Strange, Mark Herdeg, Ray Hookway, Tom Evans, Monty Vanderbilt, and Tony Tye.

The small, core team that designed and developed the initial software and participated in subsequent releases is among the finalists for the Engineering Team Award. Given the success of FX!32 with its users, honors are not new to this team. The software has received industry accolades since its initial release:

- Technology of the Year Award from Windows Sources at PC Expo 1997
- WIN 100 Software for Windows NT *[Windows Magazine]*
- 1996 Editors' Choice Award of Distinction—Best Technology *[BYTE Magazine]*
- B.O.S.S. Best of Show Select Award *[BackOffice Magazine]*
- 1996 Wired for 3D Award *[3D Design]*.

FX!32 is a tremendous boon to customers in terms of productivity and cost savings.

These awards acknowledge a significant technical achievement, a product that delivers on its promise, and software that fulfills customer expectations. Not surprisingly, the team that built the FX!32 software continues to work with customers to enhance this unique binary translation product.

The FX!32 Development Team

Anton Chernoff
George A. Darcy
Thomas P. Evans
Mark A. Herdeg
Raymond J. Hookway
Norman Rubin
John A. Strange
Steven T. Tye
Monty Vanderbilt

*

team achievement

The Rawhide Development team. Front row, from left: Bruce Alford, Glenn Herdeg, Darrel Donaldson, Frank Touserkani, Subhash Dandage, and Bill Braucher. Second row, from left: Dale Keck, Dennis Hayes, Dave Mayo, Chris Reed, Colin Brench, Roger Dame, Don Smelser, Paul Guglielmi, Mark DeAmicis, Bill Cummins, Jim Staples, Norberto Collado, Art Singer, Todd Davis, Ann Harrold, and Norm Plante. Third row, from left: George Harris, Russ Iknaian, Masood Heydari, Dick Beaven, Len Haywood, Bob Astapoveh, Bob McClain, Rich Freiss, Betty Ann Tyson, John Stevens, Oleg Klimowicz, Kathe Rhoades, Dave Carlson, Steve Lindquist, Andy Koning, Wally Hamel, and Dan Wissell. Top row, from left: Dennis Bak, Mike Aho, Tony Bento, Bill Gist, Jim Rosencrans, Bill Blodgett, Don Dutile, Sam Duncan, Mark Stefanski, Rick Olson, and Dave Bateman.

Rawhide

The Rawhide Development team delivered a complete midrange server family that satisfies the individual needs of DIGITAL's customers.

The Rawhide Development team's mission: "Mass customization to satisfy individual customer's needs through channels." As proof of its success and customer acceptance, the AlphaServer 4100 systems have generated significant revenue for DIGITAL in the first 14 months of the product life cycle. Known within DIGITAL as "Rawhide," the AlphaServer 4100 and AlphaServer 4000 family of midrange servers features a flexible and modular design. The Rawhide Development team followed a highly effective Concept Engineering process to determine a comprehensive set of product requirements based on customer feedback. The team then created a roadmap of products for the Rawhide family. Subhash Dandage, engineering manager, says "This cross-functional team has done an exemplary job of defining and delivering a complete midrange server family that has become the flagship of DIGITAL's award-winning server lineup."

While designing for flexibility, the Rawhide Development team did not sacrifice performance. In fact, the AlphaServer 4100 sys-

The Rawhide Development team's mission: 'Mass customization to satisfy individual customer's needs through channels.'

tems have demonstrated leadership performance in several benchmarks. The design achieved the world's best single-node decision-support performance and value for a midrange system in all three TPC-D measurements: performance, throughput, and price/performance. The AlphaServer 4100 model 5/466 with two processors shattered all Windows NT and UNIX performance records for Lotus Notes 4.5, outclassing all other alternatives from any vendor or platform!

Appreciative of the Rawhide Development team's hard work, cohesiveness, and steadfastness, Masood Heydari, vice president of AlphaServer Platform Development, asserted: "I saw the team go far beyond the call of duty to commit to and subsequently meet the most aggressive schedules." The Rawhide Development team achieved power-on to FRS in a record 6.5 months compared to the previous best record of about 12 months for this class of product.

The AlphaServer 4100 has received many industry awards, including the AIM NT Hot Iron Award for best-performing Windows NT domain server and the AIM UNIX Hot Iron Awards for best price/performance among UNIX shared systems ($150,000) and best price/performance among UNIX file servers ($150,000). *Datamation* proclaimed the AlphaServer 4100 as the 1997 Product of the Year.

The Rawhide Development Team

Michael J. Aho
Bruce L. Alford
Walter D. Arbo
Robert W. Astapoveh
Dennis T. Bak
Jean H. Basmaji
David V. Bateman
Richard C. Beaven
Anthony Bento
William M. Blodgett
Margaret-Ann K. Bolton
William K. Braucher
Colin E. Brench
William S. Briggs
Matthew D. Buchman
Daniel L. Callahan
David A. Carlson
Norberto Collado
Harold F. Cullison
Paul J. Curran
Zarka Cvetanovic
Roger A. Dame
Subhash R. Dandage
Todd H. Davis
Mark A. DeAmicis
Richard P. Devlin
Darrel D. Donaldson
John H. Drasher
Linda M. Dube
Samuel H. Duncan
Donald G. Dutile
Michael S. Fein
Douglas D. Field
Arina Finkelstein
Richard C. Freiss
Joan Gale
Kevin J. Gamache
Frank W. Gatulis
Edward W. Gent
William B. Gist
Linda T. Greska
Robert A. Guenther
Paul M. Guglielmi
Walter L. Hamel
Robert L. Hanson
George J. Harris
Ann Harrold
Dennis F. Hayes
Leonard P. Haywood
Glenn A. Herdeg
Carol A. Hester
Barbara R. Hood
Jeffrey A. Huber
Russell B. Iknaian
Dale R. Keck
Craig D. Keefer
Oleg Klimowicz
Andrej Kocev
Herbert R. Kolk
Andrew P. Koning
Dmetro Kormeluk
Virginia C. Lamere
John C. Lawrence
Kevin J. Lemieux
Steven E. Lindquist
Dennis M. Litwinetz
Bryan S. Locke
John J. Lynch
David T. Mayo
Robert R. McClain
John K. Nee
Bonnie G. Oliver
Richard E. Olson
Roger D. Pannell
Norman W. Plante
Traci W. Post
Christopher L. Reed
Kathe Rhoades
Douglas J. Richard
James F. Rosencrans
Eduard Rozman
Brian Sanborn
Mary A. Sartori
Joseph L. Scala
Arthur L. Singer
Terrence R. Skrypek
Donald W. Smelser
James F. Staples
Mark L. Stefanski
Maurice B. Steinman
John E. Stevens
Michael J. Thomas
Farhad F. Touserkani
Elizabeth A. Tyson
Daniel Wissell

An **awards banquet** will be held in **January** to honor the **finalists and announce the winners** of the **Technical Excellence Awards**. Recipients of the **Cumulative Patent Awards** also will be recognized that evening.

Addressing Information Needs with an Accent on Europe

DIGITAL employees, whose business dealings require specialized knowledge of Europe, are encouraged to seek help from the online WebLibrary, as well as from on-site Information Centres in Reading and Valbonne.

By Wendy Humphriss, Corporate Library Group, Valbonne, France, and Carol Webb, Corporate Library Group, Reading, UK

HumphrissW@mail.dec.com; WebbC@mail.dec.com

The DIGITAL technical community spans the globe, as do the corporate intranet and the online accessibility of the Corporate Library Group's (CLG) WebLibrary. Electronic delivery of a vast array of information to the desktop is at the heart of CLG support wherever it originates—including the Reading and Valbonne Information Centres.

Following is a review of available technical information resources with a special focus on the European continent.

Technical Resources Page

The WebLibrary's technical resource page, available via the corporate intranet, provides an abundance of links to technical associations, research organizations, conferences, trade shows, technical journals, standards, technical reports, in-house training opportunities, and more. Here is a sampling:

- ACM Digital Library
- Community of Science: Search databases for patent information or expertise in a particular field.
- Commerce Business Daily
- DIGITAL Library Catalog: Access the collections of various DIGITAL site libraries, totaling more than 63,000 items.
- Ei Compendex: Search an interdisciplinary engineering database having more than 3 million summaries of journal articles, technical reports, conference papers, and proceedings dating from 1970 to the present.
- Daily updated news: Customize your desktop receipt of news.
- Patents: Search IBM's full-text patent database and other patent databases.
- *Technical Insight Alerts:* Review seven weekly newsletters that track developments and research in technical areas to identify emerging trends.

Online Syndicated Market Research

Among the various types of market research available online are *Datapro Reports*, which focus on telecommunications, networking, and computer technology (systems and peripherals, software, etc.). Recent topics having a European focus include the following:

- British Telecom's Internet services
- France Telecom's Internet services
- Eritelcom Telecom Europe PBX
- Germany: the commercial and regulatory environment
- Intelligent networks in the US and Europe
- The Czech Republic: IT business issues
- ADSL Services in the US and Europe: overview

Datapro even offers services that extend beyond Europe. *International Telecommunications* provides country coverage from A (Algeria) to Z (Zimbabwe).

Topics Are Limitless

DIGITAL Technology Pathfinder leads the user to Web-based information about technology-related projects in which DIGITAL participates. Of particular interest is European Union Research and Development Information, a category that includes current DIGITAL projects such as the following:

- KIMSAC: A kiosk-based, integrated multimedia service providing information access for citizens
- EUROMEDIA: a distributed multimedia archive for cooperative TV production
- VEGA: a virtual enterprise using groupware tools and distributed architectures

- ACTranS: a transaction-processing toolkit for ACTS

Collectanea is a database of periodical abstracts and full-text articles on some 50 special-interest areas.

The WebLibrary provides electronic access to a large collection of journals and magazines including the following titles:

- *BusinessWeek*
- *Byte*
- *Computer Research News Online*
- *Digital Technical Journal*
- *The Economist*
- *Fortune*
- *HotWired*
- *IEEE Transactions on Parallel and Distributed Systems*
- *Internet* (UK)
- *Technology Review* (from MIT)
- *PC World*
- *PC Magazine*
- *Science*
- *WebCentral* (UK)
- *Windows NT Magazine*

On-Site in the UK and France

DIGITAL's European Information Centres in Reading (REO), UK, and Valbonne (VBO), France, work in collaboration with CLG facilities in the US. Both European sites have extensive reference resources and on-site libraries of books, journals, internal technical reports, standards, and audio-visual material—all of which are indexed in the DIGITAL Library Catalog.

The CD-ROMs, reference books, journals, technical reports, and many other materials are directly accessible to employees. Following is a sampling of the on-site resources at REO and VBO.

CD-ROMs

IHS Telecomms. (available at VBO and REO) Full-page images of the telecommunications standards from the following organizations: ANSI, EIA/TIA, FIPS, IEC, IEEE, ISO, ITU-R, ITU-T, and UL

ETSI. (available only at VBO) Full-text standards from the European Telecommunications Standards Institute

ILI/Infonorme. (available at REO) An index of national, international, and industry standards

Computer Select. Current computer industry information from the European and US computer trade press; full text for 65 journals and abstracts for 88 more; also full text of product announcements, and software and hardware product specifications. Titles include *Computer Weekly, Information Week,* and *Internet World*

ABI/Inform. More than 550,000 citations to abstracts from over 1,000 international publications dating from1985 to the present. Business strategies and tactics, management tools and trends, accountancy, computers, economics, law, marketing, and human resources; publications include *Fortune, Harvard Business Review,* and *European Management Journal.*

DIGITAL employees urgently seeking a specific article on a European topic can contact the Valbonne or Reading Information Centres for assistance. VBO–DTN 828-6005. REO—DTN 830-4800.

External Online Databases

The staff at the REO and VBO Information Centres can assist users in accessing specialized database hosts that are gateways to a vast range of technical, business, industry, and market analysis information. These databases are searched via specialized command languages, and the staff can identify and access data to match your information needs. Databases include

- Dialog
- DataStar
- Maid
- Reuters Online
- Derwent's World Patents Index: US and European patents.
- Derwent's European Patents Full Text: US and European patents.
- Inspec: Full text of IEE and IEEE journal articles, conference proceedings, and similar documents (only abstracts for some older material)
- Inside Conferences: Index and citations to all papers in the collections of the British Library presented at congresses, symposia, conferences, expositions, workshops, and meetings; more than 15,000 proceedings added annually.

- IAC Prompt: Overview of markets and technologies from journals, newsletters, and other publications
- ABI/Inform: Similar to the CD-ROM version mentioned earlier, but this is full-text version

Tarifica European Manuals

Available at REO, the *Tarifica European Manuals* are a source of in-depth coverage on the tariffs of 37 western, central, and eastern European countries. It includes national and international tariffs for PSTN, Freephone, ISDN, VPN, analog and digital leased lines, telex, PSDN, mobile telephony, and paging. Data is verified every 6 months.

On-site Journal Collections

Both European Information Centres have extensive collections of magazines and journals, including the UK and French IT press and a number of technical reviews.

DIGITAL employees urgently seeking a specific article on a European topic can contact the Valbonne or Reading Information Centres for assistance. VBO—DTN 828-6005. REO—DTN 830-4800. ✻

web*sites*

The following URLs address the corporate intranet.

http://weblib.ako.dec.com
The Corporate Library Group's WebLibrary

http://weblib.ako.dec.com/clg/catalog/dlncat.htm
The DIGITAL Library Catalog

http://weblib.ako.dec.com/clg/info/tip.htm
Technical Information Resources

http://weblib.ako.dec.com/Datapro/toc.htm
Datapro Reports

http://weblib.ako.dec.com/clg/etg/etgtop.htm
DIGITAL Technology Pathfinder
Find information about technology-related projects in which DIGITAL participates.

http://weblib.ako.dec.com/clg/info/collectanea.htm
Collectanea

http://weblib.ako.dec.com/journals.htm
A link to a list of electronic journals and magazines

Collaborative Ventures to Locate New Technology

To identify and promote promising technologies, the External Technology Group is actively involved in more than 75 projects at universities and research institutions worldwide.

By Ken King, External Technology Group, Maynard, Massachusetts

Photos: D. Willett

The External Technology Group: from left, Igor Varsek, manager; Ken King; Joachim Schaper, director, European Applied Research Center; Sue Dorsey; and David Loveman.

The mission of the External Technology Group (ETG) is to engage universities and other technology-oriented customers in projects with DIGITAL to identify, evaluate, and promote the acquisition and use of technology that will enable DIGITAL to extend its technical leadership and expand its future business.

Directed by Igor Varsek, ETG falls under the aegis of the Corporate Technology Strategy and Services organization as part of Bill Strecker's Corporate Strategy and Technology group.

Projects and Programs

Through its External Technology Grants Program (ETGP), ETG establishes and drives projects in collaboration with universities in the US, Europe, and the Asia-Pacific region to identify technology and "know-how" on behalf of DIGITAL business units (i.e., the "sponsors" of the projects). Typically, the universities receive allowances (i.e., grants) that consist of DIGITAL hardware and software products as compensation for their research.

Through its European Applied Research Center, CEC Karlsruhe in Germany, ETG is also working with strategic customers and university partners to locate promising new technology that DIGITAL engineering can further develop.

The recently established Strategic Technology and Research (STAR) group, also located in Karlsruhe, deploys new technology based on research by DIGITAL and ETG partners. STAR is chartered to apply and evaluate new technology in a customer-defined environment. Through its European Union (EU) liaison office in Brussels, ETG encourages collaboration and supports the participation of DIGITAL organizations in selected European research consortia through which customers and universities join forces to address complex technical issues. These consortia are often co-funded by national or European Union–sponsored R&D programs. Although contracting with universities to do research remains the cornerstone of the ETG charter, FY98 efforts will focus upon the following:

- Working with leading-edge customers to apply technology toward new solutions. This will allow DIGITAL to gain an understanding of real customer requirements in new areas and help ensure that DIGITAL will be able to differentiate itself from competitors in those market areas. Efforts will focus upon *solution experiment* areas (described more fully later).

'Pleiades' Stars at MIT

On October 22, MIT and DIGITAL announced a research grant consisting of a $1.5 million AlphaServer multiprocessor computing system. Dubbed "Pleiades" in honor of the star cluster in Taurus, the 28-processor system consists of seven AlphaServer 4100s and is housed at the MIT Laboratory for Computer Science (LCS) in Cambridge, Massachusetts. The most powerful computer system ever installed on the MIT campus, Pleiades eclipses and physically displaces the 32-processor Sun system that had been the primary LCS compute server.

Through the research projects conducted using the new system, DIGITAL will acquire

- Hands-on experience with MIT's scalable, high-bandwidth Arctic interconnection network
- Valuable knowledge about network interfaces for clusters via MIT's StarT project

DIGITAL will gain access to new software technology, such as the following easy-to-use, uniform, robust programming models for clusters:

- pH, a high-level implicitly parallel programming language
- Cilk, a parallel programming language with notion of provable performance
- Multithreaded programming
- Fast numerical core algorithms ✻

In late October, DIGITAL presented the Pleiades multiprocessor computer system to MIT. On hand for the event were, from left, Arvind Parthasarathi of the MIT LCS Computation Structures Group; Michael Dertouzos, LCS director; and Sam Fuller, vice president of the DIGITAL Corporate Technology Strategy and Services Group. (See related story at left.)

- Working with governments towards co-sponsorship and political support of DIGITAL initiatives. Particular attention will be directed toward EU activities and high performance technical computing activities in the US.
- Expanding ETG geographical scope in selected countries in the Asia-Pacific region, particularly Japan and Australia.

In Support of Corporate Technology Imperatives

ETG is chartered to support the corporate strategy and, in particular, the corporate technology strategy. Although CEC programs are already strongly aligned with the corporate strategy (i.e., Internet and networked business solutions), all ETG programs will be realigned over time to sharpen their focus on the current *technology imperatives:*

- The Web as the platform
- Alpha servers are to be used to drive high performance technical computing (HPTC)
- Windows NT is for enterprise applications

In addition, ETG will continue to directly support a select set of *core technologies,* such as semiconductors, identified in the corporate technology strategy.

The ETG Approach

ETG works along two dimensions: *focused technology programs* and *solution experiments.*

Focused technology programs

Focused technology programs manage a set of research efforts aimed at developing new technologies or supporting current ones.

All ETG programs will be realigned over time to sharpen their focus on the current technology imperatives.

Three focused technology programs currently exist within ETG:

- The Web as the platform
- High performance technical computing
- "Over the Horizon Research"

The Web as the platform has been categorized into three sub-areas in which DIGITAL can differentiate itself from its competitors. These are the networking and system infrastructure (Gil Brezler), electronic commerce (David Loveman), and education applications (Ken King).

Within the high performance technical computing program, ETG staff members are looking at the technology components (Gary Cantwell), the graphical visualization aspects (Peter Kochevar), and some selected applications (Frank Severin).

An important function of the Corporate Technology Strategy group is to help determine the technologies that may be needed by DIGITAL in the future and how DIGITAL can best acquire experience with these technologies. The "Over the Horizon" external research (OTHER) program (Igor Varsek, Ken King) funds a small set of projects in areas believed to be of future importance to DIGITAL.

In addition, Digital Semiconductor runs its own external technology program, but ETG does provide contracting support (Sue Dorsey).

For further information on these programs, contact the ETG staff member indicated for that area.

The presentation of the Pleiades computer system to MIT attracted a crowd to the Laboratory for Computer Sciences, where, at right, CTSS Vice President Sam Fuller addressed the group. (See related story at left.)

Kona: More Than a Scenic Island

ETG has worked for a number of years with Bruce Foster, the DIGITAL sponsor, on a series of projects involving various aspects of compiler and language technology. One of the newest projects is the University of Hawaii–Kona project. Kona is a Java-based, collaborative environment to improve software quality through formal technical review. Kona supports software developers as they:

- Build and maintain a database of review guidelines
- Perform distributed review of software development artifacts
- Measure and evaluate the review
- Customize the review process

In collaboration with DIGITAL, Kona will be implemented in an Alpha Personal Workstation environment running under Windows NT.

The project began in Hawaii in Q298. In addition, a graduate student worked last summer at DIGITAL facilities in Nashua, New Hampshire, on a project to determine possible run-time problems in semantically correct Java programs.

The Kona project is part of the work of the Collaborative Software Development Laboratory (CSDL). The principal investigator for Kona is Associate Professor Philip Johnson. ✱

Purple Protein Memories

For several years, DIGITAL has worked with Professor Robert Birge of Syracuse University, whose field of research is molecular electronics. (In October 1997, he was named by *TIME Digital* as one of the magazine's "50 Cyber Elite.")

At the Center for Molecular Electronics, current research uses bacteriorhodopsin (a purple protein found in a salt-marsh bacterium) as a memory element. Protein advantages include

- Density (currently about 9 GB of memory in a volume equivalent to two sugar cubes)
- Speed (switching time in the subpicosecond to femtosecond range)
- Ability to be genetically engineered for desirable properties

The goal is to develop a computer program that can predict the opto-electronic properties of native and genetically engineered proteins with sufficient certainty to allow researchers to make a priori determinations about the effects of amino-acid and chromophore substitution on the properties of the protein.

Alpha Personal Workstations will be used for scientific molecular modeling and to develop new modeling programs. Basic research will involve developing computer programs to simulate electron spectroscopy and the molecular dynamics of light-transducing proteins.

Relationships with creative researchers like Professor Birge may help to guide DIGITAL technology in the post-silicon era. ✻

Solution experiments

Solution experiments are a means to explore, evaluate, and incrementally stimulate the evolution of technologies in an application context, preferably jointly with customers. They offer DIGITAL a chance to understand which technologies are important to customers and what DIGITAL can do to differentiate itself in a given market area. The solution experiments are conducted in coordination with a focused technology program or one of the ETG centers.

The focus areas for solution experiments (currently driven by CEC/STAR) are as follows:

- *Electronic commerce:* Investigation of regional and inter-regional electronic commerce using public (kiosks) and semi-public access points on a European scale, supporting multinational content and certified payment methods.
- *Digital media warehouses:* Infrastructure for digital content management, specifically indexing and archiving of content for digital audio and video broadcasters in an international WAN environment.
- *Virtual enterprise fabrics:* Infrastructure for business process and teamwork support across enterprise boundaries.
- *Distance learning:* Infrastructure for Web-based learning and teaching for both traditional (elementary, secondary, college) and lifetime learning applications.
- *High performance technical computing:* Lighthouse applications based on clustered SMP systems.

For additional details on these programs and projects already under way, please see the newly revised ETG intranet pages. ✻

web*sites*

intranet
http://www-server.mso.dec.com/etg/etg.htm.
The External Technology Group home page

intranet
http://www-server.mso.dec.com/etg/ETG%20Handbook/etgp.htm
Read more about the External Technology Grants Program.

internet
http://www.kar.dec.com/
ETG's European Applied Research Center, Karlsruhe, Germany

internet
http://www.kar.dec.com/star/
Find out more about the Strategic Technology and Research (STAR) group, located in Karlsruhe, Germany.

internet
http://www.ics.hawaii.edu/
The University of Hawaii Department of Information and Computer Sciences home page where you can learn more about Kona.

internet
http://www.cat.syr.edu/
Learn more about the Syracuse University, CASE Center, Optical and Molecular Computing Program.

In Pursuit of 'Intellectual Gold'

The Corporate Licensing Office collaborates with DIGITAL business units and advanced research labs to maximize the corporation's intellectual investment in technology.

By Dana St. James, Corporate Licensing Office, Maynard, Massachusetts

dana.st.james@digital.com

Intellectual property (IP) in the form of patents, copyrights, trade secrets, and trademarks has been referred to as "the new wealth of nations.[1]" It is replacing natural resources and industrial base as the principal factor that makes a nation prosperous. The emergence of IP as the world's new "gold" means that more and more companies are cashing in on the licensing of IP as a way to increase their return on R&D investment. In 1991, DIGITAL established the Corporate Licensing Office (CLO) to begin work in this crucial area.

The Prospectors

DIGITAL's prospectors are the CLO licensing executives, people whose backgrounds include a rich blend of engineering and technical knowledge, business experience, and training in the formal licensing process. Their relevant experience at DIGITAL ranges from 10 to more than 20 years, so they know the technical landscape and how to "stake their claim" to promising IP.


D. Willett

The Corporate Licensing Office staff. From left: Steve Hargrave, Pam Baddeley, Ron Reiling, Dana St. James, Peg Tillery, and Babu Obilichetti. Not present for the photo: Don Drinkwater, Ted Faigle, and Jane Richard.

Finding the Lode

DIGITAL mines rich veins of intellectual gold, originating in the R&D of the Research and Advanced Development (RAD) laboratories and in the business units where DIGITAL products are designed.

The CLO uses multiple techniques to unearth these riches:

- The CLO is part of the Corporate Strategy and Technology (CST) group, which also includes the RAD labs. Working with CST and RAD Business Development, the CLO unrelentingly seeks the best use of DIGITAL's new technologies, which are developed principally for use by the business units. However, licensing is a viable alternative for technology that the business units decide not to use.
- Our *Patent Taxonomy Project* involves the evaluation of each of the existing 2,000-plus patents of DIGITAL and each new patent as it is filed. Every patent is reviewed by a licensing executive and the inventor (if available) or another expert in the patent's field to determine its licensing potential.
- Working with DIGITAL's *Invention Review Committees*, licensing executives hear about the latest inventions and advise on patent decisions.

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[1] *Warshofsky, F.,* The Patent Wars (The Battle to Own the World's Technology) *(John Wiley & Co., Inc., 1994).*

The CLO licensing executives know the technical landscape and how to 'stake their claim' to promising intellectual property.

- Via *referrals*, the CLO learns about possible infringements and promising DIGITAL technology.

- When the use of a DIGITAL technology ends, due to program cancellation, end-of-life, or maturity of a product, the CLO evaluates the technology for its licensing potential. Currently used technology also may be suitable for licensing if a complementary (e.g., noncompeting) use for it exists.

- Regarding possible infringements, employees familiar with DIGITAL's technology might see another company's product that looks strikingly similar to ours in design, performance, features, etc. The CLO encourages such observations and follows up with an infringement analysis, if warranted.

Evaluating the Find

After a technology is identified as worthy of licensing, licensing executives evaluate it for the following characteristics:

- *Completeness:* Is the technology in a useable state? If not, is the technology worthy of completion and does DIGITAL have the necessary resources to complete it? Alternatively, are potential licensees available who have the skill and resources to complete it?

- *Ownership:* Does DIGITAL have full title to the technology? Consultants, partners, interns, and others who have worked on the technology may have a claim of ownership. Also, any part of the technology taken from a non-DIGITAL source, e.g., software code "borrowed" from a clipboard, may interfere with clear ownership. The CLO knows how to go about "cleaning up" any blemishes on DIGITAL's title.

- *Strength:* Will the patents and copyrights withstand challenge, especially in an enforcement case? Patents are presumed to be valid when issued by the US Patent Office. However, this presumption can be rebutted if, for example, someone can show that the invention was in the public domain prior to filing.

- *Uniqueness:* Does this technology provide the only, best, fastest, or cheapest way to do something? If not, why would anybody license it?

- *Marketability:* Is there a market for this technology? Licensing executives conduct a thorough market analysis to answer this question.

- *Valuation:* What is this technology worth? Licensing executives use up-to-date valuation methods.

- *Corporate Due Diligence:* Does licensing complement the goals and objectives of DIGITAL? Are we creating a competitor? If an enforcement issue arises, is the alleged infringer a customer, supplier, or partner? Will taking action provoke a counterclaim?

Mining the Gold

Once the "intellectual find" is judged to be of sufficient potential, the CLO next seeks the necessary approvals to go forward. Licensing of strategic technology requires formal approval from the vice president of the business unit responsible for the technology. A licensing executive will present a formal proposal to the VP or his/her designee, which includes marketing data, as well as the possible benefits and risks associated with the program. If approval is obtained, the CLO notifies others at DIGITAL having an interest in the technology, such as other business units that use it. Relationship managers and account managers also are informed of any relevant potential infringements.

Finding the Gold Market

Additional market research is conducted by the licensing executives, assisted by the CLO project specialists, electronic services, and the Corporate Library Group. After identifying the market segments that can best use the technology, licensing executives directly contact promising prospects in these segments by mail or telephone or face-to-face to personally show how DIGITAL technology can benefit them. Interested prospects are further screened to ensure that they have sufficient financial resources and/or credit history to support their anticipated development, marketing, and payment obligations. In addition, for the royalty arrangement to be successful, the prospect must have the technical resources to sustain a successful licensing program. This is particularly true in an exclusive licensing transaction in which the licensee will be the only source of royalties.

Selling the Gold

After a prospective licensee shows sufficient interest, the licensing executive assembles a negotiating team consisting of those with relevant business, technical, and legal background. Together they set a strategy to determine the best way to exploit the technology. Often, a term sheet will be created to set out the range of negotiating goals. At this point, they settle issues such as whether the license will be exclusive or non-exclusive, how DIGITAL will be paid (e.g., licensing fee and/or royalty), and whether DIGITAL will have grant-back rights to improvements. The team then negotiates an acceptable, written agreement for signature by the appropriate VP. In enforcement cases, should DIGITAL be unable to settle amicably with the infringer, the licensing executive works with the business unit or lab in conjunction with the Law Department in order to resolve the matter.

After the Gold Is Sold

Licensing executives oversee the technology transfer. They work with the business unit or lab to ensure that the technology is delivered on time via the correct media and that any promised technical assistance is provided. The licensing executive—always on the lookout for problems—continues to manage the relationship by maintaining contact with the licensee and those at DIGITAL with ongoing responsibilities.

Meanwhile, the CLO royalty administrator keeps track of required royalty reporting and conducts internal fiscal reporting to ensure that business units receive their payments in designated accounts. Missed reports or payments, unusual royalty trends, and other warning signs trigger action to investigate, including audits of licensees, if warranted, and, as a last option, possible legal action.

Employees may see a product strikingly similar to ours. The Corporate Licensing Office welcomes and encourages such observations.

Conclusion

Licensing is a viable option used to capitalize on DIGITAL's intellectual gold. The CLO, DIGITAL's licensing center of expertise, exists to help each business unit and RAD lab maximize its investment in our technology.

Learn more about the CLO and some of its licensing programs from the Web sites listed below or by contacting Dana St. James, director, Corporate Licensing Office at (978) 493-5248 (DTN 223-5248); fax: (978) 493-9007 (DTN 223-9007); or Mail Stop: MSO2-3/C11. ✻

web*sites*

internet
http://www.digital.com/info/corporate-licensing/
The Corporate Licensing InfoCenter

intranet
http://www.imc.das.dec.com/clo-int_dev
The Corporate Licensing Office home page

Patent Awards

DIGITAL's worldwide engineering groups continued to strengthen the corporate intellectual property portfolio with the addition of 35 patents during Q1 FY98. Forty-one inventors received cash awards for each patent granted by the first issuing country. Issued patents assigned to DIGITAL now exceed 1,600.

Patent Award Recipients from Massachusetts and New Hampshire
Front row, seated, from left: Mike Romm, Bill Grundmann, Nick Rethman, Paul Goodwin, Don Smelser, David Mayo, and Michael Chautin. Second row, seated, from left: Dan Wissell, Dave Fenwick, David A. Tatosian, William B. Gist, Ron Brender, and Bob Willard. Standing, from left: Tom Gannon, director of Corporate Technical and Information Services; Don Scott, Digital Semiconductor patent engineer; Mike Ciannetta, Networks & Storage patent engineer; Bob Reed, Honorarium and Patent Award Program manager; Bob Palmer, DIGITAL chairman, chief executive officer, and president; Bill Strecker, vice president, Corporate Strategy and Technology, and chief technical officer; Sam Fuller, vice president, Corporate Technology Strategy and Services, and chief scientist; Bob Supnik, vice president, Research and Advanced Development.

Patent Award Recipients from Colorado
From left: Bill Miller, Clark Lubbers, Richie Lary, Susan Elkington, and Dave Thiel.

Battery Selection Considerations

Choosing the proper battery for a specific application can reduce cost and result in a design that will better serve the customer.

By K. Barry Williams, Power Supplies Filters, Maynard, Massachusetts

Battery Applications

All systems designed by DIGITAL engineers involve battery applications, whether for a real-time clock or a battery backup (BBU). Key elements to consider when selecting batteries are the desired attributes of the battery in terms of functionality, size, life expectancy, environmental impact, and, of course, cost. In addition, a choice must be made between primary batteries (nonrechargeable) or secondary (rechargeable).

Functionality requirements are taken into account by the "C" rating of the battery system. "C" is a term used to measure the capacity of a battery system and is usually annotated in ampere-hours. Not all batteries are measured in the same units of time, some are measured in a 20-hour rate whereas others are rated in a 5-hour rate.

Size factors include the length, width, height, and weight of the battery, as well as shape: round, rectangular, or even planar. Efficient usage of space is often a critical feature in a system design.

Life expectancy, measured in months, affects storage, cycle life, and service life. Some batteries cannot withstand long storage because the chemistry in the battery degrades over time, so timely receipt from the supplier is critical.

Environmental issues include adherence to international and local laws that regulate material content, marking, transportation, and end-of-life handling (see "Environmental factors in battery selection," *Forefront,* Winter 1997, p. 33).

Table 1. Battery types, C ratings, and discharge rates

Battery type (secondary)	C rating (ampere-hour)	Discharge rate (max.)
Lead acid	2.20–65.00	5.0 C
Nickel-cadmium	0.18–6.00	10.0 C
Nickel-metal-hydride	1.10–2.40	3.0 C
Lithium-ion	0.50–3.00	1.5 C
Lithium polymer	0.04–10.00	1.5 C

Table 2. Temperature ranges and number of charge/discharge cycles (based on 100% discharge for every cycle)

Battery type (secondary)	Temperature range (°C)	Cycle life, 100% discharge
Lead-acid	>0 to 40	240
Nickel-cadmium	−20 to 60	500 to 700
Nickel-metal-hydride	0 to 45	300 to 500
Lithium-ion	−20 to 60	500 to 1,000
Lithium polymer	−20 to 60	700

Battery Selection

Selection of a battery starts by determining the necessary C rate. Then the actual run time needed in the worst temperature environment in which it might operate must be determined. On the basis of these two requirements, a primary battery system or a secondary battery system can be chosen. Tables 1 and 2 provide information on battery type, temperature range, C ratings, and discharge rates.

Nickel-cadmium cells also may be affected by what is termed the "memory effect." This phenomenon is independent of the age of the battery (new or old), the state of charge, or the temperature of the battery. Rather, it is dependent on the lack of use. If this battery is selected, the user should try to match the number of charge/discharge cycles to the anticipated application. The battery needs to be in constant use. The "memory effect" can be erased with a proper discharge and recharge regime at its maximum C rate.

Storage

All of these batteries should be stored at 20 °C to 25 °C. Lead-acid cells should be stored at the higher temperature and should be considered perishable. At 25 °C, lead-acid will retain only 50% of its capacity after 12 months and therefore should not be stored for a long time. Nickel-cadmium

Table 3. C rating of lead-acid battery rated for 10 ampere-hours

Load (amperes)	Run time (hours)	Rating (ampere-hour)
6.5	1.0	6.5
1.8	5.0	9.0
0.95	10.0	9.5
0.5	20.0	10.0
0.255	40.0	10.2

Table 4. Battery types rated according to watt-hours/kilogram and watt-hours/liter

Battery type (secondary)	Watt-hours/kilogram	Watt-hours/liter
Lead-acid	32.5	85.20
Nickel-cadmium	34.0–52.0	97.67–146.50
Nickel-metal-hydride	55.4	189.00
Lithium-ion	117.0	283.00
Lithium polymer	132.0	318.50

as well as nickel-metal-hydrides should not be stored for more than 36 months. Because all batteries experience some degradation when left on the shelf, it is recommended that the storage of batteries be kept to a minimum (e.g., 3 months) to achieve maximum use from the battery system. This is true even for lithium-based batteries, which are storable for 8 years.

C Rating of Batteries

The C rating is determined by the run time of the battery and the amperes delivered to a load. Not all batteries are rated the same, which adds confusion to the selection process. For example, lead-acid cells have a C rating based on a 20-hour run time, whereas nickel-cadmium cells, nickel-metal-hydrides, and rechargeable lithium-based cells are rated at 5-hour run times. The C rating is determined by multiplying the load current by the run time in hours. Increasing the run time and decreasing the load current yields a constant number; this is referred to as the C rating (Table 3).

Batteries are also measured in watt-hours per kilogram and watt-hours per liter. To make this information useful for comparison, a 5-hour C rating should be used because this is the C rating of the nickel-based and lithium-based systems. The lead-acid battery is used at the 5-hour rating instead of its 20-hour rating (Table 4).

Key elements to consider when selecting batteries are the desired attributes of the battery.

Impedance of Batteries

The impedance of a battery system is usually given in direct current resistance (DCR). Commonly, a small signal generator set to a frequency of 1,000 Hz is used to measure the voltage drop across the battery. Although this is useful information, it does not reveal the battery's characteristics at higher frequencies or at other than full charge. Lead-acid batteries and nickel-cadmium batteries have similar characteristics and have the lowest DCR of the batteries used in large volumes. Typical lead-acid batteries have a resistance of about 6.5 milli–ohms per cell, whereas a high-energy nickel-cadmium is about 4.0 milliohms per cell. Nickel-metal-hydride batteries exhibit a resistance of about 20 to 80 milliohms; the resistance of a lithium-ion unit is about 40 to 65 milliohms. It seems that both the lead-acid and the nickel-cadmium provide the highest discharge rates compared to the other technologies. Temperature and the specific gravity of the electrolyte also affect internal resistance of lead-acid batteries.

Figures 1 and 2 show the effects of frequency on internal battery impedance in the charged and discharged states for lead-acid batteries and for lithium-polymer batteries.

Charger Design

Charger design is clearly an important factor when selecting rechargeable battery systems. Because of the sensitivity to heat, voltage, and charging rates of the various battery types,

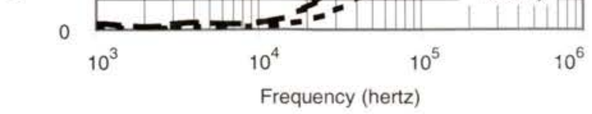


Figure 1. The effects of frequency on internal battery impedance on the charged and uncharged states of typical lead-acid batteries

Lead-acid cells should be stored at the lower temperature and should be considered perishable.

charger circuit design must include temperature and voltage monitoring features. Details regarding design of battery charging circuits are beyond the scope of this article.

Future Battery Technology

Battery development today is fundamentally focused on the lithium-polymer systems, particularly in the areas of lithium-manganese and lithium-sulfur. The manganese technology provides for a high voltage, 3.7 volts nominal, and the lithium-sulfur provides 2 volts, each having a high density in terms of watt-hours per kilogram and watt-hours per liter. The sulfur-based system has the advantage of being a direct replacement for lead-acid systems, but currently cannot match the high rate of discharge that lead-acid provides. Over the next several years, great improvements in these technologies are expected that will increase the discharge rate yet reduce the package size without reducing the cycle life of the battery. The goal for both technologies is to have at least the same cycle life of the nickel-cadmium battery while retaining an equal service life of about 8 years, typical of most lithium-based systems.

The great advantage of the polymer technology is the flexibility of the package itself. It can be formed to almost any shape, lending itself to greater efficiencies of packaging. This is of great importance in portable equipment. For example, a 10-ampere-hour battery measuring 8 inches by 10 inches by 0.12 inches thick will provide 37 watt-hours of run time. By using three of these batteries in series (at less than 0.50 inches thick), a notebook PC can be powered for about 8 hours. The theoretical limit for a lithium-manganese battery system is about 3.84 ampere-hours/gram or about 1,400 watt-hours/kilogram. Present limits are about 10% of these numbers.

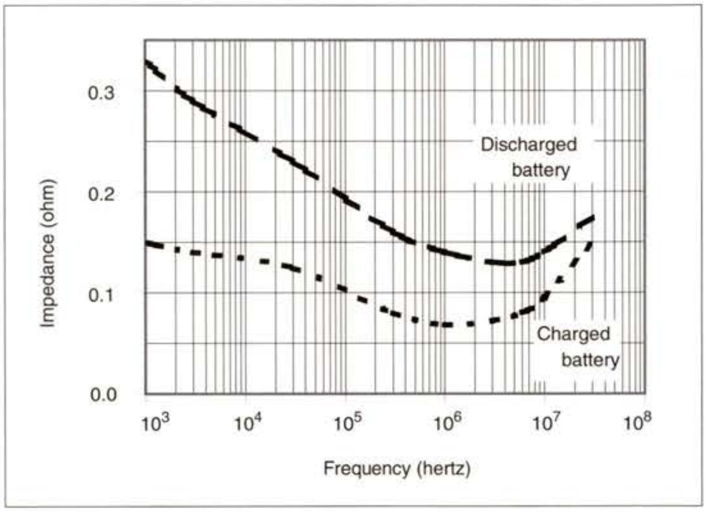


Figure 2. The effects of frequency on internal battery impedance on the charged and uncharged states of typical lithium-polymer batteries

Another advantage of polymer batteries is that they use no liquid electrolyte system and so do not leak, eliminating one problem that can occur with lithium-ion technology.

Summary

The characteristics of major battery types are outlined below:

Lead-acid batteries

- For high rates of discharge (i.e., greater than 6 ampere-hours).
- For replacement of nickel-based systems, if cost or packaging is an issue.
- Regulated and classified as toxic material, although highly recyclable.
- Limited service life and likely to need replacement during warranty period.
- Perishable, so storage should be minimized.

Nickel-cadmium batteries

- For portable equipment when discharge rate less than 6 ampere-hours and run time less than 30 minutes.
- For temperatures up to 60 °C.
- For replacement of nickel-metal-hydride batteries, if cost is an issue.
- Regulated and classified as toxic material, although highly recyclable—more so than lead-acid.
- For use when battery actively used; avoid if battery unused for prolonged time.
- Five types of cells available for high-discharge or for high-temperature applications.
- A large selection of cells available.
- Storage typically not a problem.

Nickel-metal-hydride batteries

- Higher energy density than nickel-cadmium cells.

Tom Wrenn of Product Safety Incident Management, at left, and author Barry Williams chat about batteries.

Another advantage of polymer batteries is that they use no liquid electrolyte system and so do not leak.

- Cell availability limited.
- Ampere-hour ratings limited.
- For portable equipment.
- Regulated but not classified as toxic; however, not easily recycled.
- Temperature range limited.
- Storage typically not a problem.

Lithium-ion batteries

- High energy density.
- Cell availability limited.
- Ampere-hour rating limited.
- Not regulated; ability to recycle unknown.
- Long service life.
- Wide operating and storage temperature range.
- Most expensive but lowest user cost, i.e., lowest lifetime cost.
- For portable equipment.
- Uses lithium salts as electrolyte system.

Lithium polymer batteries

- Less expensive than lithium-ion and about same cost as nickel-based systems.
- Planar design.
- Not regulated, but ability to recycle unknown.
- Allows flexible packaging for greater space efficiencies.
- No liquid electrolyte system; a totally dry battery.
- Wide temperature range for storage and operating conditions.
- Generally not yet available. Widespread usage not expected until late 1998 or early 1999 when high-volume equipment will be in place for general use. ✳

Engineering Promotions

Many thanks for the text and photo contributions from the supervisors and colleagues of the DIGITAL engineers whose collaborative and individual achievements earned them these promotions.

Andrew Birrell Promoted to Corporate Consulting Engineer

Andrew Birrell has been promoted to corporate consulting engineer in recognition of his major contributions to software technology in remote procedure calls, threads, naming services, and distributed file systems. Most recently, he worked on Internet-based information and security services. He has been instrumental in helping increase the focus of DIGITAL on advanced Web-based products and services.

Before joining the DIGITAL Systems Research Center in Palo Alto, California, in 1984, Andrew worked at the Xerox Palo Alto Research Center. Andrew has published numerous technical papers and has been awarded patents on distributed-systems technology while working for Xerox and DIGITAL. Andrew holds a BS and PhD from Cambridge University.

Ed Benson Promoted to Software Consulting Engineer

Ed Benson's promotion to software consulting engineer acknowledges his contributions to high performance technical computing. His recent work includes run-time and message-passing support for distributed memory programming systems, Parallel Virtual Machine (PVM), Message Passing Interface (MPI), and High Performance Fortran (HPF).

Before the advent of high-performance, Alpha-based systems, Ed led system software efforts associated with SIMD and MIMD partnering endeavors.

During his first 7 years at DIGITAL, Ed focused on real-time computing. He was project leader for VAXlab development and developed many of the device drivers used in the product. Ed also contributed to the POSIX real-time (1003.4) facilities for both OpenVMS and DIGITAL UNIX.

Ed holds a BS from Tufts University and has been with DIGITAL since 1984. Before joining DIGITAL, he worked at Harvard University and ADAC Corporation.

Sharon Britton Promoted to Hardware Consulting Engineer

Sharon Britton's promotion to hardware consulting engineer acknowledges her work on Alpha microprocessors during the past 8 years and, in particular, her contributions to the design and development of the EV6 Alpha chip. She has noteworthy accomplishments in circuit design and circuit verification.

Sharon was a principal designer on the EV6 Ibox and also contributed to the Cbox. She designed the register renaming unit (mapper) and the instruction retire unit. As back-end verification leader, she was responsible for directing and coordinating much of the physical and electrical verification of the chip.

Sharon holds a BSEE from Boston University and an SMEE from MIT. She has been awarded one patent and has co-authored numerous technical papers.

Steve Heng Promoted to Manufacturing Consulting Engineer

Steve Heng has been promoted to manufacturing consulting engineer on the basis of his demonstrated expertise, innovation, and leadership in the area of Alpha end-use sockets and cooling, as well as for his exceptional laboratory skills. Steve's outstanding contributions over the past 4 years have resulted in the implementation of end-use sockets for every Alpha microprocessor designed and manufactured by Digital Semiconductor.

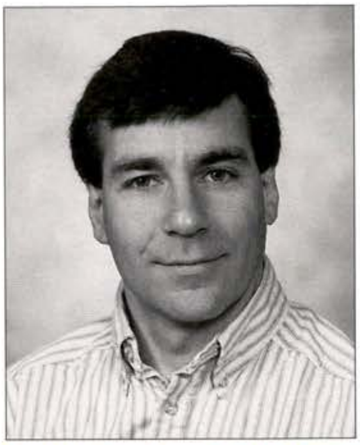
Steve earned BS and MS degrees in mechanical engineering from Louisiana State University and a PhD in mechanical engineering from Georgia Institute of Technology. He has been with DIGITAL since 1988.

Dan Leibholz Promoted to Consulting Engineer

Dan Leibholz has been promoted to consulting engineer on the basis of his outstanding contributions to the corporation in computer architecture and specifically EV6 over the past 9 years.

Dan joined the EV6 program in 1993 to conduct performance modeling and research in the areas of instruction queues, issue units, register renaming, and branch prediction. He was responsible for the architecture, the register renaming unit, and the instruction issue queue. He later assumed responsibility for chip specification, PLL control logic, and clock and reset strategy. In addition, Dan was lead on the full-chip integration for schematic logic verification.

Dan holds BSEE and MSEE degrees from Brown University. He has been awarded one patent; numerous EV6 disclosures are in process. He has co-authored several technical papers and has delivered conference presentations.



Ed McLellan Promoted to Hardware Consulting Engineer

Ed McLellan's promotion to hardware consulting engineer acknowledges his contributions to computer architecture over the past 17 years and, specifically, to EV4 and branch prediction on EV6. Ed has worked on six major microprocessor designs at Digital Semiconductor: the J11 chip, CVAX, microPrism, EV4, EV45, and EV6.

During the past 4 years, Ed has contributed to the overall pipeline design, performance analysis, and the out-of-order issue design of EV6. Ed was the architectural leader for the front end of the EV6 pipeline. In addition to the branch-predictor design, he developed the overall instruction cache configuration, which included the invention of a novel set-predictive cache and line predictor. Ed also invented a new subroutine stack to hold call-return addresses in out-of-order issue machines.

Ed earned a BS in computer science from Rensselaer Polytechnic Institute and completed post-graduate coursework in computer architecture at the University of Massachusetts. He has been awarded five patents and has three pending, with six disclosures in process. He has co-authored numerous technical papers.

Bob Morgan Promoted to Senior Software Consulting Engineer

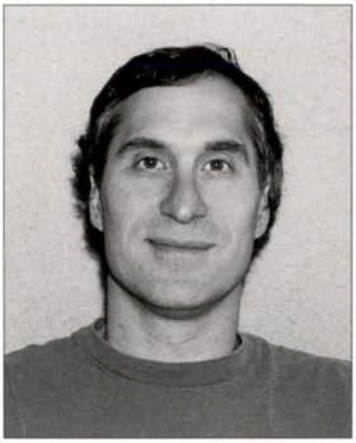
Bob Morgan's promotion to senior software consulting engineer acknowledges his long history of contributions to compiler technology and engineering. He is an industry-recognized expert in compilation techniques for parallel and other advanced architectures and is currently responsible for evaluating and acquiring external technology for use in DIGITAL's production compilers in the Core Technology/-High-Performance Technical Computing group. Bob manages relationships with compiler projects at Rice University, Stanford University, and AMSD in Moscow. He also leads a project aimed at keeping DIGITAL compilers and compiler developers up-to-date with the latest research.

Among Bob's many noteworthy accomplishments are the development of an Alpha compiler "cookbook" used by software vendors who want to move their development tools to the Alpha architecture, and the development and delivery of a training course in advanced optimization and code-generation techniques for DIGITAL's senior compiler developers. Bob recently completed a book on these topics to be published by Digital Press.

Bob joined DIGITAL in 1992 as chief architect for the high-performance Fortran compiler and as team leader for parallel tools in MPSG. His next assignment was with the UNIX engineering group, where he was instrumental in improving the run-time performance of the UNIX C compiler (acc). Bob was subsequently asked to head the Compiler Technology Office to increase cooperation among different compiler groups. After the consolidation of the various compiler-engineering efforts, he assumed his current role as program manager for external compiler technology.

Bob has more than 30 years of experience in the computer industry. Before joining DIGITAL, he worked at Compass, Intermetrics, and BB&N. In addition to programming language and compiler design and implementation, he has worked on network software, real-time operating systems, and software engineering tools.

Bob earned a BS in mathematics from MIT and completed coursework towards a PhD in mathematics at MIT. He established the mathematics department at Gordon College and thereafter served for 6 years as an assistant professor of mathematics. He has been a senior lecturer in computer science at Boston University since 1976.



Andy Padla Promoted to Hardware Consulting Engineer

Andy Padla's promotion to hardware consulting engineer recognizes his significant and innovative contributions to fault management design for the TurboLaser family of products, a hugely successful product line that has maintained a position of leadership in the industry.

A member of the Multivendor Customer Services Serviceability Engineering group, Andy's help was specifically requested by the Alpha Server Platform Development group at a critical time in the design cycle. He still is the key contributor to the TurboLaser fault-management architecture and its implementation. Andy's contributions to the associated analysis and reporting features of the TurboLaser's fault-management error handling have ensured that service delivery practices are successful and cost-effective.

As a member of the Serviceability Engineering organization for the past 10 years, Andy has led the advancement of fault-management design and architecture. He is an acknowledged expert in the field of errors and serviceability. He has developed fault-management strategies, specifications, and designs for mid-range to high-end products (VAX 6500/6600, DEC 7000/10000, AlphaServer 8200/8400 [TurboLaser]).

His contributions span many areas: design of data integrity; exception reporting mechanisms; fault handling for PAL, UNIX, VMS, and NT operating systems; and fault-state capture. Andy has spearheaded the development of algorithms used in symptom-directed diagnosis, and his accomplishments include new and creative techniques to address areas of data capture and filter algorithms.

Most recently, Andy was responsible for developing the error strategy to be adopted for TurboLaser 6. In this role, he highlighted the areas that caused problems in the past, such as multiple interrupts based on single errors, assignment of interrupts, avoidance of double-error conditions, fault isolation, and fault insertion. Andy developed a detailed and reasonable plan that was easily implemented by the design team.

David Rusling Promoted to Software Consulting Engineer

David Rusling's promotion to software consulting engineer recognizes his Linux and StrongARM software work. He was involved with the early software development kits for Alpha-based motherboards before directing the design of the architecture and implementation of MILO, a load mechanism for Linux on Alpha-based motherboards. (Linux is a freeware, UNIX operating system that is experiencing explosive growth in the academic community.) Recently, David has been involved in defining and developing a tools and operating-system strategy for the StrongARM processor, including a small source pool of StrongARM/platform-specific code known as MicroHAL. MicroHAL is a library of low-level software designed to provide a portable base for running applications and booting operating systems. Details of the work can be found at http://linux.reo.dec.com.

David has wide-ranging software experience, gained in designing and writing device drivers; routing, transport, and session layers of the network stack; and network management code. He has been with Digital for 12 years, 7 with Networks Engineering. In November 1992, he became a founding member of the European Semiconductor Applications Engineering group.

Stephen J. Sicola Promoted to Consulting Engineer

Steve Sicola's promotion to consulting engineer acknowledges his many contributions to storage-related projects, including the HSC50 controller, throughout the 1980s. Steve was instrumental in the test and diagnostic field early in his career, leading a team that designed the architecture for and built the CMIST VLSI chip, which tested modules from the inside out. This project used the world's first JTAG engine and provided, for testing, component isolation from the built-in software and hardware.

Since 1991, Steve has been the leader and system architect of the StorageWorks controllers for CI, DSSI, SCSI, and now Fibre Channel. Steve has been involved in all aspects of product development: hardware, software, packaging, and support. He has also been a key player in industrial standards development for SCSI-3 and work related to Windows NT and clustering.

Steve, who joined Digital at the Colorado facility in 1979, has been awarded three patents and has eight patents pending. He is a graduate of Stanford University.

Howard Smith Promoted to Consulting Engineer

Howard Smith of Digital Semiconductor's Materials Characterization and Analytical Technology group has been promoted to consulting engineer in recognition of his significant contributions to the Alpha CPU program through his work in laboratory dopant profile characterization. His work in the development of critical and unique laboratory analysis methods and his research into new characterization technologies has been essential to the development of all Alpha process technologies by providing accurate characterization of dopant distributions for use in device development and process optimization. This work was vital to the development, qualification, and production of CMOS-3 (Mariah), CMOS-4 (NVAX, EV4), CMOS-5 (EV5), and CMOS-6 (EV56, EV6, and StrongARM).

Howard joined DIGITAL in 1986 as a founding member of the Materials and Structures Analysis Laboratory team within the Advanced Semiconductor Development (ASD) group. As ASD's expert in dopant and trace-element characterization, he brought secondary ion mass spectrometry (SIMS) capability to DIGITAL. Subsequently, he developed quantitative SIMS methods for characterizing device doping, interconnect dielectrics, gate dielectrics, and interconnect diffusion barriers. To complement SIMS, Howard fostered the implementation of a method of dopant profiling known as spreading-resistance profiling. Currently, he is working on novel scanned-probe microscopy methods for laboratory two-dimensional device characterization and on methods for SIMS ultra-shallow dopant profile characterization. In this role, Howard leads in-house efforts and actively participates in research collaborations with university research groups, industry consortia, and instrumentation vendors.

After receiving a BA degree from DePauw University, Howard earned MS and PhD degrees in analytical chemistry from Cornell University; his thesis topic was the development of secondary ion mass spectrometry methods. He has published numerous papers on the development of laboratory characterization methods and is a founding member of the program committee for the biennial International Workshop on Characterization of Ultra-Shallow Junctions.

DeWight Whitehorn Promoted to Software Consulting Engineer

DeWight Whitehorn's promotion to software consulting engineer acknowledges his significant and innovative contributions to the success of major customers and Multivendor Customer Services (MCS). Especially noteworthy is DeWight's successful tenure as an MCS consultant to Bell Communications Research (Bellcore) and the regional telecommunications operating companies in the Service Control Point (SCP) and Intelligent Service Peripheral projects.

Recognizing that software and hardware failures have an equally significant impact on overall system availability, Bellcore and DIGITAL have implemented a unique, multivendor support plan that ensures a rapid, integrated response to both types of failure. DIGITAL's Platinum Support is a comprehensive, highly customized support program for computing environments requiring extremely high availability. DIGITAL established a dedicated, highly skilled support team at the Colorado Springs Customer Support Center to provide problem diagnosis and resolution in the event of system outage.

Providing technical team leadership, DeWight and the Bellcore Mission Critical Platinum Services Support Team have solved a wide range of customer business problems, including those related to unique applications, operating systems, and the overall customer environment.

DeWight's contributions to new design and resolution of major DIGITAL software design limitations have directly contributed to expanded business relationships. In the face of fierce competition, he has enhanced the leadership role of DIGITAL in the telephony industry by helping Bellcore to develop the architecture for the next generation of the SCP project. Current DIGITAL SCP platforms have handled almost 200 billion toll-free telephone calls without service interruption. These platforms service 80–85% of all toll-free calls in North America.

Currently, DeWight is the lead engineer of a group of DIGITAL principal engineers which is focusing on DECevent knowledge-generation and knowledge-capture work. (DECevent is an event-management tool used with DIGITAL UNIX, OpenVMS, and Windows NT operating systems.) ✳

DIGITAL Wins Big in Fall Hot Iron Awards Competition

Leaving competitors in the dust, Alpha and Intel-based Prioris ZX and MX series servers took first-place honors in AIM Technology's fall Hot Iron Awards competition.

By George A. Murphy, AlphaServer Base Product Marketing, Maynard, Massachusetts

At a ceremony held during IT Forum in New York City on September 16, the AlphaServer 8200, AlphaServer 4100, and Intel-based Prioris ZX6000 and MX6000 series systems won in 10 of 22 Hot Iron categories.

Held annually in spring and fall, the Hot Iron Awards ceremony recognizes UNIX and NT server products that show outstanding price/performance and throughput against AIM Technology's server and workstation benchmark test suite. These benchmarks feature AIM's proprietary load/mix modeling technology to accurately and reliably model virtually any end-user application environment.

AIM Technology, Computerworld, Intel, SCO, and Exhibit Emporium sponsored the fall awards event.

The following DIGITAL products won Hot Iron Awards:

File Server Mix/UNIX

- Best price/performance throughput ($150,000 and over)
  AlphaServer 4100 5/466
- Best price/performance throughput ($50,000–$149,999)
  Prioris ZX 6000 Series (6200MP/4)
- Best price/performance throughput ($25,000–$49,999)
  Prioris MX6266
- Best throughput performance ($150,000 and over)
  AlphaServer 4100 5/400
- Best throughput performance ($25,000–$49,999)
  Prioris ZX 6000 Series (6200MP/3)
- Best throughput performance (less than $25,000)
  Prioris MX6200

General Workstation Mix/UNIX

- Best performer ($25,000 and over)
  AlphaServer 4100 5/466

File Server Mix/UNIX

- Best overall performance
  AlphaServer 8200 5/440


D. Willett

The Rawhide (AlphaServer 4100) Team
From left, kneeling: Mark Stefanski, Bryan Locke, Dennis Hayes, Roger Dame, Bill Cummins, Norberto Collado, Mark DeAmicis, Todd Davis, Dan Wissell, Ann Harrold. From left, standing: George Murphy (AlphaServer Base Product Marketing), Demetro Kormeluk, Jim Staples, Dale Keck, David Dalrymple, Steve Lindquist, Mo Steinman, Ted Gent, Rick Olson, Steve Coe, Doug Field, Sam Duncan, Darrel Donaldson, Mike Thomas, Don Smelser, Subhash Dandage, Ed Rozman, Glenn Herdeg, Bob McClain, John Kirchoff, Colin Brench, Art Singer, David Carlson, Zarka Cvetanovic, Phyllis Savage, Andy Koning, Jie Li, Bruce Alford, Masood Heydari (vice president, AlphaServer Product Development), Brian Croxon (vice president, AlphaServer Business Segment).

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The HX6200 and ZX6200 Series Development Team, United States
From left: Duane Dickhut (vice president and general manager, Server Business Segment), Deb Savoie, Mark Christmann, Bill Greenlund, Tom Manter, and Elias Behrakis. Not present for the photo: Koralia Franklin, Harry Rogers, and Richard Krause.

HX6200 and ZX6200 Series Development Team, Taiwan
Front row, from left: John Lin, A.W. Shao, Charles Yang, Fred Wu, C.J. Hsu, Ben Chang, Andy Lin, Kenny Wang, and Chris Sun. Middle row, from left: H.J. Huang, Arthur Huang, Oliver Lin, Alice Szu, Greta Chen, Fred Liu, Jenny Fan, Margaret Chen, Linger Lin, Maurice Hsu, and Jack Leu. Back row, from left: Y.G. Huang, C.T. Tai, Steve Wang, Steven Chang, Anthony Lo, YuMei Huang, Robin Chang, Paul Yang, Peter Hsu, C.S. Chen, Roger Yu, Highter Lee, Candy Chang, S.C. Kong, Y.E. Peng, Fiton Huang, H.Y. Tan, Lily Liu, Valerie Tsun, and B.Y. Chen.

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The TurboLaser (AlphaServer 8200) Team
From left, kneeling: Steve Ho, Ernie Preisig, Jose Flores, Mark Muzzi, Dave Bellew , Andrew Whitlingum, Jeff Doyle, and Tony Garcia. From left, standing: George Murphy (AlphaServer Base Product Marketing), Dave Fenwick, Don Wunschel, Carol Udall, John Morris, Donna Skillings, Dave Hartwell, Bill Santon, Don Villani, Cindy Murray, Masood Heydari (vice president, AlphaServer Product Development), Denis Foley, Brian Croxon, (vice president, AlphaServer Business Segment), John Kirchoff, Patricia Makrianis, Andrew Koning, and Maryann Marcoux.

- Best price/performance throughput ($25,000–$50,000) Prioris ZX 6000 Series (6200MP/4–256 MB)
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Competitors in the 'Dusty' Distance

A hearty congratulation to the AlphaServer and Prioris engineering teams for designing and engineering these award-winning server products! Digital Equipment Corporation is viewed as the vendor to beat for the honored AIM Technology Hot Iron Awards.

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Vista: Performance Data Visualization Using Generic Modules

Visualization tools for parallel and distributed computing are often narrowly focused and inflexible. An open tool architecture based on generic components can be more widely useful.

By Robert H. Halstead, Jr.,
Cambridge Research Laboratory,
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Small-scale symmetric multiprocessors with two to four processors are becoming ubiquitous, even approaching the desktop, and larger parallel systems are important in many high-end applications. Although many applications are being parallelized, the execution and performance of threaded, parallel, or distributed programs can often be quite difficult to understand. This difficulty stems mainly from two attributes of such program executions: their often large scale and the rich variety of resources and interactions they involve.

A second challenge for purveyors of performance-tuning tools is that there are many models for parallel and distributed programming, with no sign of convergence toward a single standard. In some models, such as MPI[1] and PVM, programmers directly control the actions of physical processors that communicate via explicit message passing. In thread-based programming, on the other hand, programs are organized into threads that can move dynamically between processors, communicating through shared memory using synchronization objects such as mutexes. High Performance Fortran[2] presents a third model, in which the distribution of data is somewhat explicit but communication and synchronization are completely implicit. Distributed transaction processing presents yet a different combination of attributes.

No single "winner" among these models is likely to emerge, so tool technology needs to be applicable across this space. Existing tools, however, are often targeted rather specifically to just one model and are based on assumptions that prevent them from being applied easily to other models. For example, several tools have been built for MPI-like models, providing views based on the premise that a fixed number of processors remain dedicated to the computation from beginning to end. These tools cannot be applied to thread-based programs in which threads are dynamically created and destroyed. Thus, although visualization tools for parallel applications exist today, they are often inflexible—restricted to a fixed language, computation model, machine architecture, or set of capabilities.

The Vista System

Vista is an analysis and visualization system designed to have the adaptability that model-specific tools lack and also to offer the flexibility and variety of viewpoints needed to address the problems of scale and richness mentioned above. A prototype has been developed at the Cambridge Research Laboratory (CRL) and can be downloaded by interested users. This article describes the prototype and its architectural philosophy.

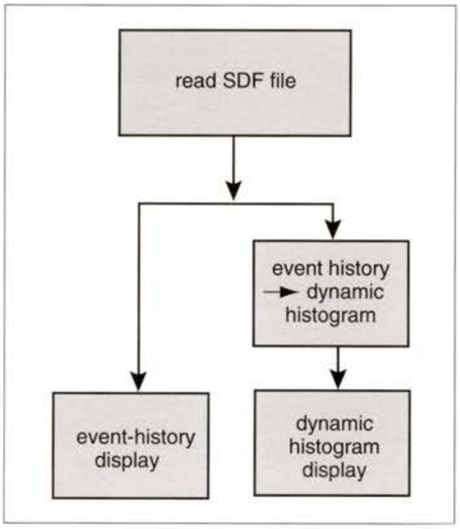
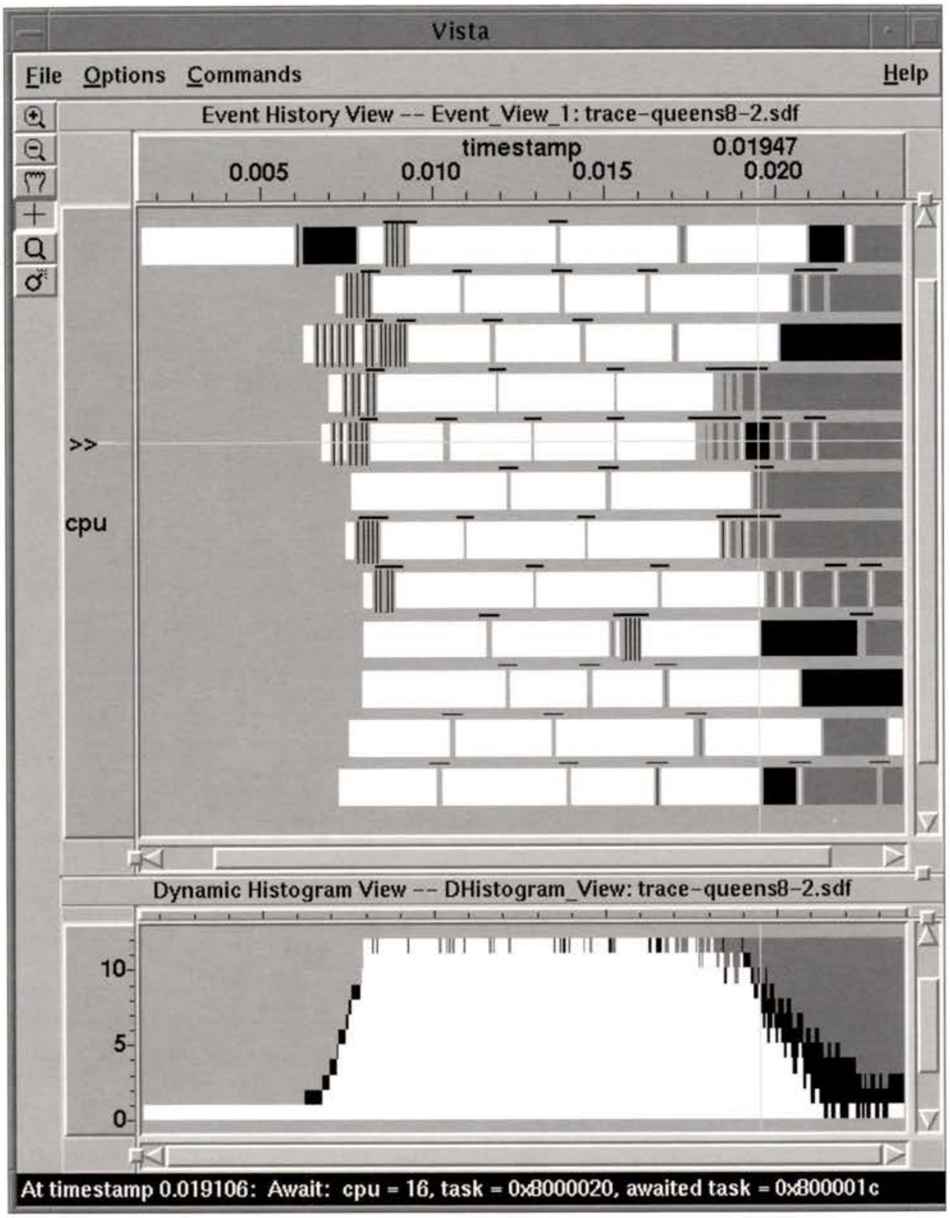


Figure 1. A simple Vista module network

The process of tuning a program's performance can be divided roughly into several phases: data collection, data analysis, visualization, and finally insight into how to improve performance. Vista focuses on the analysis and visualization phases. Although Vista is not itself a data collection tool, it does include components that are useful in collecting data for later processing using Vista.

Processing in Vista is performed by analysis and visualization modules assembled into module networks (Figure 1). Each module has some number of input and output ports, which carry Vista data sets. This particular network contains one "source" module ("read SDF file") which reads a data file and outputs the corresponding data set into the module network, two "sink" modules (the "display" modules) which absorb a data set and present it



At timestamp 0.019106: Await: cpu = 16, task = 0x8000020, awaited task = 0x800001c

Figure 2. Display generated by the module network of Figure 1

in a window on the screen, and one "filter" module which processes an input data set to generate an output data set.

Figure 2 shows the graphical display resulting from this module network. In the case illustrated, the original data file contains an event history recorded during a program execution. The display has one pane at the top showing the event history itself and a second pane showing a derived "dynamic histogram" data set.

The event-history display uses one horizontal band to represent each processor that participated in this execution, with colors indicating each processor's state as a function of time. Since only monochrome images can be presented here, white has been used to indicate that a processor is busy, whereas black and gray indicate two "flavors" of idle time. (Black indicates an idle period that began when a task blocked; gray indicates idle time that began when a task terminated.) The thin black rectangles above the processor bands indicate events occurring so closely together in time that they can only be seen by increasing the magnification. Finally, the dynamic histogram display shows the number of processors that were in each state as a function of time. These display modules each provide only one way of looking at their respective data sets; other display modules could be provided that would display the same data sets differently.

When the mouse is moved over a processor's band, details about the event that caused the processor to enter its current state are displayed in the text pane at the bottom of the Vista window. In Figure 2, this pane shows the details of the `Await` event marked by the crosshair cursors. As you can see, this event has both a `cpu` and a `task` field. In fact, you are seeing the execution of a threaded program in which each thread is marked by a unique `task` value. With a change in display configuration parameters, the same execution can be viewed in terms of logical threads (Figure 3).

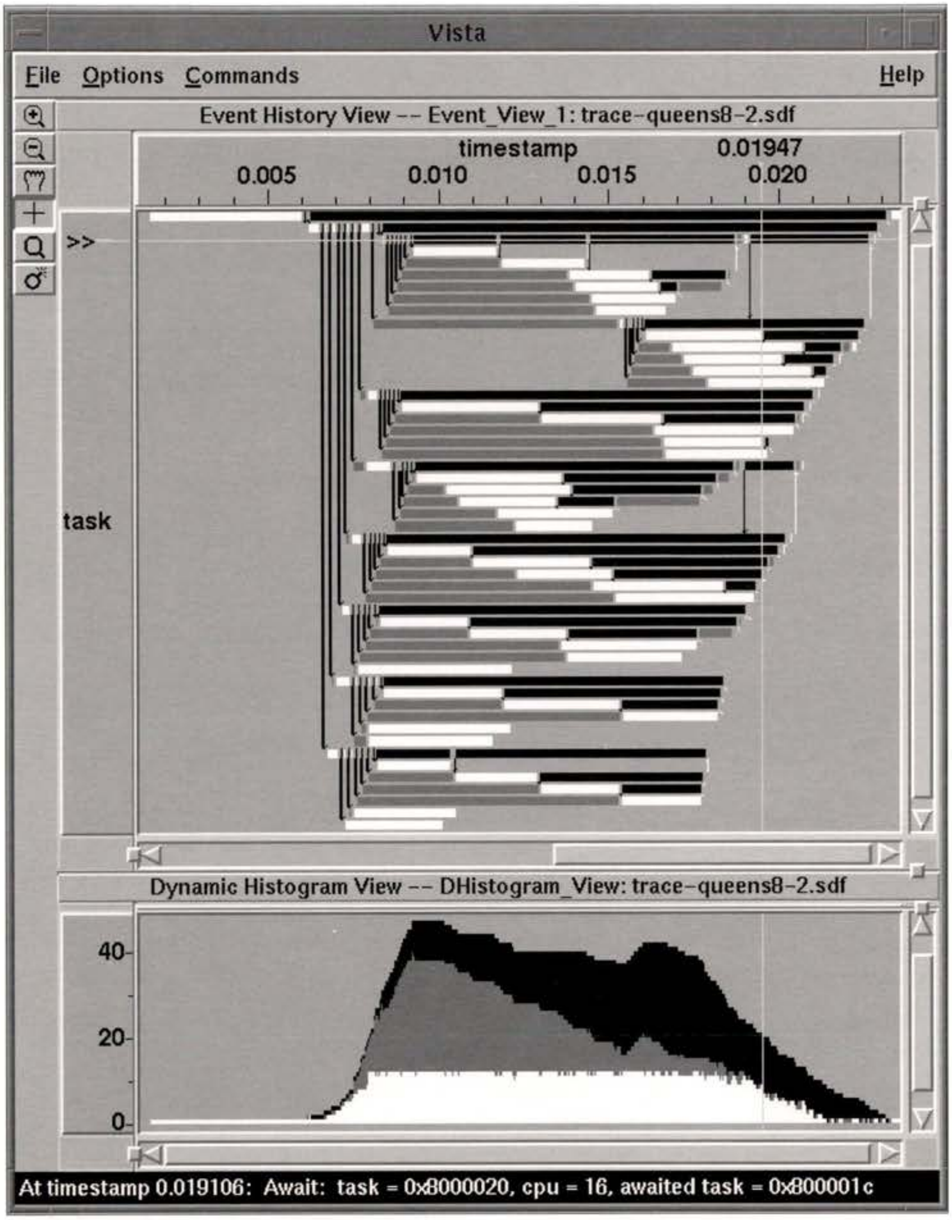
This view shows the states of threads, rather than physical processors. The "color coding" in Figure 3 differs from Figure 2: white indicates a running thread, black indicates a blocked thread, and gray indicates a runnable, but not actually running, thread. Certain events, such as thread creation, induce relationships between threads (indicated in Figure 3 by arrows). Representing these relationships explicitly helps programmers find their way around the maze of threads. The relationships can also be used, as they have been in Figure 3, to pick a display order for threads that highlights the logical structure of the computation.

The displays shown in Figures 2 and 3 have several other interactive behaviors. The mouse can be used to specify zoom and scroll operations in both the horizontal and vertical dimensions. The time scales in the multiple panes are linked so that a zoom or scroll operation in one pane is propagated to all the others. Multiple cursors can be placed on the displays to mark points of interest, and cursors in the time dimension are automatically propagated to all display panes and updated when a cursor moves. These "live linking" features facilitate data exploration from different but coordinated viewpoints.

Finally, several display attributes, such as the colors used for different thread states, can be changed using a configuration dialog box. The initial values of these attributes are specified by annotations in the input data set; thus, a visualization session can begin immediately, without being preceded by a configuration phase in which display attributes are initialized. This architecture allows the vendor of an instrumentation package to control the default appearance of data that is visualized and minimizes the need for reading manuals or pushing buttons before beginning to look at the data.

Architecture of Vista

Vista achieves its flexibility by means of three major features.



At timestamp 0.019106: Await: task = 0x8000020, cpu = 16, awaited task = 0x800001c

Figure 3. Thread-oriented display generated by the module network of Figure 1

- Vista's open architecture allows visualizations to be built (as illustrated in Figure 1) by assembling networks of processing and visualization modules. Ideally, Vista would come with a basic set of modules implementing generally useful functions. Tool developers or sophisticated users could create more specialized modules for particular applications.

- Vista uses SDF, a self-describing file format that is flexible enough to represent almost any kind of performance data.

- Vista defines three generic performance data set types: event histories, static histograms, and dynamic histograms. Modules are designed to be "plug-compatible," with each input and output data set an instance of one of these three types. Each type is defined in terms of concepts generic enough to be meaningful across a wide range of programming models, and each type has a canonical representation in terms of the SDF format, which provides a common and flexible substrate for all Vista data sets.

Module networks and a self-describing file format also are seen in the University of Illinois Pablo system,[3,4]

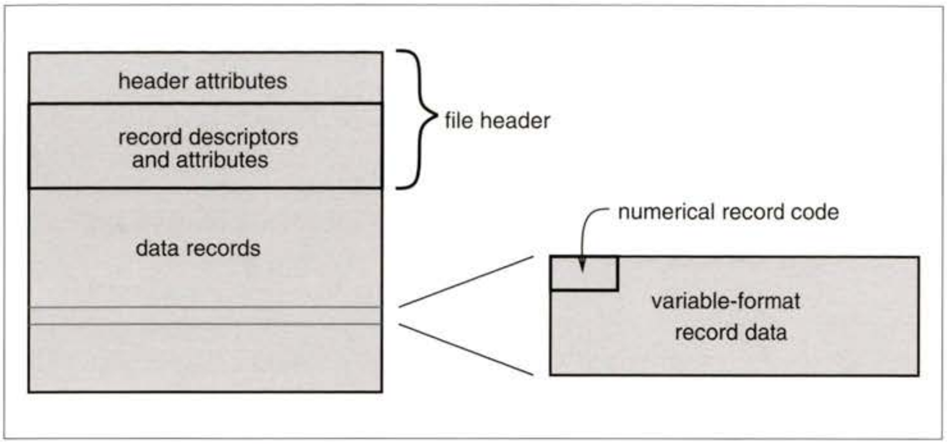


Figure 4. Overall structure of an SDF file

but the use of generic performance data set types is unique to Vista.

Self-describing file format
An SDF file consists of a descriptive header followed by a series of data records (Figure 4). The header describes the structure and meaning of the data records, specifying the format of data records and the names of record types and record fields. This information is analogous to *struct* definitions in C programs, which give a name to each structure type and to each field within a structure, as well as specifying the sequence of fields in each structure and the type and representation for the data in each field. In addition, the SDF file header provides a capability to include annotations called *attributes*, which may be associated with the file as a whole, with an individual record descriptor, or with a field within a record descriptor.

Fields in SDF files can hold scalar or array values. A selection of basic types is available for scalar fields, including both signed and unsigned integers, floating-point numbers, and enumeration types, in several sizes ranging from 8 to 64 bits. ASCII character strings and arrays of character strings are also available as field types.

An SDF file's data records follow the file header. Data records are represented in a compact binary form which can be transferred efficiently between SDF files and memory-resident data structures, yet the presence of the header information allows the data to be presented and used as though it were stored in a much more human-oriented file format. The "PDF" format used by several Alpha performance tools resembles a subset of SDF and was in fact inspired by SDF.

Vista's performance data set types
Vista uses three fundamental performance data set types:

- An *event history* is a collection of events. Each event includes time and place information indicating when and where it occurred, as well as any other information that can be represented in the SDF format. Event histories are useful for execution traces and logs.

- A *static histogram* contains sparse arrays of numbers. The indices along each array dimension can be either numbers or character strings. Static histograms accommodate profiling data that is typically presented as a table, bar graph, or pie chart, such as the data produced by the *prof* and *gprof* profilers.

- A *dynamic histogram* is like a static histogram with a time dimension. Thus, a dynamic histogram is a collection of sparse arrays, but unlike the numerical constants found in static-histogram arrays, dynamic-histogram arrays contain time-varying values. Dynamic histograms are useful for data sets that record the changing loads on processors, memory, communication links, or other system resources.

A detailed discussion of the features that make these data-set types generic is too long to include here. Therefore, we will consider event histories as an example. The key is to focus on useful properties that transcend the details of a particular programming model. For event histories the idea that each event has a "when" and a "where," suitably generalized, is the most fundamental property. Vista's event histories use the concepts of *time base* and *threading field* to represent these two attributes. Every Vista event history has at least one time base and one threading field. For example, the event history displayed in Figures 2 and 3 has two threading fields—`cpu` and `task`—and the contrast between these two figures illustrates the usefulness of multiple threading fields. Similarly, there are situations in which multiple time bases are useful, such as when each event is recorded with both a wall-clock time and a virtual (user) time. Threading fields and time bases are generic because they are useful across the range of programming models toward which Vista is targeted. Other generic features of event histories include the notions of state and binary relation-

Vista is an analysis and visualization system designed to have the adaptability that model-specific tools lack and also to offer the flexibility and variety of viewpoints needed to address the problems of scale and richness.

ships, as illustrated in Figures 2 and 3. To achieve Vista's goals, this idea of generic design must be carried through to the design of the analysis and visualization modules too, but the design of generic data set types provides the foundation for the rest.

Vista Status

The Vista prototype currently includes the modules shown in Figure 1, as well as other modules for creating and displaying static histograms. Although Vista's architecture encompasses histograms as well as event histories, at this time the event-history viewer is the most highly developed part of the prototype. It can display event histories containing up to 30,000 events with reasonable interactive performance; scaling this capacity to substantially larger sizes is a key priority for Vista's further development. The prototype runs on DIGITAL UNIX and is implemented using a combination of C code and Tcl/Tk scripts.

Since Vista performs visualization and analysis functions, but not data collection, there is the question of how to generate SDF files in the first place. At the moment, Vista offers no ready-to-run instrumentation packages for programming environments widely used in DIGITAL. There is, however, a library of C routines for creating SDF files, and this author is very interested in working with potential Vista users to create data collection tools for programming systems of interest.

Summary

Vista aims for a new degree of flexibility and ease-of-use through an unbundling of analyis and visualization tools, the use of a self-describing data file format, and "live linking" between different views of the same data set. This approach yields more value from each visualization tool because it can be used in more situations. This reuse, in turn, allows the investment in a tool to be amortized over more users and presents an opportunity to develop a whole suite of interoperating tools in which tool developers really can "stand on the shoulders of developers who have gone before them." This philosophy has been effective in the scientific visualization community with modular visualization systems such as AVS.[5] The performance tools community would benefit from the same approach. ✳

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web*site*

intranet
http://www.crl.dec.com/personal/halstead/vista
Read about the Vista prototype and learn how to download it.

Tornado Codes for Forward Error Correction

The Internet drops packets. Because retransmission, the usual solution, is problematic for multicast applications, another solution is proposed using new forward error correction codes.

By Michael Luby, International Computer Science Institute, Berkeley, California, and Michael Mitzenmacher, DIGITAL Systems Research Center, Palo Alto, California

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Measurements of the Internet show that packet loss occurs at a moderate rate, and this rate is not decreasing. In fact, the rate has increased slightly in the past few years. A standard solution to this problem is to request retransmission of lost packets.

For multicast applications with one sender and many receivers, this solution introduces technical difficulties. For example, consider a video server distributing a movie on the Internet to thousands of users. If the users lose different sets of packets and each user requests retransmission of these packets from the server, the server will quickly become overwhelmed by these requests. More sophisticated solutions along these lines have been considered, including sending requests for retransmission only to nearby session participants. However, these solutions as yet appear inadequate.

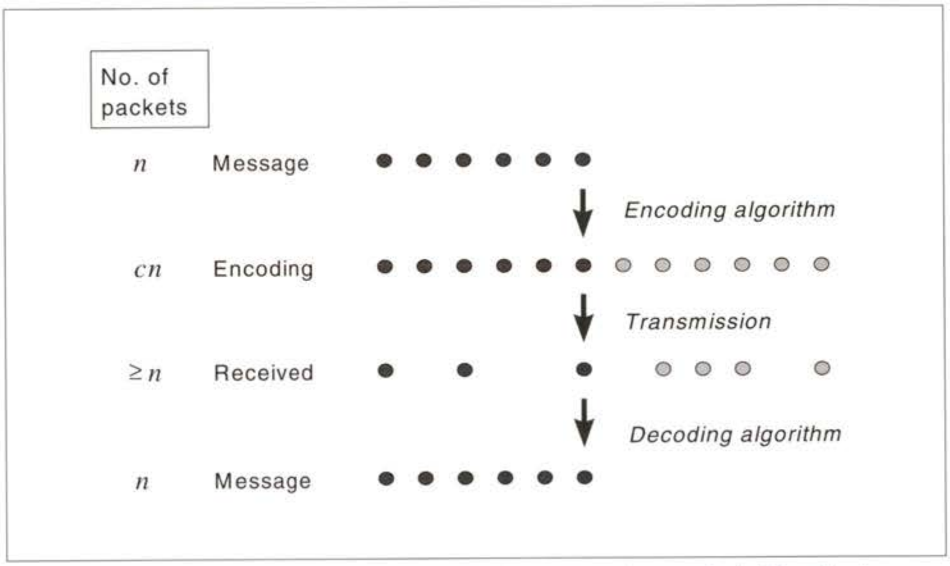


Figure 1. How an FEC code works. A message of n packets is encoded with redundancy into cn packets. If enough of the encoding is received, the message can be decoded.

Forward Error Correction

An alternative solution, called forward error correction (FEC) in the networking literature, has been advocated by several groups as a method to avoid retransmission. Instead, redundant packets are sent out along with the original message packets. The redundant information is designed so that as long as a receiver obtains enough of the transmitted packets, regardless of which packets are received, the original message can be reconstructed. Ideally, the number of encoding packets needed to decode the message is equal to the number of packets in the original message (see Figure 1).

To illustrate the advantages of FEC, consider the following simple setting. Suppose that 10,000 users are receiving a multicast transmission, and the average rate of packet loss is 10%. One way to ensure that all users receive all of the packets is to keep sending each packet until all users acknowledge their receipt. If the losses are independent for the different users, a simple calculation shows that, on average, each packet must be transmitted approximately five times. On the other hand, suppose the transmission is partitioned into messages of 100,000 packets each, and an FEC code is used to add 25,000 redundant packets to each message before transmission. Suppose no user loses more than 25,000 packets of the 125,000 packets associated with a message (i.e., the maximum loss rate is at most twice the average loss rate). Then all users will receive enough of the encoding to decode the message. The total bandwidth used by the FEC solution is smaller by a factor of 4 than the retransmission solution, and, moreover, the overall protocol is much simpler.

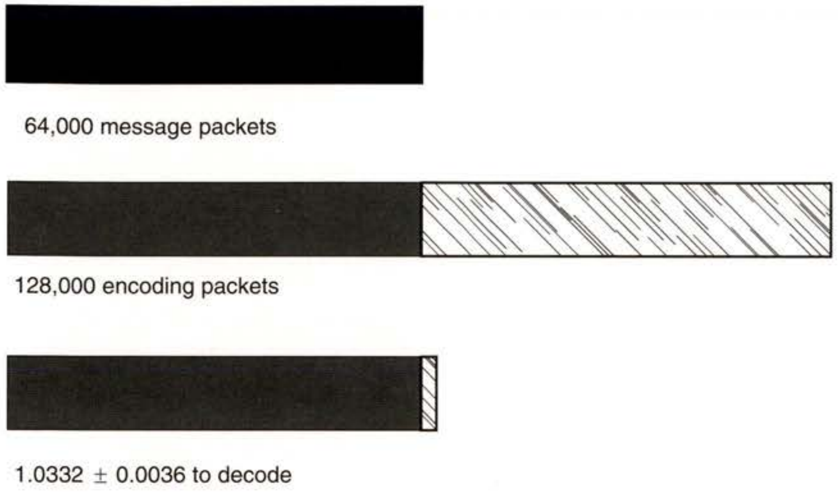


Figure 2. Results from an experiment using Tornado codes. On the basis of 10,000 trials, the average decoding overhead has been determined to be 3.32% (standard deviation = 0.36%). On an AlphaStation 500 running at 333 MHz with 192 MB of main memory, the encoding time was 3 seconds, and the decoding time was 5 seconds.

The potential for FEC codes in multicast applications has not yet been fully realized, primarily because previous software implementations of FEC codes have been too slow. Their running times are only reasonable when the number of redundant packets is small (e.g., at most 100 packets). This slowness is due to the fact that the encoding and decoding times of standard FEC codes are proportional to the length of the encoding multiplied by the number of redundant packets. Other known codes based on the fast Fourier transform have asymptotically much better decoding times, but in practice their complexity makes them too slow to decode large messages. (Implementations of such codes in custom-designed hardware run quite fast.)

New randomized FEC codes that we have developed and call Tornado codes promise to make FEC practical. Tornado codes require that slightly more than the ideal number of encoding packets be received to decode the message; we call the percent needed over the ideal number the *decoding overhead.* (Recall that the ideal number is the original number of message packets.) By allowing some decoding overhead, we can develop much faster coding schemes. Tornado codes can be encoded and decoded in time proportional to the length of the encoding multiplied by a small constant that is independent of the number of redundant packets. This small constant, which we call the *time overhead*, is typically about 5.

We have implemented these codes in software, and the results are encouraging. In practice, the decoding overhead for Tornado codes is moderate. For instance, we used the Tornado codes to produce 128,000 encoding packets from 64,000 message packets, in which each packet is 512 bytes. In 10,000 trials, the average decoding overhead was only 3.32%; in other words, about 66,000 encoding packets are enough for decoding. Furthermore, in only 1% of the trials was the decoding overhead more than 4.4% (see Figure 2). For the price of this small decoding overhead, Tornado codes obtain extremely fast encoding and decoding speeds. On an AlphaStation 500 running at 333 MHz with 192 MB of main memory, the time to encode the 32-MB message is 3 seconds, and the decoding time is 5 seconds. The encoding and decoding times for a message of this size using standard FEC codes would be at least 10,000 times longer.

Features of Tornado Codes

Tornado codes have a number of important features:

- *Simplicity*: Our algorithms use only simple XOR operations; no complicated data structures are required for their implementation.

- *Generality*: We have developed techniques to design Tornado codes for whatever *rate,* or redundancy level, is specified. (In a rate 3/4 code, for example, 3/4 of the encoding is the original message, and 1/4 of the encoding is redundancy.) Moreover, we can design codes to trade off the time overhead against the decoding overhead. (See the examples in the Table.)

Table. Decoding and time overhead tradeoffs for Tornado codes at various rates

	Rate			
Time overhead	**1/2**	**2/3**	**3/4**	**4/5**
5.70	3.6%	2.3%	1.6%	1.3%
6.82	2.4%	1.3%	1.0%	0.7%
8.01	1.4%	0.8%	0.7%	0.5%

- *Provability:* We have developed a mathematical formulation of Tornado codes that allows us to prove how well they will perform. Furthermore, we have found an infinite family of codes for which we can prove that the decoding overhead decreases quickly as a function of increasing time overhead.

Applications of Tornado Codes

The advent of our Tornado codes makes software solutions possible for problems that are orders of magnitude larger than were previously conceivable. One application is the video server multicast problem mentioned earlier, especially for high-bandwidth video streams. Another application is illustrated by the following *software distribution problem.* Suppose there is a new software release of a 32-MB binary file that millions of customers would like to download over the Internet within a period of a week. How should it be distributed?

The *FEC multicast protocol* to solve the software distribution problem works as follows. First, the distribution server partitions the file into 64,000 message packets of 512 bytes each and then encodes it into 128,000 encoding packets using our Tornado code. The distribution server then cycles through the encoding packets and multicasts them at a regular rate, say, at the rate of 10 packets per second (40 Kbits/second) for a week. (It takes about 3 1/2 hours to cycle through the entire encoding.) Any user who wants to download the software can join the multicast session at any time and download encoding packets until enough are received to be able to decode the binary file. Then the user can decode the binary file within 5 seconds.

In the traditional protocol to solve the software distribution problem, each user establishes a point-to-point connection with the distribution server to download a copy of the file. Suppose the point-to-point connections also send 10 packets per second. In some respects, the FEC multicast protocol and the point-to-point protocol are similar. In both protocols, the user needs essentially the same number of packets to decode the file, and, in both, the user can download the entire file in about the same amount of time.

Advantages of the FEC Multicast Protocol

The FEC multicast protocol has several clear advantages over the point-to-point protocol.

- The overall bandwidth used by the FEC multicast protocol over the entire week is only 100 times greater than the size of the binary file, compared to the bandwidth consumed by the transmission of the file using millions of individual point-to-point connections.

- Users participating in the FEC protocol can decode the file from any set of 66,000 distinct encoding packets. Hence, even if a user's connection sporadically fails, or if a user performs other tasks simultaneously that temporarily make it impossible to process incoming encoding packets, the decoding process can continue seamlessly thereafter.

- No explicit interaction between users and the distribution center is required for the FEC multicast protocol, and it is simpler to implement than the point-to-point protocol from the viewpoint of the distribution server and the users (although it does require multicast support from the network).

- The FEC protocol is robust against a moderate rate of packet loss.

If standard implementations of FEC codes are used instead of our Tornado codes in the FEC multicasting protocol described above, the encoding and decoding times are tens of hours instead of a few seconds. Thus, an approach that previously had no practical solution is now quite attractive because of the efficiency of our Tornado codes.

We are continuing to develop ideas for further applications; please contact us if you have any in mind.

Acknowledgments

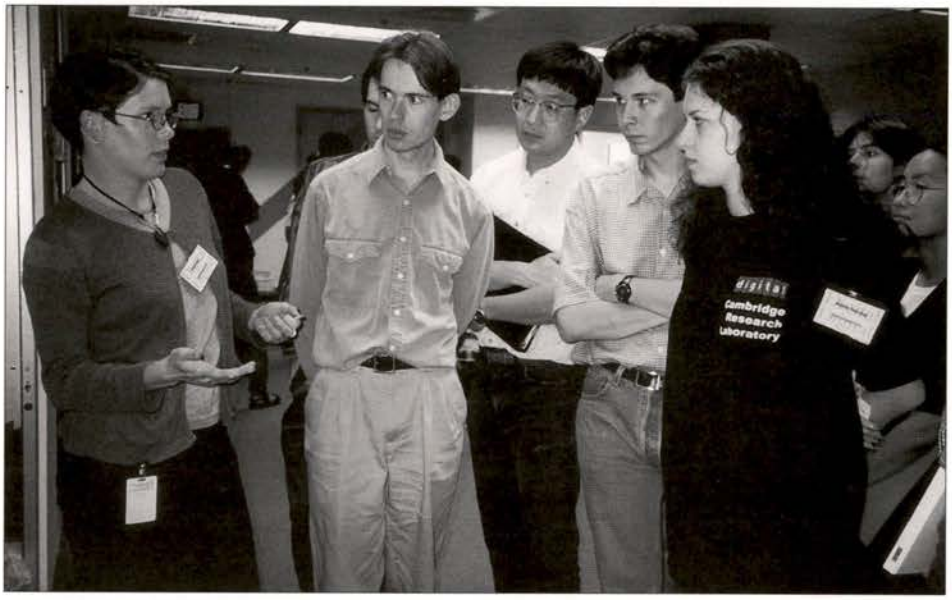
This work was developed in collaboration with Amin Shokrollahi (International Computer Science Institute, Berkeley, California), Dan Spielman (MIT), and Volker Stemann (International Computer Science Institute). ✻

Student Interns Shine at Cambridge Research Lab 'Science Fair'

Internship opportunities for doctoral students exist at all DIGITAL research laboratories. This past summer, the Cambridge Research Lab hosted 28 interns and held the program's first student 'science fair.'

Late in August, youthful enthusiasm spilled forth from clusters of cubicles into the hallways of the DIGITAL Cambridge Research Laboratory (CRL), as 28 computer-science students, aided by their DIGITAL mentors, shared ideas during an afternoon of lectures and demonstrations. For most of the students, the CRL "science fair" marked the end of 3-month, sponsored summer internships and the imminent return to academic life on campuses far from Boston.

"The internship program is the cornerstone of our university networking efforts," remarked Bob Iannucci, director of CRL. "One means of identifying new talent starts with these internships, which are focused upon concrete short-term projects tied to our longer-term research efforts."



Photos: B. Magura

From left, Carnegie Mellon University grad student Rosie Jones discusses the effect of lossy speech-signal compression on phoneme classification and recognition with Kevin Murphy, a University of California–Berkeley grad student; DIGITAL research scientist Davis Pan of the Video & Image Processing group; University of Maryland grad student Dejan Perkovic; and Natasha Tatarchuk, a Boston University grad student. Rosie's DIGITAL mentor was Christ Weikart of the Speech group.

Getting the Word Out

CRL research scientist Bert Halstead explained that a call to the CRL research staff for brief project descriptions precedes an email distribution to university computer science professors. The CRL Web site also nets candidates, as students independently troll the Web to locate summer opportunities.

Internship candidates fill out an application, submit a résumé, and undergo a phone screening. For those selected, DIGITAL supports transportation to Cambridge, provides temporary housing and a small stipend for settling into the area, and pays a weekly salary. Most interns are graduate students, but a few are undergraduate students from a special program at nearby MIT.

This year three universities in northern Europe and universities throughout the US were represented among the interns, about one-third of whom had worked at CRL in previous summers.

Benefits to DIGITAL

"The internship program is highly valued for its positive effect on the lab's energy level," commented Halstead. "All who have been involved with the interns agree that this is a great way to bring in fresh ideas and bolster the lab's capabilities."

This year's summer projects at CRL covered many topics, including streaming of real-time multimedia data, interactive annotation of audio and video streams, speech recognition, and the use of kinematic models in figure tracking (see photo captions).

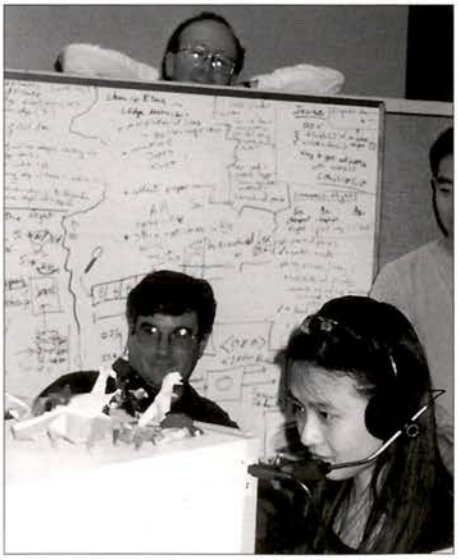
In the area of scalable computing, according to Halstead, interns were integral to the process of assessing the impact of various design options on future Alpha architectures. In addition, they assisted in work on a distributed shared memory system. One intern worked on a project known as Stampede that is developing technology for

At far right, Daniel Morris describes how to extract, reproduce, and alter the fancy footwork of Fred Astaire. His audience included (from left in the photo above) DIGITAL research scientist Frederic Dufaux of the Video & Image Processing group; Bob Iannucci, CRL director; DIGITAL research scientist Davis Pan of the Video & Image Processing group; Beth Logan, Cambridge University grad student; Angel Chang, an MIT junior; and MIT junior Patrick Kwon. Jim Rehg was Daniel's DIGITAL mentor in the use of kinematic models for 2-D and 3-D figure tracking.

building interactive applications on a clustered system of four Alpha 4100s linked with a MEMORY CHANNEL interconnect.

In the area of human-computer interaction, interns explored robust gaze tracking, face recognition using eigenfaces, and interactive kiosk development using touch-screen technology. One intern developed an emotional behavior component for DECface, while another used DECface in a touch-screen–based dynamic game called "LightDance."

For some students, a summer at CRL is their first experience working in corporate-sponsored research. "One student had never considered any option except a career in academia," commented Susan Whitehead, CRL operations manager. "After his experience at CRL, his eyes were opened to the possibilities of working in industry, while still being able to pursue high-impact ideas in an intellectually challenging environment." ✱



MIT junior Angel Chang employed human-computer interaction technologies developed at CRL to create an interactive instructional agent. Here, with DIGITAL mentor Dave Goddeau observing, Angel demonstrates the agent's attempt to teach the user how to make an origami bird. Peeking over the cubicle wall was DIGITAL research scientist Bert Halstead.

web*site*

intranet
http://www.crl.dec.com
An overview of the Cambridge Research Laboratory

Network Systems Laboratory Team Tours the East

In October, the Network Systems Laboratory—home of the corporate Internet gateway and the Digital Internet Exchange—sent a team to New England to share its expertise with East Coast engineering groups.

If you missed the Network Systems Laboratory (NSL) tour, you missed a chance to share perspectives on the future of DIGITAL and the Internet with a group of experts who spend much of their day thinking up new, strategic technologies and opportunities for DIGITAL in the Internet space.

The enthusiasm of Brian Reid, NSL director and tour leader, is contagious: "I'm so excited about the future of DIGITAL that I can hardly contain myself. I'm lucky enough to be in a place where I get a good view of what's coming and not so much of what has been. I hope that this year's NSL tour will help you see what I see and share my excitement."

If you weren't able to join the tour, don't despair. A succinct set of NSL project overviews is available on the corporate intranet. To find descriptions and contacts for the projects outlined below, start at the top-level NSL Web site in the project category.

- The **Internet Exchange** isn't a new technology but rather a new business model. For the first time, a non-telecommunications company successfully has built, owned, and operated a central office facility. Why did DIGITAL do it and why do customers care? The answers can be found at the project Web site.
- **Laser Kitty** is an NSL prototype of infrared Ethernet. Infrared device technology makes possible dramatic improvements in data rate and range of an infrared wireless XMLAN.
- The **HyperFile System** is a global file system to be built "on top" of HTTP and the Web. NSL researchers would like the HyperFile System to begin a software revolution toward truly platform-independent, location-independent applications.
- NSL is developing tools and a monitoring infrastructure, **Pandora**, to detect and isolate performance failures with the ultimate goal of expanding knowledge of Internet service failures. The project Web site provides a view into the success achieved to date.
- **Piglet** is an Internet gateway for small networks. The gateway provides safe Internet connectivity, shared Internet access, and management functions for a small office network. Its base platform is the "Shark" StrongARM board running the NetBSD operating system. Layered on top are utilities for automatic network configuration, network address translation, and the Internet tunnel service.

The Network Systems Laboratory in Brief

The DIGITAL Network Systems Laboratory (NSL), located in Palo Alto, California, is devoted to advanced research that "pushes the envelope" of networking and Internet technology. NSL has a long history of driving Internet technology within DIGITAL, advising the corporation on Internet strategy, and collaborating with groups throughout the company.

NSL built and runs the primary corporate Internet gateway, created the DIGITAL Internet Exchange, played key roles in the development of AltaVista, created the award-winning 1994 California Election Server, established the first municipal presence on the Web (the city of Palo Alto), created one of the earliest examples of a successful online business (the Future Fantasy Bookstore), and designed the NASDAQ trading network—just to mention a few achievements.

NSL research encompasses engineering, marketing, strategic studies, and aesthetic issues. ✱

A Few Words from the NSL: 'Network Everyone'

Design the business models, components, architectures, and facilities to provide affordable utility-grade networking to any place on earth that needs it, starting with places currently served by utility companies.

We believe that one vital next step in moving the Internet from being a hobby and curiosity to being a reliable (and thus nearly invisible) infrastructure is to make it more available and more useful in peoples' homes. Our laboratory has had world-class, medium-speed home networking for nearly a decade; we are working to make this kind of access available soon to many more people and to make much faster and better network connections available in many homes within 3 to 5 years. We envision this utility-grade home network facility being used for entertainment, telecommuting, personal and business communication, and for other things that have yet to be invented. A reliable data communications infrastructure, shared among many applications, is a vital first step.

One network. Everywhere. *

—from the NSL Web site

D. Willett

Brian Reid, director of the DIGITAL Network Systems Laboratory

- *Really, really* good **Web page design** goes beyond the mechanics. The excitement of the live presentation has not been captured online, but the presenter's excellent advice has.
- NSL learned a number of lessons from a pilot project on **Networked Entertainment Technology.** View history-making projects, such as the first wireless netcasts and the Mars landing at the project Web site. *

web*site*

intranet
http://nsl.pa.dec.com/nsl/
The Network Systems Laboratory Web site

DIGITAL Visual Fortran: Delivering a Shrink-Wrap Software Product

In its first 10 weeks on the market, over 6,000 licenses were sold for DIGITAL Visual Fortran, the newest in the corporation's portfolio of Fortran 90–compatible compilers.

By William Youngs, Core Technology Group, Nashua, New Hampshire

William.Youngs@digital.com

The DIGITAL Visual Fortran team. Seated, from left: Leo Treggiari, Terry Grieb, Caroline Davidson, Cindy Huang, Steve Lionel, and Mike Etzel. Standing, from left: Lorri Menard, Bob Hanek, Tom Lavigne, Peter Karam, Bill Hilliard, William Conrad, Steve Rose, Lucy Hamnett, Pierre Calixte, Robyn Sampson, Stan Whitlock, Paula Gallagher, Shin Lee, Dave McClure, and William Youngs.

Fortran is the development language of choice in high-performance technical computing markets. DIGITAL Visual Fortran (DVF), the latest in the portfolio of Fortran 90–compatible compilers from DIGITAL, is a shrink-wrap (PC retail) compiler that supports the Intel and Alpha Win32 platforms. It also incorporates Microsoft Developer Studio 97 integrated development environment (IDE). Though the product has had sales success, its development evolution was fraught with challenges.

A Rocky Beginning

In 1993, the Alpha 64-bit architecture with its "kick-butt" performance was enjoying much favorable press though the RISC competition was doing its best to ignore this fact. At the same time, DIGITAL was undergoing a major business restructuring. Our Intel system business was breaking new ground both from a design and distribution perspective, but it was still struggling to be profitable. This is the atmosphere in which Core Technology Group (CTG) engineering first proposed to develop a Fortran compiler that would support both the Intel and Alpha Win32 platforms.

Investigations on the feasibility of retargeting the optimized code-generation technology (GEM) to the register-poor Intel architecture looked promising. Regrettably, funding for the year was channeled to higher priority tasks, and the Intel code generation work was postponed.

What a Difference a Year Makes

Over the ensuing year, business restructuring continued, the corporation moved toward a closer alliance with Microsoft, and analysts projected that Win32 systems would gain share in desktop and server market segments. With DIGITAL re-establishing its former leadership in technical computing, it was a logical business move to extend the family of compatible Fortran compilers to Intel, thus supporting an emerging scalable computing strategy. Although anecdotal evidence suggested that this strategy would provide Alpha system leverage, it was difficult to quantify. If CTG engineering could establish that the revenue generated by a Win32 compiler on Intel and Alpha platforms would pay for itself, quantifying Alpha system leverage would no longer be a factor in constructing a credible P&L statement.

Editor's note: While the Winter 1997–98 issue of Forefront *was in production, the DIGITAL Visual Fortran team was named a finalist for the FY97 Engineering Team Award. See this issue's feature story beginning on p. 2.*

The team found itself improvising and breaking new ground every step of the way....

Homework Pays Off

Our detailed analysis of the PC Fortran market and competitive product pricing revealed that at least 11,000 PC Fortran licenses would have to be sold annually in order to offset costs. The market was large enough to sustain this volume, but three established players dominated the market: Microsoft, Lahey, and Watcom. Microsoft, with its 16-bit DOS and popular Windows-based Fortran products, was arguably the market leader by a significant margin. Knowing the volumes DIGITAL needed in order to offset new development costs and corporate overhead, DIGITAL decided to ask Microsoft about licensing its IDE for use with our compiler on Alpha and Intel. It seemed like a long shot because Microsoft was developing Fortran PowerStation version 4.0, based on the same Developer Studio environment. Microsoft agreed to discuss licensing its Developer Studio environment on Alpha, but licensing it on Intel was tabled except as a future possibility, because of the obvious competition it created for the Microsoft Fortran product.

Opportunity Knocks

Much to our surprise and delight, 3 months after the initial meeting to discuss licensing the IDE, Microsoft proposed that DIGITAL take over its entire Win32 Fortran business. With new business initiatives at Microsoft, Fortran was outside its core business. Microsoft was looking for a way to outsource Fortran that would make it easy for their customers to migrate. With DIGITAL seeking to re-establish leadership in technical computing and Fortran the leading development language for technical applications, Microsoft's new orphan child found a willing adoptive parent in DIGITAL.

The Contract: The Devil Is in the Details

Although DIGITAL and Microsoft agreed quickly on the framework of an agreement, the details were difficult and time-consuming to work out. It took nearly 4 months to agree on royalty, intellectual property, and compatibility terms. It took another 14 months to address minor details and to get the contract signed. Both companies shuffled organizations and players over the course of the negotiations. By the time the contract was signed, engineering was just days away from beta testing the first compiler without an IDE.

Development Squeeze

Throughout the protracted contract negotiations, Microsoft held firm on the end date for shipment of the replacement DIGITAL Intel product. DIGITAL received intermediate versions of the files needed, but the final drop of sources and binaries from Microsoft did not occur until late January 1997. The development team was obligated contractually to ship the Intel product within a few months of the final drop from Microsoft, putting the team under tremendous pressure. Any difficulty in the final integration and testing put the delivery date, and hence the contract, at risk. Fortunately, the team was able to work around the few remaining integration difficulties and complete beta testing.

The Shrink-wrap Software Challenge

Product integration issues were only a part of delivering a finished shrink-wrap software product to market. The team found itself improvising and breaking new ground every step of the way from beta test to online documentation, packaging, product distribution, and marketing.

Beta Test Program

The DIGITAL Visual Fortran beta test program was the largest ever for a compiler product—nearly 100 sites. The administrative and engineering workload associated with managing so many sites with a small team was without precedent. However, including a large number of sites in the beta test program was considered necessary to ensure the quality and robustness of such a complex and high-volume product.

Documentation

Documentation was an area in which we found ourselves improvising to compensate for an immature conversion tool set and lack of information. The writers had to convert documentation from three different forms (Microsoft rich text format [RTF], Document, and RTF with embedded styles) into a common HTML form that could be built to display with InfoViewer, the Developer Studio online documentation viewer. In less than a year, the InfoViewer source format changed from RTF with embedded styles to a specialized HTML format with extensions.

Lacking any road map, the writers located RTF-to-HTML converters and converted, built, revised, and manually added index entries to the equivalent of over 1,500 pages of online documentation and 2,000 files. While the content was still evolving, they also revised the printed multiplatform Language Reference Manual and created a Getting Started manual. Writing tasks included defining and assisting with the implementation of packaging.

Branding

As a retail product, DVF needed packaging that would be informational, colorful, and project a PC software look and feel.

Consulting with a volunteer artist, the team soon ran into basic questions about the creation and delivery of the packaging that it could not answer. Ultimately, these questions led the team to the corporate Industrial Design Group, which had all the answers but, unfortunately, a few rules. Not only *could* the design group help us, they *strongly recommended* it. If we chose to ignore corporate design rules, securing approval would have been a formidable task.

At first blush, the rules seemed overly restrictive. We were being asked to comply with branding rules that were not yet fully documented and presented significant constraints on the design of the box, the size and location of type, graphics, and color choices. After resolving some initial misunderstandings, we settled into a good working relationship with the Industrial Design Group and made rapid progress. The dialog with the design group actually helped clarify and shape the branding rules. In the end, with compromises by both groups, the packaging had the look and feel of a shrink-wrap software product, it complied with branding requirements, and it was ready on time.

Product Introduction Woes

As development activities converged toward the date of release to manufacturing, many business and process details had to be finalized before product shipment. Despite months of preparation and planning, issues remained regarding customer registration, help desk support, distribution channels, advertising, press releases, analyst briefings, and Web site content. Because it was to be a joint announcement with Microsoft, messages and timing of the release had to be coordinated by two companies which caused some last-minute announcement-date jockeying. Despite the frenzied activity of the final 2 months, on March 10, 1997 the DIGITAL Web site went public with the news of DVF availability in April. Press announcements from both companies followed shortly thereafter. With news of our product spreading fast, we were about to enjoy a full course in fulfillment blues at the "Hard Knock Café."

Because DVF was one of the corporation's first shrink-wrap software products, we were woefully naive about the workings of indirect sales channels. Although our March announcement materials clearly indicated that the product would be available in mid-April, customers began calling on the day of announcement to place orders. Though the product was not yet available, prices were on file, and technically the product was backorderable by distributors from DIGITAL manufacturing. Unfortunately, the distributors had overlooked the Systems Business Unit part (SKU) numbers in the Personal Computer Business Unit systems, which meant that resellers had no pricing information on which to base their prices to customers. Most resellers had no product information and began calling their distributors who, in turn, began looking for information. In order to unclog the system, we had to systematically walk through each of the links in the supply chain to ensure that relevant information was available and being transmitted to the next link in the chain. It took weeks to identify the links, all the players at each link, and then to persuade the responsible individuals to do the work necessary to allow the product to be ordered.

The DIGITAL Visual Fortran beta test program was the largest ever for a compiler product—nearly 100 sites.

Some amount of lag between product announcement and product availability through channels is inevitable, especially for a new product or one sold outside the United States. However, the manufacturer can do several things to minimize the lag time to the resellers.

First and foremost, a working relationship should be established with the distributors to be used and they should be given product information as early as possible. Check that the distributors enter pricing information into their systems so that it is visible to resellers. Selected resellers who know the product space should be prepared so that they have time to put product information into their systems and catalogs. The manufacturer should point customers to them for fulfillment on announcement day. Taking cues from Microsoft, we did this for DVF but we still had our share of start-up problems.

Most of the problems were the result of assuming, without checking, that part number and pricing information had been propagated downstream. With all the products vying for attention, product demand is what really drives the distributors and resellers to take action. After the product is known and the supply chain established, there are fewer start-up problems at each new release. The bright side of our channel start-up problems was that it caused a huge spike in sales once DVF shipments began flowing (nearly 2,000 sales in a week!). However, it is difficult to estimate how many sales were lost due to these problems.

Going to Market on a Tight Budget

As we have seen, market demand is the fuel that drives indirect channels. We secured one-time High Performance Technical Computing marketing support to cover a joint mailing with Microsoft to the Microsoft Fortran PowerStation installed base. Due to limited marketing dollars, the DVF development team has subsequently exploited less traditional (spelled i-n-e-x-p-e-n-s-i-v-e!) methods to promote product awareness and stimulate demand.

We put a lot of energy into creating an attractive, informative, and multipurpose Web site that we revise frequently. During weekdays, the Fortran Web site receives more than 2,000 hits per day. This Web site serves multiple purposes. An enterprising telemarketer employed by one of the aggressive resellers has extracted content from the DIGITAL Fortran Web pages to create his own DVF sales guide.

During the announcement week, DVF was featured on the DIGITAL home page. For additional visibility, we routinely provide hot links from the DVF site to Web sites that provide reciprocal hot links. To facilitate sales, we periodically conduct Web searches to locate the names of DVF resellers whom we contact and later add to the contact list located on our Web page. When a new release is issued, we post notes in targeted Internet news groups such as *comp.lang.fortran*, as well as in the Microsoft language and DEC4NT forums on CompuServe.

In addition, we are planning to produce a DVF newsletter which will be offered as an incentive to DVF users who register. (The voluntary registration rate is now 1 in 6.) By registering, users will also receive electronic notification of new releases and upgrade programs.

During weekdays, the Fortran Web site receives more than 2,000 hits per day.

We have learned that we can barter product for advertising space in reseller catalogs such as those produced by SciTech International and Programmer's Paradise. Some resellers combine products that work together and sell the "package" for less than the total price of the individual products. One reseller convinced the vendor of a complementary scientific subroutine package to discount its subroutine package 50 percent when sold in combination with DVF.

Signs of Success

You know things are going well when the competition makes frequent visits to your Web page and begins matching your introductory pricing with discounts of its own. It is also a good sign when complementary software and service providers call to negotiate volume purchase, redistribution, and packaging deals. Although it is time-consuming to follow up on each of these contacts, it can be worth the effort. In the case of DVF, royalty encumbrances limit our pricing flexibility, but we are evaluating 100-pack licenses as a means of responding to requests for site licensing and discounts on volume purchases.

Warranty and Support: A Need to Work Smarter

DVF offers a standard collection of warranty and support services but, typical of shrink-wrap products, service contract penetration is low due to the high price of the services relative to the low price of the product. The net effect of fewer support contracts is diminished formal communication between DIGITAL and the customer. This ultimately affects customer satisfaction irrespective of the quality of the product. The team implemented several innovations that exploit electronic and Web-based technologies to improve two-way communication with the customers.

- The team established a list of frequently asked questions (FAQ) about DVF on its Web site. Posting of the FAQ resulted in an immediate 30 percent drop in out-of-warranty problem reports.
- The team created an electronic problem-reporting system which automatically replies to the sender, converts subject line to note topic, decodes any attached MIME-encoded files, formats, and posts the mail in an internal notes file for action. Customers get immediate feedback, and issues are tracked and assigned with a minimum of overhead.
- The team made available free downloadable patch kits to fix known problems between releases. Each new patch kit contains contents of the previous patch kit along with new bug fixes. The patch utility automatically detects the revision level of the user software and applies the appropriate patches to update the user to the current patch level.

The team is developing a Web-based user-to-user help forum hosted by DIGITAL and monitored by Fortran engineering. The forum will provide an electronic way for DVF users to help each other and for DIGITAL engineering to monitor concerns and issues (and even make a suggestion now and then).

Value Returned

The investment in DVF has returned value to the corporation in many ways:

- *Revenue.* DVF is a profitable layered product that provides Alpha system leverage.
- *Third-party pull.* DVF provides an industrial strength Win32 Fortran compiler that has motivated partner migration to DIGITAL Win32 platforms (e.g., MSC/Nastran, ESRI, Dakota Software, KAI, Sutrasoft, Numerical Recipes, NAG, VNI, and Lynchval Systems).
- *Support of NT integration.* DVF supports the UNIX All-Connect and the OpenVMS Affinity (wave 5) marketing initiatives which demonstrates DIGITAL commitment to NT integration within the enterprise.
- A *scalable solution.* DIGITAL is the only system vendor with compatible Fortran solutions that range from Intel laptops to high-performance RISC servers. For example, DVF was used to develop the MM5 demonstration on a Turbolaser for Microsoft Scalability Day, a half-day press and industry analyst event held on May 20, 1997.
- A *successful Microsoft partnership.* DVF combines leadership technologies from Microsoft and DIGITAL and is the result of an unprecedented business and technical collaboration between the two companies. DIGITAL is the only vendor that has enabled mixed language development using Microsoft Visual C++ and Fortran *from within the same development environment.*
- *Serving a growing market segment.* With Win32 systems commanding ever larger shares of the desktop and server market, DVF is the right product at the right time to support emerging development preferences within the high-performance technical computing community.
- *Introducing new customers to Digital products.* DVF sells outside the traditional DIGITAL customer base, which is extremely important to expanding business on a long-term basis.

> **Key to the success of DIGITAL Visual Fortran has been the willingness of team members to work outside their traditional roles and do 'whatever it takes' to get the job done.**

In summary, delivering a successful shrink-wrap software product requires planning, creativity, adaptability, tenacity, luck, and a lot of hard work, but the potential benefits make the journey worth the risk. Key to the success of DIGITAL Visual Fortran has been the willingness of team members to work outside their traditional roles and do "whatever it takes" to get the job done. ✳

web *site*

internet
http://www.digital.com/fortran/
Looking for information about DIGITAL Visual Fortran? Start here.

Building a Coherent Web-Based Computing World

At a 3-day convocation held in October, speakers discussed the technology, policy, and open standards underlying the DIGITAL Web strategy.

By Bruce MacDonald, Industry Standards and Consortia, Corporate Standards Group, Acton, Massachusetts

Bruce.MacDonald@digital.com

The advent of a World Wide Web that uses standardized network protocols and ubiquitous Java-enabled browsers in conjunction with large storage capacity and efficient retrieval engines offers a unique business opportunity for DIGITAL.

The challenge for DIGITAL is to provide avenues to these new capabilities. To ensure that DIGITAL has a market presence in this emerging new computing world, the corporation must be in the forefront of developments in several areas.

At the Industry Standards and Consortia (ISAC) group's Web workshop, held October 7–9, DIGITAL engineers, product planners, technology directors, and marketing staff gathered to discuss the corporation's need to influence the impending technological developments, governmental policies, and open standards that will undergird the rapidly evolving Web-based computing world.

The Web workshop included more than 25 presentations with over 200 persons in attendance. A few presentations will be summarized; all presentations can be viewed by accessing the URL shown at the end of this article.

The Market, the Opportunity, the Products

Alan Nemeth, corporate consulting engineer, focused on the large and rapidly growing market that DIGITAL will address as its Web-centered strategy evolves. Estimated at approximately US$4 billion for hardware, software, and services, the market is growing at a 9.6% compound annual growth rate.

Nemeth described Web-based systems as a set of services available through any Web-connected computer, characterized by location independence, bandwidth tolerance, ease of data retrieval, reliability, and "7 × 24" availability.

"Such a system just works," said Nemeth. "Customers can arrange for whatever level of reliability, availability, and fault tolerance they want."

DIGITAL, he said, is moving full speed ahead to build systems with these characteristics, and provided a number of examples of Web-centric systems already built and working for customers.

Discussion of the Internet products strategy was complemented later by UNIX Business Segment marketing director Tom Richardson, who presented the Internet Business Group (IBG) perspective on Internet and intranet markets.

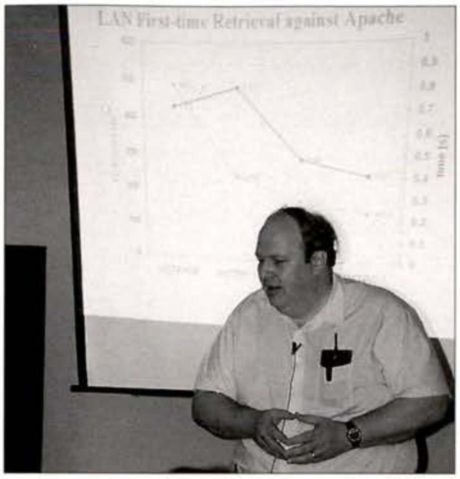
'E-commerce': Millicent

A presentation about DIGITAL Millicent, a technology that allows vendors to sell even very low-priced products on the Internet, stimulated lots of discussion. Stan Hayami, general manager of the Millicent Project, explained that Millicent is based on the model that users want increasingly more specific items and online vendors want compensation.

Alan Nemeth, corporate consulting engineer

Photos: B. MacDonald

"What if you want to buy a certain song?" asked Hayami. "Today you have to buy the whole CD to get that one song. Web capabilities enable users to download only the desired tune. Millicent allows vendors to be paid for whatever merchandise the user obtains, even though it may be just a few pennies per item. Millicent will work using a 'token approach.' A user will receive virtual tokens from a broker to spend with vendors, who complete the transaction via the broker."



Industry Standards and Consortia group member, Jim Gettys, who is now a visiting scientist with the World Wide Web Consortium at MIT

Much discussion ensued about whether consumers were ready to buy products "the Millicent way." Millicent is still in the advanced development phase," Hayami said. "Productization is planned in the near future."

Web Protocols and Standards

Speakers addressed several topics related to the technical aspects of the "wired" world of the Web.

HTTP

ISAC's Jim Gettys, who is now a visiting scientist with the World Wide Web Consortium (W3C) at MIT, made two presentations. He outlined developments in HTTP to make it a "good Internet citizen," or as Gettys explained, "providing improved performance and minimizing deployment time for both clients and servers."

He described problems in starting and ending Web sessions caused by HTTP 1.0 protocols, as well as the congestion problems encountered when a Web page needs to open multiple connections. HTTP 1.1 is designed to relieve these problems in several ways, giving users faster perceived response times and allowing Internet service providers to more effectively configure servers.

The Evolution of HTML

On the subject of the evolution of HTML to XML, Gettys pointed out that HTML is at an evolutionary dead end. XML moves beyond the simple text mark-up foundation of HTML to incorporate robust functions for mark-up of nontext information and easier inclusion of metadata.

IPv6

Corporate consulting engineer Jim Bound and Jack McCann and Eric Wong (both of whom are principal software engineers with the DIGITAL UNIX Internet Engineering group) updated the group on IPv6, the new Internet protocol. The Internet Engineering Task Force (IETF) is now developing this protocol.

IPv6 is designed to alleviate the lack of IP addresses in the current implementation of IP, as well as to improve system management, security, and the scheduling of wide bandwidths for new types of data such as video. IPv6 will feature improved route computation, improved host and router discovery, and enhancements for mobile computing.

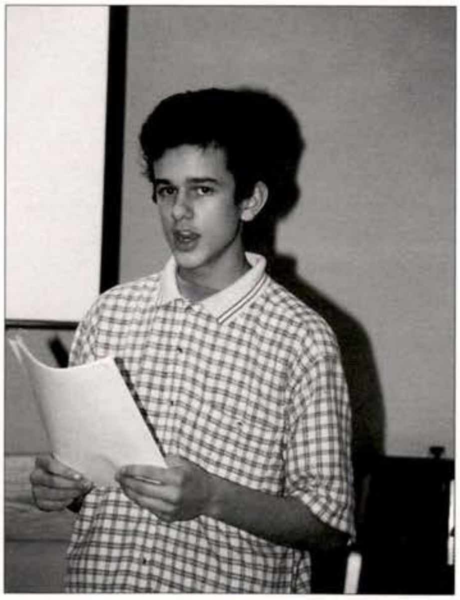
Although IPv6 base specifications are nearly at draft standard stage, the role of IETF in IPV6 implementation and the slowness of finalizing the proposed standard was discussed with some concern.

Jack McCann briefly overviewed the IPv6 UNIX implementation. He reported that the first public kit was available in April and that work is under way to move key third parties to DIGITAL UNIX IPv6.

Eric Wong discussed the IP Security Protocol (IPSP) as it relates to DIGITAL UNIX, which preceded a later general discussion by Ted T'so of the MIT Laboratory for Computer Science on the protocols being developed by the IP Security Protocol Working Group (IPSEC). Aspects of both of these presentations covered the key elements in the IPSP, including security at the IP level, encryption key recovery, the implementation of a "policy manager/-engine," and a security monitor or audit log viewer. The IPSEC client may be partially implemented by mid-1998.

JavaScript, ECMAScript, and Document Object Model

Nick Heinle, a 16-year-old senior at Needham (Massachusetts) High School and the author of *Creating Dynamic Web Pages,* a book recently published by O'Reilly Associates, discussed JavaScript developments and emerging standards. He pointed out that JavaScript is plagued by disparities between features supported or extended by Netscape and Microsoft. Heinle described the standardized version promulgated by ECMA, called ECMAScript (Standard ECMA-262), soon to be supported by both of the major Web browsers. He



High-school senior Nick Heinle, author of the O'Reilly Associates book *Creating Dynamic Web Pages*

Anne Troye-Walker of the Commission for the European Communities policy directorate for electronic commerce and industry

also talked about the Document Object Model (DOM), promulgated by the W3C, which will provide even greater control over HTML pages.

Java Skirmishes

Randy Meyers and Scott Jameson, both of whom represent DIGITAL on numerous technical advisory committees, presented related aspects of the Java standardization battles being waged primarily between Microsoft, Sun Microsystems, and their partners. Along with other members of ISO–IEC Joint Technical Committee 1, DIGITAL has voted on Sun's application to be a standards provider and to manage the Java standard. DIGITAL believes that the IT industry and the cause of Java portability will benefit from an open standards process and is actively working toward that end in the standards bodies.

"At this point, DIGITAL can't support Sun's revised publicly available specification (PAS) application because it would set a new, and, in our view, undesirable precedent for standards development and maintenance," said Jameson. "DIGITAL is concerned that Sun's current PAS application does not protect the integrity of the open standards process by encouraging all interested parties to participate and by allowing everyone to freely use the Java term when identifying conforming implementations. We appreciate the concessions that Sun has made to date and believe that a favorable long-term outcome is possible."

"Java standardization issues have created a different world," said Meyers. "Standardization isn't going to follow old processes. Documents brought to ISO will be more mature and harder to influence.... To influence the technology, DIGITAL must get involved before standardization occurs. Business relationships are going to influence positions and the development of technology."

Scott Jameson detailed 2 years of DIGITAL work to license Java and to try to influence the standards process in a variety of venues. "Early on, ISAC understood the benefits of open consensus standards for the Internet, including the evolution of Java as part of the process." The future direction of the Internet rests on the outcome of the Java debate, according to Jameson, and DIGITAL is positioned well to influence the debate.

The future direction of the Internet rests upon the outcome of the Java debate, and DIGITAL is positioned well to influence the debate.

Java Class Libraries

Will Kling, project leader for the Java virtual machine project in the Compiler and Technology group, described work on Java class libraries, the APIs used by the middleware services that are essential to application developers. Without standardization of Java as an environment (not just as a programming language), APIs will not be standardized. This will diminish Java's role as a ubiquitous environment for the deployment of Web-based applications.

Technology, Policy, and Society

Jim Isaak, ISAC director of information infrastructure standards, discussed the role of open standards in creating the "global information society." Jim pointed out that an information infrastructure, such as spoken language, is the foundation of human society.

Ted T'so of the MIT Laboratory for Computer Science

Methods of writing and printing, and, in the modern era, electronic communications have followed.

"Open standards were so essential to these structures that they were 'part of the woodwork.' They are also essential to the global information society. Incentives exist to implement and apply standards, and this should be accomplished without governmental coercion," asserted Isaak.

The Role of Governmental Entities

United States. Robert Rarog, manager of science and technology policy, DIGITAL Government Relations, outlined the "minimalist" regulatory position of the Clinton administration. This means that private industry will play the greatest possible role in regulating how the Internet is used. "However," said Rarog, "to promote and manage the use of the Internet, the government must address issues related to access, content, privacy, and taxation."

Europe. Anne Troye-Walker of the Commission for the European Communities (CEC) policy directorate for electronic commerce and industry echoed the sentiments of Rarog. She noted that cultural, linguistic, and national distinctions have forced Europe to deal early with many of the issues that now face the global Internet. Troye-Walker called for "a coherent policy framework for community actions" which also supports "industry self-management to the greatest possible extent." She described the response of 120 vendors to a "thematic call" for proposals—many from newcomers and many from the small-to-medium-sized enterprise segment groups, who seemingly wish to take advantage of the opportunities in electronic commerce.

Only when consumers understand that personal information is protected can DIGITAL maximize its growth in Internet-related areas.

Troye-Walker pointed out that the EC is not interested in regulation for regulation's sake. "All regulation must be based on the concept of a single European market with its implicit freedoms, and regulation must consider business realities."

Security on the Web

Roger French, manager of the Security Program Office, provided insights into security on the Web. He asked: "Which standards exist to promote confidence among users that applications are truly secure?" He described how developers ignored early attempts to establish security evaluation criteria. This led to the development of the so-called "common criteria." According to French, this is industry's only chance to establish a set of common criteria for evaluating and reporting on the security of software for the next 12 years. But it is not clear whether industry and the public will agree that such evaluations are needed.

Carman Mondello, regulatory liaison to ISO/IEC/JTC1, addressed the pervasive need for privacy protection standards on the Web. The ISO, driven by consumer concerns that personal data is being shared in unknown ways, is now reviewing the need for privacy standards. Mondello outlined the history of privacy standards from 1981 through the current efforts of an ISO ad hoc committee, whose report is due in January 1998. The key issues include the following:

Stan Hayami, general manager of the Millicent Project

- What type of information about a person is private?
- What constitutes adequate protection of personal information?
- How does an individual obtain redress if that privacy is violated?

Mondello recommended that DIGITAL become more heavily involved in the privacy area even though it involves work beyond the traditional engineering boundaries. He concluded: "DIGITAL needs to influence public policy in this area. The corporation needs a standards strategy for the protection of privacy. Only when consumers understand that personal information is protected can DIGITAL maximize its growth in Internet-related areas."

The Web as a Social Arena

Joseph Reagle of the W3C Technology and Policy Project spoke of the need to develop technologies that allow users to have confidence in their Web experiences. The W3C sees the Web as a venue that facilitates social (i.e., human-

From left, ISAC staffers Jim Isaak, moderator Peter Smith, Rich Hovey, and Isabelle Valet participate in a lively discussion on Internet policies, standards, and practices.

to-human) interactions with computers situated in between. It should mimic the social capabilities of people in the real world: the ability to create rich content, to make verifiable assertions, to create agreements, and to develop and manage relationships of trust.

The W3C is working on several technologies to promote these characteristics in Web-based interactions. One project is called Platform for Internet Content Selection (PICS), which allows users to set their preferences (or their children's preferences), according to a rating system. Using PICS, the user can block incoming material. Any arbitrary rating system can be used, including quality or relevance ratings. Materials could also be selected by Internet search engines, if they were to index topics on the basis of the PICS labels. (Commercial implementations are already available from Microsoft, IBM, Cyberpatrol, and NetShepherd.)

Other W3C projects include Resource Description Framework and Dsig, which provides a way to sign documents in a machine-readable form.

Reagle's reasons for Web standardization were

- To make the Web ubiquitous.
- To prevent "cultural fragmentation" while keeping the Web international in scope.
- To move the Web from an information source to a social arena.
- To support real-world business and social capabilities on the Web.
- To increase user confidence.

Open Standards and Vested Interests

There was a lively discussion among ISAC staffers Isabelle Valet, Jim Isaak, and Rich Hovey, moderated by Peter Smith. It stimulated much thought about where the "center of gravity" is in the setting of Internet policies, standards, and practices. Governments, formal and informal standards organizations, consortia, major vendors, and the entertainment industry and telcos have vested interests in the success and growth of the Internet. Smith reminded everyone that open consortia have influenced the "movers and shakers" of the world, but that bilateral consortia are influential in creating new business opportunities, gaining a competitive advantage, and driving new markets.

DIGITAL is actively and heavily involved in the development of systems, the formulation of policy on a worldwide basis, and in the setting of standards to enable the company to realize the vision of the "Web as the platform." *

web*site*

intranet
http://www-server.mso.dec.com/isac/det-agend.htm
Access Web workshop presentations in their entirety.

Java—A First Glance

Java is on the minds of many in the computer-industry these days. For nonprogrammers seeking a general understanding of Java, this is the first in a series of articles about the 'Java Revolution.'

By Richard Bonneau, PhD; Systems Application Integration Engineering; Nashua, New Hampshire

Rich.Bonneau@digital.com

If you have been involved at all in the computing world during the past year, you surely have heard about Java. Despite the sophisticated use of Java by certain segments of the DIGITAL technical community, the average computer user, who is not a programmer, may be thinking: "Java? Who cares?" After all, it's not a new application, a new computer system, a new piece of exotic hardware, or even a new caffeinated beverage!

Close Encounters with Java

You've probably had your closest contact with Java in terms of *Java applets* that can execute on Web pages. As such, many believe that Java is restricted to use as a way to make Web pages a little more attractive and dynamic—almost a *toy* language for doing *cute* things on a Web page. However, this ability to write easily for Web pages is only a small part of the value of Java.

Neither is Java the same as JavaScript, which is a scripting language for automating operations totally within a Web-browser environment. While JavaScript and Java have similarities from a language-syntax point of view, they represent distinct software technologies. In this article, only Java will be discussed.

Officially Speaking

Java is a computer programming language whose use goes well beyond Web programming. The philosophy behind development, implementation, and deployment are responsible for a complete software environment and an associated developmental mindset that broadly affects computing today.

Its creators describe Java as follows: "Java is a simple, object-oriented, distributed, interpreted, robust, secure, architecture neutral, portable, high-performance, multi-threaded, and dynamic language."

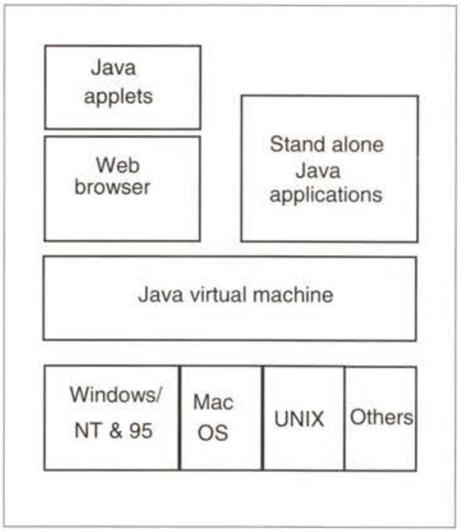
We will discuss some of those aspects of Java and how they might affect the average computer user today and in the near future.

A Simple Language

Simple or small languages lend themselves to quicker learning, less complex compilers, and, in general, less complex development environments, all of which increase programmer productivity. So Java can be easier to learn and master than other current languages (such as C, C++, Pascal, or even BASIC). In its syntax, Java looks a lot like a subset of C++, without some of the error-prone or esoteric aspects of C/C++ (e.g., pointers and multiple inheritance).

An Object-Oriented Language

The buzzword "object-oriented," in the case of Java, is a fact. Among the most popular languages, Java appears to be the most *purely* object-oriented, using a more natural representation and manipulation of objects than the others. This allows Java to take advantage of object-orientation—namely, easier definition, creation, maintenance, and management of clumps of functionality (*classes* and *packages*) usable by other developers. This is commonly referred to as *code-reusability*. To the average computer user, this means that Java developers can easily build powerful programs using more code developed by others; developers spend less time "reinventing" what others have already written and concentrate on their unique, valued-added part.



Java architecture

A Distributed Language

Given the widespread popularity of distributed systems as seen in the Internet explosion, a language that makes it easy to build distributed applications deserves a closer look. Java's creators were immersed in distributed environments and well aware of the complexities of such programming in current languages. Thus, they could include both programming primitives and object/class libraries (packages), which provides client/server and Internet access right "out of the box"—that is, right out of the Java Development Kit or JDK. As a result, a novice Java developer can write Internet-based applications in an afternoon!

A Robust Language

Because, from the outset, the Java language was intended for deployment in many different environments, robustness was required, which means that a Java program could not easily corrupt or disable the system on which it is running. Java uses several different constructs to ensure this (e.g., compile time type checking, exceptions). In many ways, Java programs are much more "well-behaved" than programs written in other popular languages.

A Secure Language

For many of the same reasons as already mentioned above, the Web page environment in which Java programs execute (the Java virtual machine) allows for and demands clear security interactions, making it impossible for them to corrupt the systems on which they run.

An Architecturally Neutral Language

One of the most significant aspects of this language is that it is tied neither directly nor indirectly to any particular computer hardware architecture. Thus, aspects of the language do not require knowledge of, nor depend on, the underlying hardware or operating system.

A Portable Language

The other most significant aspect of the language is that programs written in the Java language and *compiled* for the Java environment (into a neutral format called *bytecode* and stored in class files) can be brought to virtually any modern computing environment and should be able to run with no modifications (see Figure). Thus, a Java program written on a Macintosh system to display graphics on a Web page can be compiled there, and the compiled class file can be loaded to a UNIX system or a Windows 95 environment and run *without any modifications*. In the software engineering world where application developers toil, this is a tremendously useful feature, allowing a programmer to write a Java program *once*, after which it can be deployed on virtually all computing environments. Gone are the days of writing only for Windows, Mac, UNIX—or even IBM's MVS or DIGITAL's OpenVMS. "Write once, run everywhere" is *nearly* a reality with Java.

A Multi-Threaded Language

This facility ties in well with the growth of distributed, client/server, and Web-based programs. Thread support (allowing a single program to have several "threads" of execution that seem to occur simultaneously) dramatically simplifies the efficient programming of many server-based applications.

Not Yet Nirvana

Despite all that has been said here, Java in no way is a perfect solution for software developers. Language-definition immaturity and future evolution, as well as generally slow performance, are reasons to be restrained about Java. In addition, language standardization and competition within the computer industry are unknowns for Java. Finally, the goal of platform independence for Java is being threatened by the ongoing Sun-Microsoft skirmishes making headlines regularly.

Programs written in the Java language and then compiled for the Java environment... can be brought to virtually any modern computing environment and should be able to run with no modifications.

Summary

Java is a major industry phenomenon characterized by simpler programming and more universal availability of applications to the users of software packages. Its platform independence and object-oriented capabilities permit developers to "write once and run everywhere." This affords users greater choice of quality software wherever they wish run their applications. ✳

Integrated Approach to Year 2000 Preparedness

DIGITAL has instituted a corporate-wide response to in-house and customer Year 2000 issues.

By Steve Coughlan, Corporate Year 2000 Program, Nashua, New Hampshire

Steve.Coughlan@digital.com

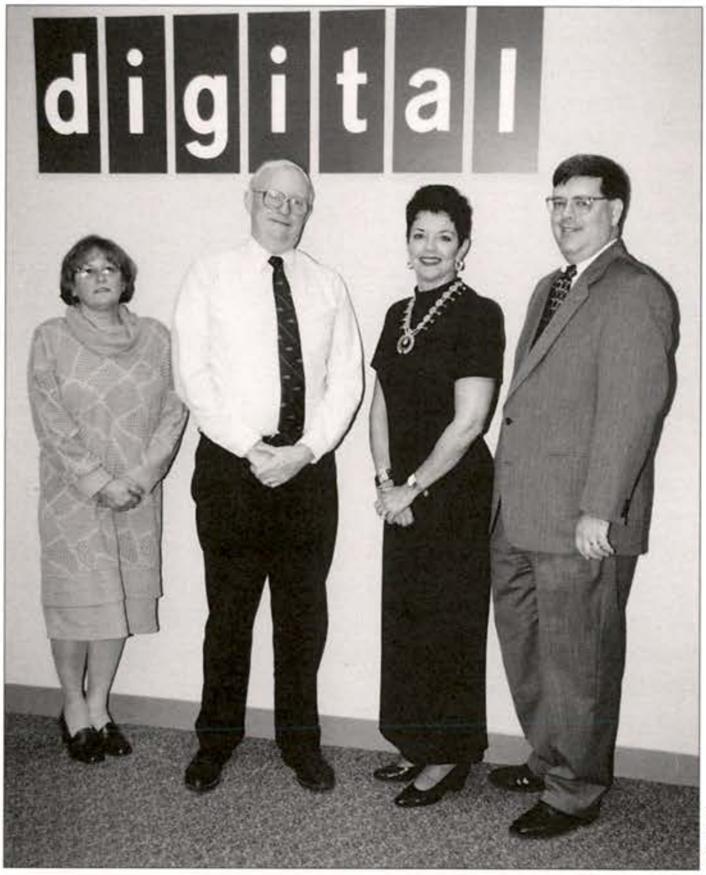
The year 2000 is rapidly approaching. As of January 1, 1998, only 730 days will remain to solve a subtle problem that is easy to describe, but difficult to mitigate. On December 31, 1999, celebrations tinged with nostalgia will mark the milestone globally. But, for the computer industry and its clients—comprising hundreds of thousands of private citizens, businesses, organizations, and governments, the moment of truth will have arrived.

Wherever a hardware device, operating system, development tool, or application programmer uses only two digits to represent the year without including the century, there will be a major problem. At best, the system will indicate errors and fail to function. At worst, it will merrily continue to process, taking incorrect actions with no warning—until the consequences are felt!

In fact, some industries that use applications projecting 3 years or more into the future have already encountered these mix-ups firsthand. Unfortunately, the vast majority of core business systems fundamental to the world economy have not logically encountered a date after 31 December 1999. Not yet.

A Historical Perspective

The roots of the problem are in the history of the computing industry. Originally, data records were constrained to fit in an 80-column Hollerith card, and system memory for an operating system and its applications was 64 KB. Simplified assumptions and reduced data elements were welcome.



D. Willett

The Corporate Year 2000 Program Office: from left, Jackie Corbett, Bob Price, Caryl Sullivan, and Steve Coughlan, director

However, when dates are ambiguous, all data processing that depends on them is suspect and, more likely, incorrect. When the output from a company's core data processing and networking infrastructure is suspect or unavailable, the reliability of computing functions at all levels is imperiled.

At the Heart of the Issue

DIGITAL and other large IT vendors are at the heart of the problem. Relying on computer systems to manage all aspects of its business, DIGITAL is not immune to Year 2000 problems. In addition, an installed base of customers relies on DIGITAL for advice on the status of products previously bought from DIGITAL and future purchases, as well as to identify risks and mitigate exposure to the hazards of noncompliance.

The DIGITAL approach to Year 2000 is company-wide. Critical dependencies exist in all divisions and functions, as the corporation prepares itself, the installed customer base, and target customers for the turn of the century.

Corporate Year 2000 Program Office

The Corporate Year 2000 (Y2K) Program Office, directed by Sam Fuller, vice president of Corporate Technology Strategy and Services and chief scientist, has jump-started the Year 2000 efforts by integrating the work of the Product, Services, and Sales and Marketing divisions as well as corporate functions such as Information Systems (IS). When collaborating with individuals throughout DIGITAL, Y2K staff members promote proactive steps at the organizational level. Solving the Year 2000 problem may actually present new business opportunities for DIGITAL!

Internal Information Systems

Hundreds of applications used within DIGITAL, numbering in the tens of thousands of individual modules worldwide, have been catalogued and prioritized. A major program to assess and convert all business-critical applications is under way, directed by Dick Scarborough, vice president of the IS Y2K Program.

Current Products

The Products Division has set a goal that products shipped after January 1, 1998, will be "Year 2000 Warranted." (See the URL at the end of this article to read the complete warranty.) This requires assessing the date-handling aspects of each product, communicating its status to sales and customers, and then resolving relevant issues or retiring the product. This effort is being led by Joellen Samojla, Products Division Y2K program manager.

Maintenance Mode Products

Multivendor Customer Services (MCS) is providing similar information and taking action for products no longer actively sold but still serviced by DIGITAL. MCS is also crafting product upgrade services to help prepare our installed base for Year 2000. John Hogan, Worldwide Software Product Service manager, is leading the MCS effort.

Services

The fast-approaching Year 2000 deadline provides a tremendous opportunity for services, ranging from assessment to tools-based application remediation, project management, and testing. DIGITAL Services has set up Expertise Centers around the world to provide these capabilities, and is serving the DIGITAL IS organization as well. Leading this effort is Donna Harrington of DIGITAL Network and Systems Integration Services Cross Industries Application Practice.

Sales and Marketing

The installed base of customers is looking to DIGITAL for Year 2000 preparedness information, thus creating an opportunity for a fresh look at DIGITAL. Year 2000 assessment and implementation will consume incremental CPU cycles, vast quantities of storage, and consulting expertise that does not exist in-house in most businesses. These and other opportunities are being addressed through the Y2K Solution Sets. The DIGITAL worldwide Sales and Marketing strategy for the Year 2000 is led by Sherrie Konkus, vice president, Y2K Solutions Marketing.

Standards

The Year 2000 challenge is caused, in part, by inadequate standards throughout the computer industry's history. Although it is too late to cure the problem through standards, it is certainly appropriate to set effective future standards. DIGITAL is actively participating in the IEEE standards process and influencing the software industry through a leadership position in ITAA, a leading software-industry trade association. Rex Lint from the Industry Standards and Consortia group leads this effort.

Time marches inexorably towards the last second of 1999. Each of us should look at his or her direct responsibilities and ask: "Are the systems I produce ready?" "Are the systems I depend on to do my job ready?" And, most disconcerting of all because we have so little control over them: "Are the other organizations I depend on going to be ready?"

If you can't answer these questions in the affirmative, check with the person in your organization who is responsible for Year 2000 readiness. ✳

web *sites*

internet
http://www.software.digital.com/year2000/
Find out about DIGITAL Year 2000 products and services.

internet
http://www.software.digital.com/year2000/y2k_isa2.htm
Read the complete warranty for "Year 2000 Warranted" products.

Sharpening Y2K Skills on Home Territory

By addressing the myriad needs of the parent corporation, the DIGITAL Network and Systems Integration Services group is accumulating hands-on experience to ensure that all its clients can adeptly avoid the Year 2000 gremlins.

By Joe Quigley, Information Systems Year 2000 Program, Littleton, Massachusetts

Most major corporations find themselves in the midst of the Year 2000 challenge. In fact, the Gartner Group, an IT advisory service, estimates that 90 percent of business applications will fail by the year 1999 without corrective measures.

Facing this common dilemma are organizations as diverse as Bankers Trust, the Irish Department of Social Welfare, ABN/AMRO (the Netherlands' largest bank), Philip Morris in Munich, Toys R Us, and DIGITAL itself. All have selected DIGITAL Network and Systems Integration Services (NSIS) to supply critical Year 2000 services.

Aiding the Corporate Y2K Compliancy Efforts

Yes, DIGITAL has actually hired NSIS, one of its own groups, to aid the Information Services (IS) Year 2000 (Y2K) Program Office, which is responsible for ensuring that all internal business systems and applications operate correctly in the year 2000 and beyond. As part of its large services portfolio, NSIS assesses Y2K needs and implements solutions for external clients. The IS Y2K Program Office has contracted with NSIS to provide similar Y2K services for the DIGITAL Americas Territory, where the greatest concentration of applications exists. Does this approach make sense?

D. Willett

From left, Yat Man Wong, Mg Raghavan, Bob Baafi, Aurelie Teebagy, and Ahmad Khashan of the Network Systems Integration Services Internal Year 2000 Project.

According to Nick Sharma, vice president of NSIS East Territory, "Our Year 2000 relationship with the IS Y2K program creates the perfect business scenario for DIGITAL. By helping the corporation meet its Year 2000 goals, we gain valuable experience for dealing with customers who have Y2K projects. When a prospective customer asks if we have had Year 2000 experience, we can answer with a resounding 'Yes!' We become the vendor of choice. In effect, DIGITAL is our largest customer."

Facing Y2K conversion issues for hundreds of business applications, DIGITAL is indeed a large customer.

"During planning, we had to decide how to staff this massive, worldwide project," recalls Dick Scarborough, vice president of the IS Y2K program. "NSIS was the obvious choice for the Americas due to its experience with large technology projects such as customer implementations of Microsoft Exchange. NSIS is now fully integrated with the IS Y2K team, and implementation of our conversion effort is well under way."

Expertise Applicable to Long-term Services Business

The IS–NSIS relationship creates a winning edge for DIGITAL. "We've teamed up with the IS Y2K group to create and use the best methodologies, processes, and tools, creating an organization to handle Y2K conversion issues on a huge scale," Sharma adds.

DIGITAL Network and Systems Integration Services: A Partial List of Y2K Clients

Citibank

British Gas

British Aerospace

Bankers Trust

Swiss Telecom

National Civil Aviation Department (Spain)

Optus

Australian Stock Exchange

Bank of Ireland

LTV Steel

City Financial Product Ltd.

Aramark Uniforms

Reuters

BRTN

Toys R Us

Bankers Trust (UK)

British Petroleum

Courtaulds

Hydro Electric

Australia Post

TransAlta

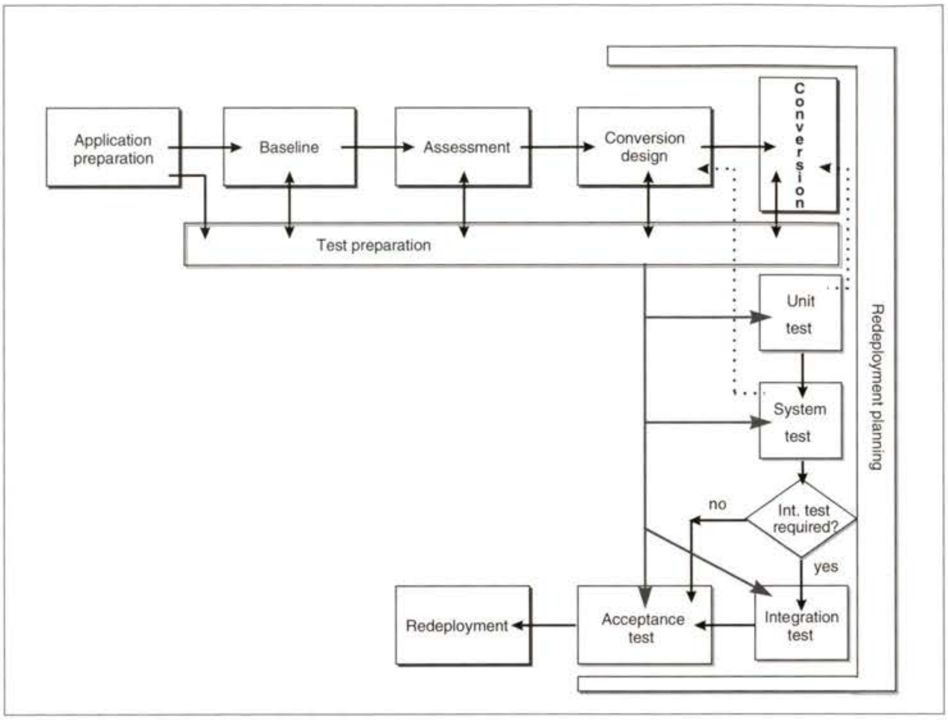
National Power

Siemens

AT&T (UK)

Bank of Scotland

Glaxo ✳



The Year 2000 process

"DIGITAL derives other, less obvious advantages," he continues. "NSIS plans to increase its revenue substantially by the year 2000 and will need additional skilled personnel to meet its goals. As Y2K work winds down, we will transfer these trained team members to new customer projects. Customers will benefit greatly from their technological skill." ✳

By helping the corporation meet its Year 2000 goals, NSIS gains invaluable experience for dealings with customers who have Y2K projects.

'Smart Kiosk' Greets Visitors to Cambridge 'Cybercafé'

A visitor to the Cybersmith Café in Cambridge, Massachusetts, laughs along with "NetHead Red," the feisty, wise-cracking "cyberpersonality" residing in the DIGITAL smart kiosk. The aim of the smart kiosk is to overcome the barriers that separate people and computers—keyboards, mice, and even the need to read.

In early September, researchers from the DIGITAL Cambridge Research Laboratory installed the first "smart kiosk" for public testing at the Cybersmith Café in Cambridge, Massachusetts.

Conventional electronic information kiosks—repositories of information that can be retrieved by users—are often seen as unapproachable and unfriendly. Users must touch them to activate them. In contrast, the DIGITAL smart kiosk, powered by twin AlphaStation 500/400 workstations, uses advances in vision recognition to sense the presence of an approaching user, facial animation and synthetic speech to greet and engage the user in scripted conversations, and Internet technology to provide information.

A key component of the DIGITAL smart kiosk is DECface software technology, a real-time, customizable, synthetic "talking head" which synchronizes facial expressions and lip movements to computer-generated speech or prerecorded audio files. By emulating the major muscles of the face and eyes, DECface generates expressions of human emotion, including six universally recognizable human expressions—happiness, sadness, surprise, anger, disgust, and fear.

For the kiosk user, DECface provides a focus of attention, a narrator for what is shown on the screen, and a prompter for action or help. A machine-vision tracking system allows the smart-kiosk character to "see" people as they approach, track them with eye and head movements, and initiate verbal contact. The technology can even determine if a potential contact is just passing by or has slowed enough to show interest.

Stop by the Cybersmith Café in Harvard Square, Cambridge, through January 1998 for a chat with "Nethead Red," the customized "cyberpersonality" created by the Cybersmith staff. Look for a more-detailed article on the technology behind the kiosk project in an upcoming issue of *Forefront.* ✳

web *site*

internet
http://www.crl.dec.com/projects/kiosk
Read more about the DIGITAL smart kiosk.

DIGITAL Employees Day at the Computer Museum

If your spouse, parents, or kids *really* want to understand the workings of a computer, head for the Boston waterfront and the Computer Museum where you can conduct your own walking tour of the "inside" of a PC! In mid-September, that's what 350 DIGITAL employees did on DIGITAL Employees Day, when flashing a DEC badge admitted families to the museum free of charge.

Yesterday's Junk, Today's Treasure

The corporation's association with the Computer Museum extends back to 1974 when former DIGITAL President Ken Olsen helped retrieve the MIT Whirlwind computer from the junk pile. (The Whirlwind was the first real-time, parallel, vacuum-tube computer with a core memory.) By 1979, DIGITAL had opened the world's first computer museum—housed at the Marlborough facility—to hold the ever-expanding collection. In 1982, the museum became an independent, nonprofit organization serving the entire computer industry and, in 1983, moved to its present Museum Wharf location in downtown Boston.

Old and New Computers in Action

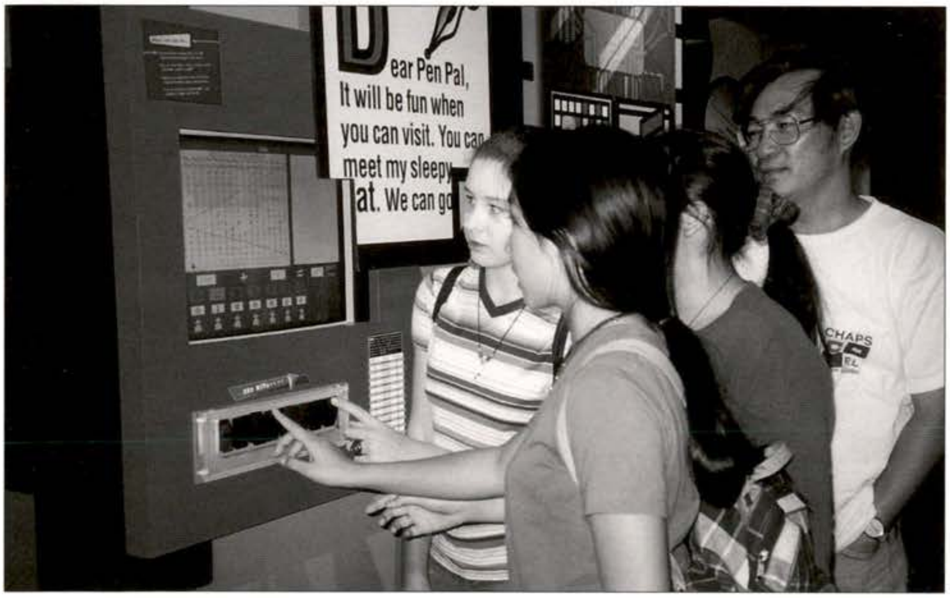
More than 110 donated computers keep the museum's 160 interactive exhibits running for visitors. Although the museum boasts a state-of-the-art video-editing suite and has received National Science Foundation funding to create an interactive Web site (www.tcm.org), vintage computers also are used to store still and moving images in databases as part of the museum's archiving process.

Photos: B. Magura

Above, perched atop the Walkthough Computer's keyboard, Kevin McKaig of Multivendor Customer Services' Eastern States Service Center Business poses with wife Demetria and children, Rachel, 7, Elias, 2, and Connor, 6.

At left, Kevin Dooley, a manufacturing engineering manager with Manufacturing Technology Systems Assembly, took his children, Ryan, 7, and Laura, 9, and their friend to the museum while his wife was studying at home.

Voice synthesis enraptures daughter Aimee as dad Michael LaFond, Personal System Group, activates the demonstration while mom Gretchen Booth looks on.



Market Wu, a principal test engineer at Digital Semiconductor, watches as daughters Regina and Olivia and a friend learn about mapping of the computer keyboard to the ASCII coding standard.

Museum outreach programs include satellite "computer clubhouses" that have enabled hundreds of inner-city youths to use powerful computer tools.

West Coast Museum Connection

A large part of the museum's collection is accessible at the Computer Museum History Center in Silicon Valley. If you wish to visit the site at Moffett Field in Mountain View, California, send an email request to collections@tcm.org. ✳

Consulting Engineer Review Process Worth the Effort

By Peter van Roekens, vice president, Multivendor Systems Engineering, Multivendor Customer Services Product Management & Development, Littleton, Massachusetts

As the DIGITAL Services Division (DSD) representative on the corporate Consulting Engineer Review Board (CERB), I know firsthand what a great opportunity this process offers both individual engineers and DSD management.

Benefits of Promotion

For members of the DSD engineering community, promotion to consulting engineer is a major career step—recognition of demonstrated leadership, innovation, and technical excellence. Promotion brings corporate-wide recognition, membership in the most respected technical community within DIGITAL, and an opportunity to learn and grow further through contacts within this select, cross-organizational peer group.

For DSD managers, identifying and grooming candidates for promotion to consulting engineer helps the division and DIGITAL maintain a "critical mass" of top technical talent. Encouraging and recognizing excellence within the DSD engineering ranks helps meet our pressing need for superior technical expertise as our customers' computing problems and information systems become increasingly complex. Growing, recognizing, and rewarding our most talented engineers is one of the best ways to motivate and retain them.

Customized Technical Training Programs

CERB guidelines can be used to design technical training programs for talented engineers who need more preparation. As Peter Mercury, vice president and general manager, Multivendor Customer Services Business Unit, wrote in a memo about technical training last December: "Technical training is...one of the keys to revenue growth, a more profitable mix of business, differentiation in the marketplace, and the ability to meet the mission-critical needs of our customers. Our people need to be on the leading edge. . . . "

Steps in the Process

The promotion process is rigorous and requires thoughtful work by both candidate and nominating manager. Candidates must be presented to a pre-review board, chaired for DSD by Mark Sullivan of MSE. If they pass the pre-board requirements, then I will support them at CERB deliberations when their nomination packages are reviewed and their suitability for promotion is put to a vote. It's all worth the effort!

Just a few weeks ago, Andy Padla and DeWight Whitehorn of MCS PM&D were promoted to consulting engineer (see p. 32–33 in this issue of *Forefront*). I was delighted to report their promotion to their management chain: Dino Genova, George Kauffman, and Jean Hoxie-Wasko, PM&D vice president.

Look for an upcoming *Forefront* article about the CERB promotion process and its role in DSD technical talent development, recognition, and retention. ✳

web*site*

intranet
http://www-server.mso.dec.com/hr/cerb/cerb_process.htm
Find details about the CERB process.

Get There Quickly!

Log on to the intranet edition of *Forefront* for fast navigation to embedded hot links found throughout the magazine.

http://www-server.mso.dec.com/forefront/index.html

***Forefront* Welcomes Your Contributions!**

Article submission deadlines for upcoming *Forefront* issues are as follows:

Spring issue: January 1, 1998

Summer issue: April 1, 1998

Fall issue: July 1, 1998

Winter Issue: October 1, 1998

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Forefront

A magazine for the technical community

Spring 1998

DIGITAL Technical Excellence Awards:

Rawhide Team Corrals Top Awards

HIGHLIGHTS

- Engineering Summit '97
- 'Smart Kiosk' Talks Back
- Delivering Indexed Audio and Video on the Web
- Engineering Promotions
- Patent Awards

Message from the Editors

Formerly in this space, Sam Fuller has provided a message for *Forefront* readers. As many of you know, Sam, vice president of Corporate Technology Strategy and Services and chief scientist, recently resigned from DIGITAL. We, therefore, take this opportunity to recognize and thank Sam for his many contributions to the company and, in particular, to the technical community of which we're a part.

Sam came to DIGITAL in 1978 as the engineering manager for the VAX Architecture Group and, in 1980, began the work of building a research organization for DIGITAL, including joint research programs with universities. Sam brought some of the most talented engineers and computer scientists to DIGITAL during this time. Always cognizant of the power of communicating important engineering work, he also established the *Digital Technical Journal* in 1985.

In recent years, he led the company's work on technical strategy and helped build a sense of cooperation and collaboration across the technical community. The Engineering Summit '97 and the Technical Excellence Awards—featured in this issue of *Forefront*—are examples of the ways in which Sam has fostered communication and recognition across the community; another, briefly noted in this issue as well, was his position as chair of the Consulting Engineer Review Board.

Sam is a member of the board of directors of the Corporation for National Research Initiatives, Analog Devices, Inc., and Inso Corporation. He has been DIGITAL's representative on the Computer Systems Policy Project Chief Technologists Committee. He is currently serving as chair of the National Research Council (NRC) study on research and development investments in information technology, has participated in the NRC study on national cryptographic policy, and was a founding member of the NRC Computer Science and Telecommunications Board. During his years at DIGITAL, Sam was elected to the National Academy of Engineering, and was named a fellow of both the IEEE and the AAAS. Sam also serves as a member of the advisory councils of Cornell University, Stanford University, and the University of Michigan.

We wish him well in his newest adventures in computing. We will miss him.

—The Editors

Spring 1998 Issue

Forefront magazine is a forum for the worldwide DIGITAL technical community to share information, technology and strategic directions, and key accomplishments.

Forefront welcomes contributions of interest to the DIGITAL technical community. The submission deadline for the Q498 edition is April 1, 1998. Contact Managing Editor Dick Willett for information.

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IN THIS ISSUE

On the Cover
Winners of the Chairman's Award for Technical Achievement, Darrel D. Donaldson, and the Engineering Team Award, the Rawhide Development team, were announced at a banquet in January. See story beginning on p. 2.

DIGITAL Technical Excellence Awards

Outstanding technical achievements were in the spotlight on January 5, when top engineering talent and senior management honored Technical Excellence Awards nominees and cumulative Patent Award recipients.

By Sharon Lipp, Corporate Strategic Functions, Acton, Massachusetts

The grandeur of the Fairmont Copley Plaza in downtown Boston was the setting for DIGITAL's tribute to finalists for the Chairman's Award for Technical Achievement and the Engineering Team Award, and the recipients of the Cumulative Patent Awards. More than 250 of DIGITAL's top engineering talent and senior management assembled at this annual event to hear the announcement of the 1997 winners of these prestigious awards.

Sam Fuller, vice president, Corporate Technology Strategy and Services, and chief scientist, welcomes everyone to the awards banquet

Bob Palmer, chairman of the board, president, and chief executive officer, delivers the keynote address.

Photos: Monty Abbott Photography

Significance of the Awards

The Chairman's Award for Technical Achievement is the highest award any individual can receive from DIGITAL for a technical contribution, whereas the Engineering Team Award is the highest technical achievement award any group of individuals can receive. The Cumulative Patent Awards recognize the importance of patents to DIGITAL's leadership in technology and recognizes employees for their contributions to the DIGITAL patent portfolio.

Sam Fuller, vice president of Corporate Technology Strategy and Services and chief scientist, welcomed everyone and initiated the evening's proceedings after a convivial reception and dinner. "Many key contributions are needed to deliver a successful product or service to our customers," he said. "These awards focus on the individuals and teams whose achievements have enabled DIGITAL to offer a product or service superior to our competition."

Chronology of Banquet Events

After welcoming the members of the Executive Committee, Sam introduced Bob Palmer, chairman of the board, president, and chief executive officer, who gave the keynote address. Bob's remarks reflected his pride in the engineering community and its contributions to DIGITAL. "This event gives me the opportunity to recognize the technical excellence and the innovation that is the life blood of the company," he said. "Since its founding over 40 years ago, DIGITAL has stood for excellence in technology."

Bob also underscored DIGITAL's continuing commitment to invest in research and development. He congratulated the award nominees and noted the difficult task of selecting finalists and winners. Bob ended his speech with a personal commitment to ensure that members of the engineering community have the tools they need, the recognition they deserve, and the opportunity to make their work and DIGITAL more successful.

Bob Palmer presents a pin to Bill Strecker, senior vice president of Corporate Strategy and Technology and chief technical officer, signifying 15 patents issued.

Bob then presented Bill Strecker, senior vice president of the Corporate Strategy and Technology Group and chief technical officer, with a gold lapel pin to denote his achievement of 15 patents issued. Bill then offered a few remarks about the importance of patents to DIGITAL. "Patents are a key element of DIGITAL's strategic management of both its technology and its business," he commented. Bill explained that patents protect DIGITAL's revenue and market positions, as well as enable favorable transactions with partners, and, when appropriate, aggressive actions against competitors. Bill encouraged the technical community to aggressively file new disclosures because "patents have been a key contributor to DIGITAL's past successes and are essential to DIGITAL's future successes as a high technology business."

Following Bill's remarks, Tom Gannon, director of Corporate Technical and Information Services and chairman of the Corporate Patent Committee, introduced the Cumulative Patent Award recipients. Bill and Sam presented to each inventor a gold lapel pin studded with a sapphire for 10 patents, a ruby for 15, and a diamond for 20, respectively. Inventors who have achieved significant cumulative patent application milestones received certificates. In short videos, recipients of the awards for 15 and 20 patents issued—Michael Romm (15), Simon Steely (15), and Rich Witek (20)—talked about their inventions and the value of intellectual property to DIGITAL.

Excellence Awards

DIGITAL
Technical
Excellence
Awards

Turning his attention to the finalists for the Chairman's Award and the Team Award, Sam spoke briefly about their accomplishments, after which a video showing the finalists talking about their projects was projected on the ballroom's two large screens. As the video faded to music and the audience applause rose, Sam asked the finalists to join him and Bill on the stage to receive their awards. (For profiles of the finalists, see *Forefront,* Winter 1997–98, pp. 2–13.)

Rawhide Wins Big

The excitement grew as Sam requested the envelope containing the name of the winner of the Engineering Team Award: the Rawhide Development Team. Five representatives of the team accepted the award on behalf of the 96-member team. (See the accompanying list of team members on p. 5.)

Bob Palmer then came forward to announce the winner of the Chairman's Award for Technical Achievement: Darrel Donaldson, Rawhide system architect. As Darrel went to the stage, a video clip highlighting his project was shown. Bob then presented Darrel with a crystal sculpture.

As the festivities came to a close, the atmosphere in the room was exuberant, as many banquet guests waited to personally congratulate inventors, finalists, and winners. What an exciting night for DIGITAL engineering! ✳

Darrel Donaldson Wins Chairman's Award for Technical Achievement

Darrel Donaldson is a hardware engineering senior consultant and Rawhide system architect. Darrel has demonstrated outstanding technical leadership during 14 years at DIGITAL, making outstanding contributions in the areas of protocols, signal integrity, chip transceiver design for multiprocessor systems and non-volatile memory chip design. As the system architect and team leader of the Rawhide project, he championed Rawhide's innovative design and the project's unconventional development approach, exhibiting creativity, technical astuteness, and perseverance. About 6 months after power-on of the first prototype, DIGITAL began shipping the AlphaServer 4100 and 4000 family of products running NT, DIGITAL UNIX and OpenVMS. As Darrel, who had assembled a large, cross-organizational team, explained it: "If you have a team of people who can work together, they get a lot done...you can't do something in 6 months if you can't work together." By June 1997, DIGITAL had shipped more than 11,000 sytems, generating over $800 million in revenue. ✳

Bob Palmer presents the Chairman's Award for Technical Achievement to Darrel Donaldson. From left: Sam Fuller, Bob Palmer, Darrel Donaldson, and Bill Strecker.

chairman's
award

Bill Strecker, third from right, with representatives of the Rawhide Development team, winner of the Engineering Team Award: from left, Ed Gent, Stephen Lindquist, Glenn Herdeg, Maurice Steinman, and Sam Duncan

team engineering

Rawhide Team Wins Engineering Team Award

The 96-member Rawhide Development team demonstrated hard work, cohesiveness, and steadfastness. Masood Heydari, vice president of AlphaServer Platform Development group, explained: "I saw the team go far beyond the call of duty to commit to and subsequently meet the most aggressive schedules. The team's collaborative development is one to replicate elsewhere." The Rawhide Development team achieved power-on to FRS in a record 6.5 months, compared to a previous best of about 12 months for this class of product.

Key to the Rawhide team's success was its commitment to developing product requirements based solely on customer needs by using a process called "concept engineering." The team created a roadmap of products for the Rawhide family—the AlphaServer 4x00 family. "From the beginning, team members listened carefully to customers, conducted customer interviews, and methodically translated what they learned into product requirements," recalled Heydari. "The Rawhide engineering team stands out as one of the most exceptional teams I have ever worked with."

"We all knew that we had something very special on this team, and I'm really honored that the corporation is taking the time to acknowledge it as well," said team member Maurice Steinman. Ed Gent, stated it this way: "It's a team thing. No single individual stands out. It's absolutely the team."

The Rawhide Development team

Michael J. Aho, Bruce L. Alford, Walter D. Arbo, Robert W. Astapoveh, Dennis T. Bak, Jean H. Basmaji, David V. Bateman, Richard C. Beaven, Anthony Bento, William M. Blodgett, Margaret-Ann K. Bolton, William K. Braucher, Colin E. Brench, William S. Briggs, Matthew D. Buchman, Daniel L. Callahan, David A. Carlson, Norberto Collado, Harold F. Cullison, Paul J. Curran, Zarka Cvetanovic, Roger A. Dame, Subhash R. Dandage, Todd H. Davis, Mark A. DeAmicis, Richard P. Devlin, Darrel D. Donaldson, John H. Drasher, Linda M. Dube, Samuel H. Duncan, Donald G. Dutile, Michael S. Fein, Douglas D. Field, Arina Finkelstein, Richard C. Freiss, Joan Gale, Kevin J. Gamache, Frank W. Gatulis, Edward W. Gent, William B. Gist, Linda T. Greska, Robert A. Guenther, Paul M. Guglielmi, Walter L. Hamel, Robert L. Hanson, George J. Harris, Ann Harrold, Dennis F. Hayes, Leonard P. Haywood, Glenn A. Herdeg, Carol A. Hester, Barbara R. Hood, Jeffrey A. Huber, Russell B. Iknaian, Dale R. Keck, Craig D. Keefer, John A. Kennedy, Oleg Klimowicz, Andrej Kocev, Herbert R. Kolk, Andrew P. Koning, Dmetro Kormeluk, Virginia C. Lamere, John C. Lawrence, Kevin J. Lemieux, Stephen E. Lindquist, Dennis M. Litwinetz, Bryan S. Locke, John J. Lynch, David T. Mayo, Robert R. McClain, John K. Nee, Bonnie G. Oliver, Richard E. Olson, Roger D. Pannell, Norman W. Plante, Traci W. Post, Christopher L. Reed, Kathe Rhoades, Douglas J. Richard, James F. Rosencrans, Eduard Rozman, Brian Sanborn, Mary A. Sartori, Joseph L. Scala, Arthur L. Singer, Terrence R. Skrypek, Donald W. Smelser , James F. Staples, Mark L. Stefanski, Maurice B. Steinman, John E. Stevens, Michael J. Thomas, Farhad F. Touserkani, Elizabeth A. Tyson, Daniel Wissell *

cumulative patent awards

Cumulative Patent Awards

The Cumulative Patent Awards recognize DIGITAL inventors who have contributed significantly to the corporate patent portfolio. This year 35 individuals were recognized.

Twenty patents issued

DIGITAL Semiconductor: *Richard Witek.* Only the fifth DIGITAL engineer to achieve this patent milestone, Rich also received a "Patent Hall of Fame" plaque listing his 20 patents.

Fifteen patents issued

Corporate Strategy and Technology: *William Strecker.* Network Product Business Unit: *Michael Romm.* UNIX and OpenVMS Systems Business Unit: *Simon Steely.*

Ten patents issued

Corporate Strategy and Technology: *Robert Ulichney.* DIGITAL Semiconductor: *Simoni Ben-Michael.* Storage Systems Business Unit: *David Thiel.* UNIX and OpenVMS Systems Business Unit: *Wayne Cardoza, David Hartwell, John Lynch, Barry Maskas, Simon Steely, Kurt Thaller.*

Five patents issued

Computer Special Systems: *John Lenthall.* DIGITAL Semiconductor: *Peter Bannon, Simoni Ben-Michael, Steven Butler, John Edmondson, Geoffrey Lowney, Edward McLellan, Gilbert Wolrich.* Multivendor Customer Services Business Unit: *Peter Anick.* Network Product Business Unit: *Michael Shand, Andrew Walton.* UNIX and OpenVMS Systems Business Unit: *Thomas Benson, Denis Foley, Steven Hobbs, Andrew Mason, Lawrence Palmer, Ricky Palmer, Nicholas Warchol, Daniel Wissell.*

Twenty patent applications

Corporate Strategy and Technology: *Mike Burrows.* DIGITAL Semiconductor: *Simoni Ben-Michael, Robert Rose.* Network Product Business Unit: *Michael Romm.*

Ten patent applications

Corporate Strategy and Technology: *Andrew Birrell, Edward Wobber.* DIGITAL Semiconductor: *Matthew Adiletta, Edward McLellan, William Wheeler.* Network Product Business Unit: *Anna Charny, Jerry Hutchison.* Windows NT Systems Business Unit: *Robert Frame.* ✳

Sam Fuller, at left, and Bill Strecker, far right, with some recipients of awards for 20 patent applications. From left: Simoni Ben-Michael, Robert Rose, and Michael Romm.

Matthew Adiletta, recipient of an award for 10 patent applications, with Bill Strecker

Andrew Birrell, recipient of an award for 10 patent applications, with Sam Fuller

Anna Charny, recipient of an award for 10 patent applications

Sam Fuller, at left, and Bill Strecker, at right, with some recipients of awards for five patent applications. From left: Geoff Lowney, Simoni Ben-Michael, Peter Anick, Ed Caldwell, and Peter Bannon.

Sam Fuller, at left, and Bill Strecker, at right, with some recipients of awards for five patent applications. From left: Ricky Palmer, Larry Palmer, Andrew Mason, Tom Benson, Dan Wissell, Steve Hobbs, Mike Shand, and Andrew Walton.

Ted Wobber, recipient of an award for 10 patent applications, with Bill Strecker.

Sam Fuller, far left, and Bill Strecker, far right, with some recipients of 10 patent applications. From left: Wayne Cardoza, Dave Thiel, Simoni Ben-Michael, Dave Hartwell, Kurt Thaller, and Bob Ulichney.

From left, Sam Fuller with recipients of awards for 15 patents issued: Michael Romm and Bill Strecker.

Rich Witek, left, received an award for 20 patents issued from Bill Strecker.

awards finalists

Bill Strecker, far right, and FX!32 Development team members, from left, Steve Tye, Tom Evans, Anton Chernoff, Mark Herdeg, and Ray Hookway

Bill Strecker, third from left, with DIGITAL HiNote Ultra 2000 team members, from left, Richard Hennessy, Premanand Sakarda, Rob Frame, Mike Maddix, and Scott Pirdy

DIGITAL Visual Fortran team members. Seated, from left: Cynthia Huang, Terry Grieb, and Carol Davidson. Second row: Kathy Appellof, Jesse Lipcon (vice president, Systems Business Group), Larry Weissman, and Deb Canova. Back row: Bill Hilliard, Bill Blake, Marion Dancy, Mike Etzel, Joel Clinkenbeard, William Youngs, and Harry Copperman (senior vice president and general manager of the Products Division).

At far right, Harry Copperman, senior vice president and general manager of the Products Division, and Jesse Lipcon, vice president, Systems Business Group with DIGITAL UNIX TruCluster V1.0 team members. From right, seated: Ray Chibbaro, Brian Stevens, Bill Snaman. Standing, from left: Kent Ferson, Hai Huang, Mitch Condylis, Joe Pepicelli, Mark Longo, Joe Amato, and Wayne Cardoza.

Finalist Rich Witek, senior corporate consulting engineer and StrongARM Architecture Team leader, with Bill Strecker, left, and Sam Fuller, right

From left, finalist Stan Foster, Information Systems consultant and messaging architect, with Bill Strecker

Finalist Hugh Wilkinson, consulting software engineer and VNswitch product architect, with Tom Gannon, center, and Bill Strecker, right

From left, finalist Richard Kaufmann, High Performance Computing technical director, with Tom Gannon and Bill Strecker

web *sites*

intranet

http://www-server.mso.dec.com/awards/home.htm
General information about the DIGITAL Technical Excellence Awards

http://www-server.mso.dec.com/awards/winners.htm
Read more about the winners of the Technical Excellence Awards.

http://www-corporate.ecom.dec.com/forefront/97winter/
Profiles of the five nominated engineering teams

Nomination Committee. From left, Bill Laing, corporate consultant; and vice presidents Sam Fuller, Jesse Lipcon, and Mahendra Patel. Not shown: vice presidents Rich Hollingsworth, Jean Hoxie-Wasko, and Jim Kuenzel.

Planning Committee. Donna Berard, Bob Reed, Sharon Lipp, Tom Gannon, Sharon Henderson, and Jon Braley

Nomination Process

A six-member advisory board, appointed by Sam Fuller, reviews nominations and selects finalists for the Chairman's Award and the Engineering Team Award. This year's board members were vice presidents Rich Hollingsworth, Jean Hoxie-Wasko, Jim Kuenzel, Jesse Lipcon, Mahendra Patel, and Bill Laing, corporate consultant. After the board reviewed nomination packages submitted in late September 1997, their recommendations were reported to Bob Palmer.

The board based its evaluations on two major criteria: technical achievement, and business impact and value to customers. Many contributions are needed to deliver successful products and services to DIGITAL's customers. These awards focus on the individuals and teams whose endeavors have enabled DIGITAL to offer products and services superior to those of our competition or that have created entirely new markets. Based on these criteria, five finalists were chosen by the board for each award. ✳

Engineering Summit '97: Achieving Technology Leadership in Web-Based Enterprise Computing

In mid-December, senior members of DIGITAL's global technical community gathered to invigorate cross-organizational dialog and collaboration between product engineers and systems integration engineers in response to conjectures by networking experts and accounts of real-life customer experiences.

By Beth Magura, Corporate Technical Publications, Acton, Massachusetts

Visions of the Web's evolving universality, pragmatic descriptions of complex customer solutions, amusing anecdotes about rapid-fire user feedback, tales of mistakes that became successes, hallway chats, quips about competitors, sneak peeks of pilot technology projects, training opportunities. All were part of a 3-day "engineering summit" meeting sponsored by the Internet Business Unit (IBU) and Corporate Technology Strategy and Services (CTSS). More than 250 senior members of the DIGITAL technical community converged on the Boston University Corporate Education Center in Tyngsboro, Massachusetts, to participate.

Increased Engineering Synergism: A Threefold Goal

In his opening remarks, CTSS Vice President Sam Fuller outlined the broad goals that increased synergism among the engineering groups will enable:

- Building a common understanding and common terminology for DIGITAL's Web-based business and technology strategy
- Expanding understanding of the needs and requirements of DIGITAL customers
- Identifying a differentiating technology that will give DIGITAL a competitive advantage

Corporate Strategy and Technology Vice President Bill Strecker thanked the attendees for traveling to New England in winter to participate in activating the corporate-wide dialog to:

- Review DIGITAL's perspectives on enterprise networked computing
- Develop DIGITAL's Web platform architecture
- Discuss DIGITAL's strategy to deliver Web-based enterprise computing solutions

Fortifying professional liaisons with colleagues and striking up new associations was encouraged by Don Harbert, IBU vice president. "Let's reestablish the human networks that foster innovation."

Stimulating Thoughts: The Speakers

Provoking attendees to consider the Web-based networking world from many angles, speakers at the summit were

- ◆ Brian Reid, director, DIGITAL Network Systems Laboratory, Palo Alto, California. Topic: "Internet technology meets politics and both are stunned." (See accompanying presentation excerpts.)
- John Klensin, MCI Telecommunications. Topic: "Scaling to universal connectivity: Some user-visible issues."
- ◆ Daniel E. Geer, Jr., vice president, CertCo, coauthor of *Web Security Sourcebook: A Complete Guide to Web Security Threats and Solutions*, and vice president of USENIX. Topic: "Breaking into banks—security lessons learned in finance." (Dinner speaker at the American Textile History Museum.)
- ◆ Bill Cheswick, Internet security expert, Lucent Technologies. Topic: "Stupid net tricks."

Photos: D. Willett

Corporate Strategy and Technology Vice President Bill Strecker, left, and Corporate Technology Strategy and Services Vice President Sam Fuller greet summit attendees.

DIGITAL Solutions: Case Studies from the Field

Widely divergent customer goals led to various Network and Systems Integration Services (NSIS) approaches, which were outlined in case studies. Presentations preceded by a ◆ can be viewed in greater detail on the corporate intranet at:

http://tcdg.zko.dec.com/Presentations/index.htm

- Sri Raghavan, NSIS, with DIGITAL customer Terry Startsman, senior vice president, Interealty Corp. Topic: MISTI (Multi-Industry Search and Transaction Infrastructure): The project, the technology and prospects.
- Mike Huffaker, NSIS, with DIGITAL customer Steve Ward, vice president, Century Communications. Topic: Working with Internet service providers.
- Steve Briggs and Alex Conn, NSIS, with DIGITAL customer Ken Kostok. Topic: The Braintree Electric Light Department initiative: Use of hybrid fiber coax to provide community services (electricity, cable TV, interactive broadband, broadcasting, video on demand, and/or telecommunications).
- Chris Marshall, NSIS. Topic: Two *Washington Post* projects: Development of the '96 Election Server and implementation of the *Post*'s online edition, washingtonpost.com.
- Fabio Bagatin, senior solution architect, NSIS. Topic: The Vatican Web site: Present and future challenges. (See accompanying presentation excerpts.)

DIGITAL Products: Research Generates Web Winner

Showcasing the power of DIGITAL hardware with superior DIGITAL software resulted in an unexpected Internet winner: AltaVista.

- Louis Monier, technical director, AltaVista Search Service. Topic: An update on AltaVista. (See accompanying presentation excerpts.) ✳

Brian Reid: 'Everything Is Connected'

DIGITAL's network visionary is Brian Reid, director of the Network Systems Laboratory in Palo Alto, California. Highlights of his keynote address follow:

Four trends are converging to totally disrupt the Internet, making it more chaotic, interesting, and profitable for DIGITAL and its partners:

- Deregulation is resulting in multiple players having smaller portions of the action. Cheap wins.
- Component escalation, e.g., disks escalating to StorageWorks escalating to File Servers.
- "Everything will be connected."
- Locality matters. Internet technology is being used to do distinctly nonglobal things.

* * *

Two ubiquitous services will exist in parallel: one to deliver volts and one to deliver bits. Customers will obtain bits from an information utility operator that, in turn, will depend on a utility operator, i.e., a telco, a cable company, an ISP or some, as yet, unknown entity.

Within 24 months, in more than just a couple of countries, IP–based telephone and cable TV systems will exist in parallel with what is already in place.

* * *


Brian Reid, director of DIGITAL's Network Systems Lab

The interconnect, or gateway, is the key to success. The business of "Internetworking" deals with the phenomena surrounding gateways: a lust for power and control, a quest for allocation of blame, and minimization of cost, i.e., make it cheap. DIGITAL should be selling space near the Internet Exchange, while our customers buy servers from us to sell Internet service.

* * *

DIGITAL's place in the Internet market will be to build, to upgrade, and to diagnose while the network is still running. Integration is innovation.

* * *

The message of Silicon Valley:

- Be flexible and learn fast.
- Try it and see what happens.
- Everything is a learning opportunity. ✳

Louis Monier, technical director, AltaVista Search Service

'If you don't think and act like an Internet company, nobody wants to play with you.'

Louis Monier: On Being an Internet Company

Louis Monier is the technical director of the AltaVista Search Service. The AltaVista Web site, initiated in December 1995 solely to showcase the speed of AlphaServer systems, received 200,000 hits the day before its official introduction on the Web. Today AltaVista handles 27 million search queries each day, making it the Web's largest search service. Presentation highlights follow:

If you don't think and act like an Internet company, nobody wants to play with you.

* * *

AltaVista is the fourth largest Web site in the world, ranked behind Netscape, Microsoft, and Yahoo. AltaVista revenues have grown from zero a year ago [Q2FY97] to US$5 million in Q198.

* * *

AltaVista Lesson #1: Worship thy users

The measure of our success is the quality of each user's experience.

- Our users have made us what we are.
- Users are vocal. Weekly messages total more than a thousand—some ruthlessly unedited!
- Users cannot be modeled easily.
- User feedback helps define what to do next.

AltaVista Lesson #2: Listen to feedback

In July 1997, a new user interface was introduced. Testing consisted of 2 weeks on the DIGITAL intranet and a 1-week sneak preview on the Web. Within 12 hours, hundreds of messages were received about the bottom-of-page navigation graphic used to access the hierarchical batches of query results. Users demanded numbers on that graphic.

Lesson #3: Short engineering cycle

- Whoever is first on the Web grabs mind-share.
- The Web evolves quickly. Within 3 months, the problems will have changed, and the users will have changed.
- Introduce a bug on Monday; fix it on Tuesday. The testing environment is hard to duplicate. User feedback is hard to predict.
- There is hardly any penalty for putting something wrong on the Web.
- Nothing is ever final on the Web.

AltaVista Lesson #4: Technology is the key

Our differentiator is technology—and this will remain a dominant future focus. However, complementing AltaVista's world-class search-engine capabilities with selective partnerships to provide unique, technology-enabled services or content is also a future aim. Adding multilingual translation services is a recent example of this.

We define ourselves by our 7 × 24 technology. Our site is always up. Since August 1996, we have not been down one second.

* * *

AltaVista hardware and statistics

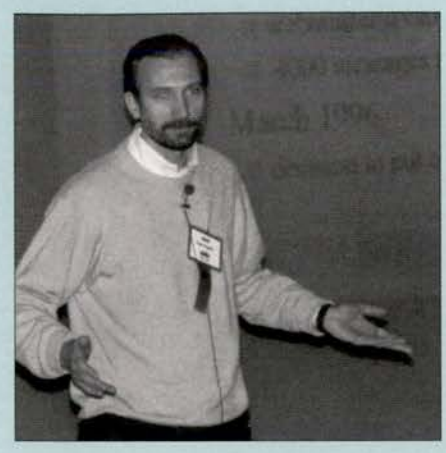
- The Crawler: One AlphaServer 4100. 10 million queries per day.
- Web Indexer: Twenty AlphaServer 8400s. 27 million queries per day.
- Front-end: Five AlphaServer 500s. A custom Web server. 63 million hits per day.

General philosophy

- Univeral access: Old browsers die slowly. (Lynx represents 1% of AltaVista traffic.)
- The Web is global.
- Users aren't dumb.
- Users will not read the manual.
- Users will tell you what they need.

Conclusion

AltaVista likes to stay on the low-tech side of browsers because a fraction of users is eliminated whenever we use the latest browser technology. ✳



Fabio Bagatin, senior solution architect, Network and Systems Integration Services

Fabio Bagatin: The Vatican's Web Site

Fabio Bagatin is an NSIS senior solutions architect assigned to the Vatican. Although DIGITAL donated a computer to the Vatican in October 1995, NSIS assessment and collaboration on the implementation of a Web site did not begin until about a year later. A few highlights of his case study follow:

Scope of the site

- The Vatican Web site was opened to the public on Easter Sunday in 1997. On that day, after Pope John Paul II's Angelus message, the site received 3 million hits.
- The Vatican Web site consists of more than 300 MB of documents in six navigational languages. Any particular document may be presented in up to 12 languages.
- Plans are underway to digitize all publications of the Pope since the Council of Trent in 1545. The Vatican maintains 30 miles (40 km) of underground libraries. Some of these documents will eventually be published on the Web.
- The Vatican wishes to extend its audio and video capability to include real-time broadcasting of the Angelus and Vatican radio news over the Internet. For the Year 2000 Jubilee, real-time video broadcasting of the opening of the Holy Door and other important Jubilee ceremonies are planned.

Security

Security issues are paramount to the Holy See Internet office, which is gaining importance within the church. Higher levels of security, confidentiality, and integrity are desired.

A typical security attack tally: 20 minor attacks per day, four clever attacks per week.

If anyone breaks into the Vatican Web site, DIGITAL is out!

Web tools needed

Streamlining the operation of the Vatican Web site requires

- Web server farms and a way to manage them
- Improved site-management tools capable of maintaining more than 20,000 files
- Web server support for multilingual navigation
- Live audio/video servers with multisite forwarding
- Web capacity planning tools ✳

Pachyderm Pilot

Editor's note: The summit concluded with Andrew Birrell, corporate consulting engineer, briefly describing Pachyderm, a new DIGITAL software application.

Pachyderm is a Web-based, personal information utility that uses the AltaVista Search technology to provide an innovative and immediate method of finding information. It is usable from any location with a standard Web browser.

Pachyderm enjoys the location independence provided by the Internet without compromising the level of functionality offered; it provides the same view of a user's data whether accessed from the desktop, an airport kiosk, or a palm PC.

Every word of a user's data is indexed, so a "search" for information, results in an immediate return of a list of documents. This allows a new approach, in which the user chooses a selection of documents highly relevant to the current need, rather than manually retrieving from several fixed folders. Such fixed hierarchies become quickly dated and do not fit a user's evolving needs.

Pachyderm is specifically aimed at the ISP/telco segment and is currently being piloted internally and externally. ✳

web*sites*

intranet
http://demo1nio.dec.com:1656/indexer/start.html

internet
http://www.research.digital.com/SRC/pachyderm/

From left, Andrew Birrell, corporate consulting engineer; Bill Strecker, CST vice president; and Don Harbert, IBU vice president, watch a pilot technology demonstration.

"The 'Wild West of the Internet' is hugely large," remarked Internet security expert Bill Cheswick of Lucent Technologies, who regaled attendees with tales of "stupid Net tricks" and perverse viruses.

Chris Melling of the Internet Software Group, Reading, UK, demonstrated Pachyderm. (See related story about Pachyderm on p. 17.)

NSIS customer Terry Startsman, senior vice president of Interealty (the largest supplier of outsourcing and information services to the real estate business in the US), describes a MISTI project undertaken with Sri Raghavan, NSIS.

CTSS Vice President Sam Fuller and speaker John Klensin of MCI Telecommunications

Jeff Mogul, Western Research Lab researcher, summarized key points from the Web servers breakout session.

Vik Muiznieks, NSIS technical director and manager of Applied Internet Technologies, right, initiates discussion of compilers and tools at a breakout session.

Chris Marshall, senior solution architect, NSIS, describes projects undertaken for the *Washington Post.*

On behalf of his breakout-session colleagues, Jim Gettys, consulting software engineer, summarized ways to imbue systems with personality.

web *site*

intranet

http://tcdg.zko.dec.com/Presentations/index.htm

Speaker presentations preceded in the text by a ♦ can be viewed in greater detail here.

Quickly Find Technology Information

With methods similar to those used in a walk-in library, users now can conduct research, pose a query, or browse directly from the redesigned WebLibrary home page.

By Joan O'Brien, Corporate Library Group, Acton, Massachusetts

joan.obrien@digital.com

The WebLibrary's new look and feel make desktop navigation easier than ever.

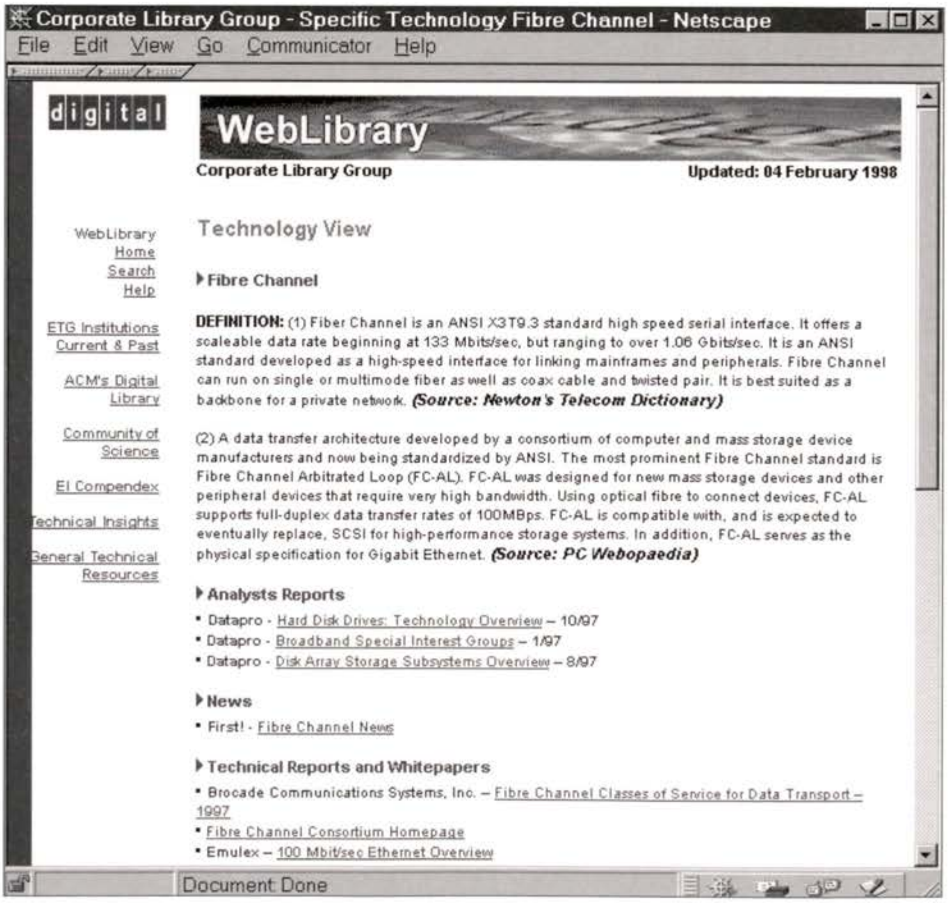
Conducting Research

From the WebLibrary home page, selecting "Research" will bring you to several research categories. From "Technology Views," you can access technical information resources from international sources and internal DIGITAL sources with an emphasis on DIGITAL's strategic technologies. You can choose from the following:

- **Strategic Technology Views.** Find definitions and links to specific sources pertaining to DIGITAL's strategic technologies. (See sample screens.)
- **External Technology Group Institutions.** View a compilation of research institutions, current and past, having relationships with DIGITAL.
- **ACM Digital Library.** Search 5 years of full-text proceedings, conferences, and journals.
- **Community of Science.** Register to network with experts in your field from the US (international capability to be added soon). Find out which types of research the government is funding. Search for patents with the easy-to-use search engine.
- **EI Compendex.** Search a database containing more than 20 years of technology information from global resources. Order reprints online.
- **Technical Insights.** Examine seven weekly newsletters dealing with emerging technologies.
- **General Technical Resources.** Access technical reference resources including sources for associations, conferences, patents, dictionaries, standards, journals, and other technical resources.

Posing Queries

From the WebLibrary home page, selecting "Search" allows you to enter a question or questions using a specific resource.



Technology View

▸ Fibre Channel

DEFINITION: (1) Fiber Channel is an ANSI X3T9.3 standard high speed serial interface. It offers a scaleable data rate beginning at 133 Mbits/sec, but ranging to over 1.06 Gbits/sec. It is an ANSI standard developed as a high-speed interface for linking mainframes and peripherals. Fibre Channel can run on single or multimode fiber as well as coax cable and twisted pair. It is best suited as a backbone for a private network. ***(Source: Newton's Telecom Dictionary)***

(2) A data transfer architecture developed by a consortium of computer and mass storage device manufacturers and now being standardized by ANSI. The most prominent Fibre Channel standard is Fibre Channel Arbitrated Loop (FC-AL). FC-AL was designed for new mass storage devices and other peripheral devices that require very high bandwidth. Using optical fibre to connect devices, FC-AL supports full-duplex data transfer rates of 100MBps. FC-AL is compatible with, and is expected to eventually replace, SCSI for high-performance storage systems. In addition, FC-AL serves as the physical specification for Gigabit Ethernet. ***(Source: PC Webopaedia)***

▸ **Analysts Reports**

- Datapro - Hard Disk Drives: Technology Overview – 10/97
- Datapro - Broadband Special Interest Groups – 1/97
- Datapro - Disk Array Storage Subsystems Overview – 8/97

▸ **News**

- First! - Fibre Channel News

▸ **Technical Reports and Whitepapers**

- Brocade Communications Systems, Inc. – Fibre Channel Classes of Service for Data Transport – 1997
- Fibre Channel Consortium Homepage
- Emulex – 100 Mbit/sec Ethernet Overview

Browsing Online

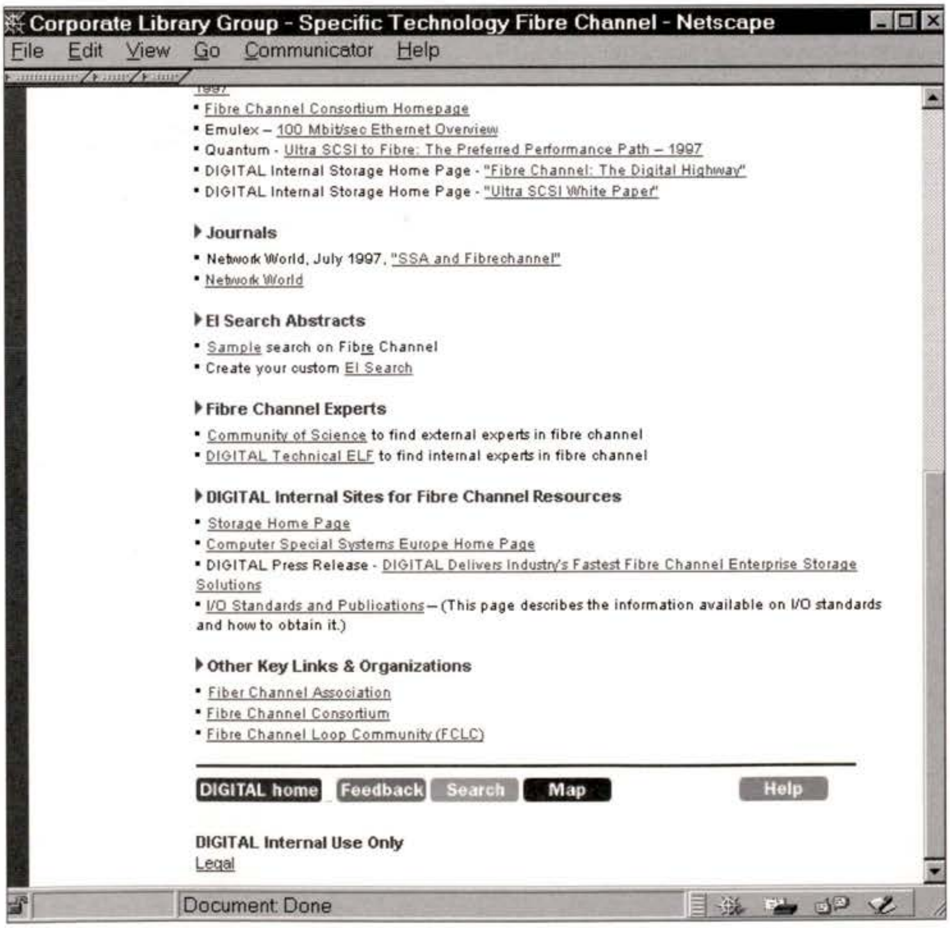
From the WebLibrary home page, selecting "Browse" allows you to find all WebLibrary resources, arranged by category and title. Think of it as walking through the periodical shelves in an actual library scanning for a certain journal or report.

Critiquing the WebLibrary

The goal of the WebLibrary is to filter the vast flood of technology-related information to ensure access to the most strategically pertinent data is. Feedback from users about their WebLibrary experiences is essential for improvement. Let us know your opinions. ✳

web *site*

intranet
http://weblib.ako.dec.com
The Corporate Library Group's WebLibrary



Corporate Library Group - Specific Technology Fibre Channel - Netscape

- Fibre Channel Consortium Homepage
- Emulex – 100 Mbit/sec Ethernet Overview
- Quantum - Ultra SCSI to Fibre: The Preferred Performance Path – 1997
- DIGITAL Internal Storage Home Page - "Fibre Channel: The Digital Highway"
- DIGITAL Internal Storage Home Page - "Ultra SCSI White Paper"

▸ Journals

- Network World, July 1997, "SSA and Fibrechannel"
- Network World

▸ EI Search Abstracts

- Sample search on Fibre Channel
- Create your custom EI Search

▸ Fibre Channel Experts

- Community of Science to find external experts in fibre channel
- DIGITAL Technical ELF to find internal experts in fibre channel

▸ DIGITAL Internal Sites for Fibre Channel Resources

- Storage Home Page
- Computer Special Systems Europe Home Page
- DIGITAL Press Release - DIGITAL Delivers Industry's Fastest Fibre Channel Enterprise Storage Solutions
- I/O Standards and Publications – (This page describes the information available on I/O standards and how to obtain it.)

▸ Other Key Links & Organizations

- Fiber Channel Association
- Fibre Channel Consortium
- Fibre Channel Loop Community (FCLC)

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Legal

Via the WebLibrary home page, you can navigate to pages devoted to specific technologies. Choose "Research," "Technology Views," "Specific Technology Resources," and then select from a long list of terms. At left and above, the Fibre Channel page is shown in its entirety.

Customize Your News!

From the WebLibrary home page, use "Customize" to define your information needs; a selection of news will be delivered to you by email or to your Web page immediately or at a later time that you choose. Customized news is gleaned from many international sources.

Standard Setup Process

1. Select "Customize" on the WebLibrary home page.
2. Register. (It takes less than 1 minute.)
3. Select a topic or topics from among preselected "topic trees."
4. Check off boxes to establish what, when, and how you want to receive your information.

Setup for Specialized Topics

1. Select "Design a Query."
2. Enter your search criteria.
3. Check off boxes to establish what, when, and how you want to receive your information.

Need help?

If you need help getting started, no problem. Send email to CSTWebLibrary@digital.com. ✳

Applied Research in DIGITAL: A Multinational Approach

The evolution of DIGITAL's applied research arm in Germany has spanned collaborations with academia, European governmental agencies, and projects that are customer-defined and -funded.

By Lutz Heuser, Strategic Technology and Applied Research, Karlsruhe, Germany; Joachim Schaper, CEC Karlsruhe–European Applied Research Center, Karlsruhe, Germany; and Igor Varsek, External Technology Group, Maynard, Massachusetts

{Heuser, Schaper}@kar.dec.com; Igor.varsek@digital.com


The worldwide External Technology Group staff gathered for "Innovation Day," the tenth anniversary celebration of CEC Karlsruhe. From left: Andrea Klumpp, Bettina Mussgnug, Rudolf Brandner, Wolfgang Gerteis, Bernhard Frommherz, Gerd Hoelzing, Manfred Koethe, Andreas Krebs, Igor Varsek, Torsten Leidig, Susan Dorsey, Kirsten Regenbogen, Oliver Frick, Burkhard Neidecker-Lutz, Michael Altenhofen, Lutz Heuser, Joachim Schaper, Sam Fuller (vice president of Corporate Technology Strategy and Services), Petra Hockstein, Ken King, Gary Cantwell, Peter Kochevar, Olivier Dewandre, Gil Brezler, Susan Thomas, Jochen Feyock, Markus Jork, Karsten Schultz, and Eckhard Farrenkopf.

Established in 1987 as a "campus-based engineering center" at the University of Karlsruhe, Germany, CEC Karlsruhe recently celebrated its 10th anniversary. About 100 members of the public were invited to "Innovation Day" activities, which highlighted DIGITAL applied research in Europe. This commemoration offers a chance to reflect on the origins of the organization and its role in technology development.

Evolution of CEC Karlsruhe

After several years of productive cooperation between the DIGITAL External Research Program and the University of Karlsruhe, in 1987 DIGITAL established, a small laboratory of researchers and engineers adjacent to the university campus.

Chartered to bridge the cultural and geographic gap between research projects of leading European universities and DIGITAL's engineering groups, CEC Karlsruhe's mission has been to promote technology and talent transfer. From the outset, CEC Karlsruhe has defined research and development challenges for universities willing to engage in long-term working relationships with DIGITAL. This has proven to be efficient and mutually rewarding for all parties involved.

Jointly funded by the External Research Program and DIGITAL's German subsidiary, CEC Karlsruhe began operation in November 1987 with Igor Varsek heading a group of five. The first projects involved software development as well as multimedia authoring and distance learning. Funding was quickly increased by several DIGITAL organizations, most notably High Performance Computing Educational Services and Software Development Tools (SDT). Within a few months, the CEC Karlsruhe staff was supervising more than a dozen doctoral students and many undergraduates.

The following is a sampling of some of the early projects of CEC Karlsruhe:

- SCACEC (a network and cluster monitoring tool)
- DOCASE (an object-oriented development environment and tools)
- NESTOR (a groupware platform for multimedia authoring and distance learning)

Such projects were fundamental to the evolution of the group's core competencies: high performance networks, and advanced Internet and electronic-commerce technologies.

The CEC Karlsruhe model of joint projects between academia and DIGITAL researchers also was used between 1988 and 1992 in Vienna, Eindhoven (the Netherlands), and Milan.

Within a few years, CEC Karlsruhe successfully transferred technology and expertise to several product groups, most notably in the area of X window, X media, rdb and Express. The product-related work was funded mostly by the corresponding DIGITAL product groups, which enabled CEC Karlsruhe to grow to about 20 DIGITAL employees collaborating with more than 30 graduate students. However, this funding model was not sustainable in the wake of corporate restructuring pressures. To maintain its focus on applied research projects, CEC Karlsruhe began, in 1991, to compete directly in the open market for funding.

Customer-Funded Research Projects

Deutsche Telekom (now DT AG) supported the first set of customer-funded research projects by participating in a multiyear research and development consortium, called BERKOM (BERlin KOMmunikation). Its goal was to design and implement, along with other research and industry partners, such as IBM, Hewlett-Packard, and Siemens, a set of multimedia teleservices for Deutsche Telekom's then-emerging broadband networks.

By the time Lutz Heuser had assumed management of CEC Karlsruhe in 1992, customer-oriented research had become a major source of technology and funding. BERKOM attracted other customers as European telecommunications was deregulated, and CEC Karlsruhe's reputation as a productive partner helped forge a mutually beneficial working relationship with DeTeBerkom (DT AG's research section). This subsequently spawned a set of products that were licensed to independent software vendors, i.e., Multimedia Collaboration, or used as a vehicle to launch new product development efforts, such as the next-generation Internet protocols RSVP and IPv6-over-ATM.

At the same time, the European External Research Program and CEC Karlsruhe began to target projects sponsored by European governments (the so-called Framework Programmes) to disseminate CEC Karlsruhe's technology and research results to other partners and early adopters in Europe. As a consequence, the charter of CEC Karlsruhe was extended in 1995 to form the External Technology Group's European Applied Research Center.

CEC Karlsruhe now addresses specific European issues within the four major projects of the fourth European Framework Programme, among them

- Euromedia—a professional archive platform for broadcasters
- Vega and Actrans—virtual enterprise and secure transaction support
- MERKADO—an electronic-commerce platform for public access to new services

Customer-oriented research has become a major source of technology and funding.

Renowned Consulting Resource

As a recognized member of the German research community, CEC Karlsruhe became involved in the broadband trials of the German Research Network that was built on top of DT AG's ATM infrastructure. The Virtual Learning Lab project, undertaken jointly by CEC Karlsruhe with multimedia content providers and several retraining institutions (Berufsförderungswerken), has been funded by the German research ministry. CEC Karlsruhe has become a renowned consulting resource for global and large accounts and partners such as Deutsche Telekom AG, BMW, SAP AG, and several European TV and radio broadcasters.

Strategic customers prefer to work with CEC Karlsruhe when developing pilot applications such as:

- High performance networking, in particular ATM–based networks
- Next-generation Internet protocols, such as IPv6 and RSVP
- Professional multimedia services, including indexing, transmission, and storage
- Internet appliances, such as Web-enabled vending machines

Throughout the years, CEC Karlsruhe has become a renowned consulting resource for global or large accounts.

- Cooperative working/learning environments
- Electronic commerce for the general public
- Virtual enterprise architectures and technologies

Establishing the Strategic Technology and Applied Research Group

As customer-defined applied research projects have increased, it became apparent that successful applied research projects consist of two aspects: an "outbound thrust" and an "inbound thrust." The outbound thrust refers to defining prototypical solutions and disseminating them into a real-life user community, i.e., to early adopters. The inbound thrust refers to the transfer of technology, platforms, and solutions back to DIGITAL, i.e., the original mission of CEC Karlsruhe.

To add focus to the "outbound thrust, " the Strategic Technology and Applied Research (STAR) group was formed in April 1997. Led by Lutz Heuser, it will work with large, strategic partners to develop real-life "solution experiments." Strategic technologies can then be evaluated with customers at an early stage.

CEC Karlsruhe Today

Joachim Schaper now manages the CEC Karlsruhe, expanding its competencies towards embedded Internet appliances (together with SAP technology), IP security, and secure applications. On the horizon is the next wave of European government–funded projects within the IT for Learning/Information access tasks of ESPRIT. ✳

web*site*

internet
http://www.kar.dec.com/etg/public/10th/
Find out more about CEC Karlsruhe's Innovation Day.

Patent Awards

Twenty-eight patents, issued by the US Patent and Trademark Office, further enhanced DIGITAL's intellectual property portfolio, now totaling more than 1,600 active patents. Thirty-four inventors received cash awards from their supporting business units for their contributions and technical innovations.

D. Willett

Patent Award Recipients from Massachusetts and New Hampshire
Seated, from left: Elbert Bloom, Stephen Van Doren, Mark Herdeg, Ron Brender, Gabriel Bischoff, Scott Taylor, Don Smelser, Colin Brench, and Gil Wolrich. Standing, from left: Mike Giannetta, Networks & Storage patent engineer; Don Scott, DIGITAL Semiconductor patent engineer; Bob Reed, Honorarium and Patent Award Program manager; Robert Hart; Richard Plourde; Larry Seiler; Sharon Lipp, Corporate Patent Program; Tom Gannon, director of Corporate Technical and Information Services; Sam Fuller, vice president, Corporate Technology Strategy and Services; and Mike Chautin, UNIX & OpenVMS patent engineer.

Patent Award Recipient from Colorado
Steve Sicola

K.O. Beckman

Patent Award Recipients from California
From left, Bob McNamara, Mark Shand, and Jeff Mogul

Patent Award Recipients from Colorado
From left, Clark Lubbers and Susan Elkington

Environmental Self-Declaration Addresses Customer Concerns

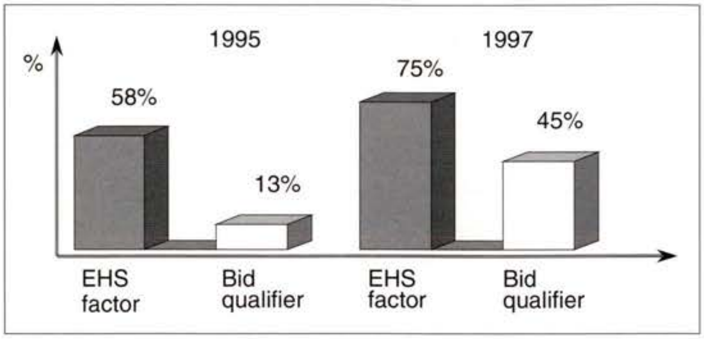
Voluntary self-declaration is becoming a recognized means of communicating product environmental attributes to customers.

By Larry Nielsen, Product Stewardship Group; Corporate Environment, Health and Safety, Maynard, Massachusetts

Customers are becoming increasingly interested in the environmental impact of the products they buy and in the environmental performance of the companies they do business with. This interest is particularly strong in Europe. (See "Survey of European Customers" at right.) The European Computer Manufacturers Association (ECMA) has developed a promising way to communicate environment, health, and safety (EHS) information to customers.

Voluntary Self-Declarations

About 2 years ago, amid growing concern about the lack of standardized environmental attributes for information technology equipment, ECMA established Technical Committee (TC) 38. This committee, which includes representatives from major IT suppliers including DIGITAL, was charged with establishing a common set of environmental attributes as the basis for voluntary self-declaration. Modeled after a self-declaration approach used by the Swedish Information Technology Organization (SITO), the TC 38 initiative seeks to voluntarily standardize a set of environment, health and safety (EHS) attributes across Europe and establish an alternative to existing third-party environmental labels ("ecolabels") originating in Europe (e.g., German Blue Angel, Swedish TCO'95, Nordic White Swan).



Percentage of surveyed European customers who are interested in EHS factors when purchasing IT products and consider EHS performance as a bid qualifier. (See "Survey of European Customers.")

Initial TC38 definitions of these environmental attributes have been published in *ECMA Technical Report 70* (TR/70). The report includes attributes lists and standardized forms for personal computers, printers, copiers, and television sets. This year ECMA is expected to expand TR/70 to include other IT products such as servers, network hardware, fax machines, and cellular phones. By following TR/70 guidelines, IT suppliers can respond to customer EHS questions by using product self-declarations. In fact, IBM and Hewlett Packard already issue TR/70–based forms for some of their products.

The Corporate Product Stewardship Group is working with various DIGITAL business segments to "test drive" TR/70 and refine the process for the corporation's needs. Generally speaking, TR/70 seems easy to use on all applicable DIGITAL products.

Self-Declaration versus Ecolabels

Self-declaration, as described in TR/70, offers the following advantages over third-party ecolabels:

- There is no need to pay a fee to a third-party organization to pass judgment on the basis of possibly arbitrary criteria.
- Turnaround time is controlled entirely by the declarer. (Third-party review and approval can take as long as 6 months with some ecolabels.)
- The customer can judge the environmental performance of the product on the basis of values declared by the manufacturer.

Once completed, the self-declaration can be used in advertising, marketing materials, and to support bid requests—much the same as an ecolabel. TR/70 self-declaration should provide a useful alternative to ecolabel certification, becoming a recognized means of communicating product environmental attributes to customers.

Environmental Attributes in TR/70

Attributes included in TR/70 address global environmental pollution (aspects such as end-of-life disposition) and features that relate to the immediate user-computer interface. Following is a summary of the attributes currently included:

Global environmental attributes

- Upgradability to extend useful life
- Energy consumption
- Battery requirements
- Chemical emissions and materials used
- Product documentation (user manuals)
- Ease of disassembly
- Parts requiring special handling
- Reusable parts
- Marking of plastic materials

User-computer interface attributes

- Electromagnetic compatibility (EMC)
- Acoustical noise

For assistance with requirements in these areas, please contact the appropriate DIGITAL Domain Manager:
EMC: Peter Boers, DTN 297-4889.
Acoustics: Bob Lotz, DTN 223-5774.

Self-Declaration and Design for Environment

A new DIGITAL standard will reference EHS/product stewardship requirements for all DIGITAL products. This document will assist developers of products, both manufactured by DIGITAL and those that are out-sourced, in understanding product-related environmental issues, including those covered by TR/70. This document will help product developers understand regulatory and voluntary requirements for products. Requirement checklists for key product categories are set up in three levels:

- Regulatory requirements
- Voluntary attributes outlined by ECMA TR/70 and/or DIGITAL standards
- Other voluntary EHS "best practices"

Staff members from the Product Stewardship Group are also available for direct support in this area:
Alpha Servers, Storage, Printers: George Yender (DTN 223-8746)
Networks: David Spengler, DTN 223-7671
NT Systems: Larry Nielsen, DTN 223-8391
Alpha Semiconductors: Richard Merlot, DTN 887-4225

Refer questions on this information or any topic related to product stewardship to Frank Rooney at DTN 223-7647. ✳

web*sites*

internet
http://ecma.ch/techrep/e-tr-070.htm
ECMA Technical Report 70 and related information

intranet
http://www.aeo.dec.com/ehs/ps/TechCom/checklists
Summary requirement checklists for key product categories

Survey of European Customers

In 1995 and 1997, 32 large European accounts in six countries were surveyed to gauge customer interest in product environment, health, and safety issues.

Percentage of surveyed European customers (1) interested in EHS factors when purchasing IT products and (2) which consider EHS performance as a bid-qualifier.

Account managers of direct accounts and resellers were surveyed by telephone or interviewed using a standard questionnaire. The survey focused on various customer sectors, including industry, government, telecom, and automotive.

Accounts surveyed in the UK, France, Germany, the Netherlands, Sweden, and Switzerland included

- British Telecom
- Rover
- ABB
- Telia
- Philips
- Shell
- Aerospaciale
- Alcatel
- Union Bank of Switzerland
- Swiss Federal Government
- Commerzbank
- Deutsche Telekom ✳

ENERGY STAR Changes Affect Three Product Categories

US Environmental Protection Agency ENERGY STAR amendments affect DIGITAL Personal Workstations, PCs, and monitors.

By Larry Nielsen, Product Stewardship Group; Corporate Environment, Health and Safety, Maynard, Massachusetts

Amendments to the US Environmental Protection Agency's ENERGY STAR program for Office Equipment will affect three DIGITAL product categories: high-end PCs, DIGITAL Personal Workstations, and monitors. Not as comprehensive as the emerging European Computer Manufacturers Association TR/70 guidelines (see the preceding article in the Product Stewardship section), the ENERGY STAR program is gaining global acceptance as an indicator of energy-efficient IT products. On January 1, 1998, an amended memorandum of understanding (MOU) took effect, defining some criteria for the program.

A more liberal limit for "sleep" mode will allow more high-end PCs and workstations unable to meet the previous 30-watt limit to be certified as ENERGY STAR–compliant. ENERGY STAR monitors must now have a second-level "deep sleep" mode.

Sleep Mode for PCs and Workstations

For computers with power supplies having a maximum continuous output power rating less than or equal to 200 watts, the sleep mode requirement remains at 30 watts. For computers with power supplies having a maximum continuous output power rating greater than 200 watts, the sleep mode must be no more than 15% of its maximum continuous output power rating. For example, a computer with a power supply rated at 300 watts maximum continuous power output must have a sleep mode less than 45 watts (15% × 300 watts).

Second Deep Sleep Mode Added for Monitors

Monitors must be able to automatically enter two successive low-power modes. In the first low-power sleep mode, which is similar to the Display Power Management Signaling (DPMS) "suspend" mode, the monitor must consume 15 watts or less after a period of inactivity. If the monitor continues to idle, CPU instructions must signal it to enter a second low-power deep sleep mode (similar to the DPMS "off" mode), consuming 8 watts or less.

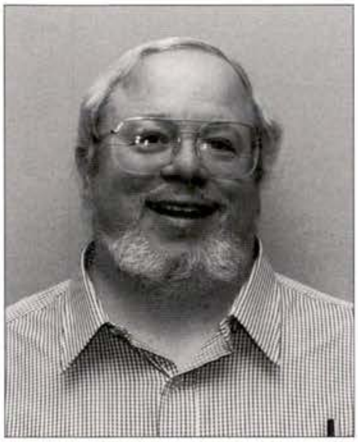
Requirements, such as monitor control, shipping products with features enabled, and explanations in product user manuals, are outlined in the detailed MOU. To obtain a copy of the amended MOU, contact Larry Nielsen, Product Stewardship Group, DTN 223-8391 or via Exchange mail. ✳

web*site*

internet
http://www.epa.gov/office/
The ENERGY STAR program

Engineering Promotions

Many thanks for the text and photo contributions from the supervisors and colleagues of the DIGITAL engineers whose collaborative and individual achievements earned them these promotions.



Barry Rubinson Promoted to Corporate Consulting Engineer

Barry Rubinson has been promoted to corporate consulting engineer in recognition of his significant contributions to DIGITAL.

A capable software designer, who clearly grasps many software technologies, Barry can review software designs and focus on critical issues to deliver successful projects.

Barry began his career at DIGITAL in 1974 and, as the project leader for PDP-15 software, he delivered DIGITAL's first smart I/O controller, the Unichannel. He then moved on to Corporate Research, where he continued his study of intelligent I/O systems, which culminated in the design of the architecture of the HSC-50, the VAX cluster I/O controller. While serving as project leader for the firmware development of the UDA50 storage controller, he also specified the overall storage architecture. Barry has received 10 patents for his work in storage systems architecture and I/O interfaces.

Since his promotion to senior consulting engineer in 1985, Barry's many significant contributions have demonstrated excellent entrepreneurial and technical leadership skills.

Later, working in Database Systems, Barry was project leader for DIGITAL's first relational database system, Rdb ELN, which prototyped DIGITAL's relational architecture (DSRI) that was used in Rdb/VMS. He then became technical director for both Database Systems and Transaction Processing Systems during their rapid growth periods, when he also chaired the ISO transaction processing standards committee.

In 1991, Barry and Jim Gray established a Database and Transaction Processing advanced development lab in San Francisco. Barry recognized the emerging opportunity for true client/server development tools that would make the development of distributed applications a reality. Many of his ideas about creating such a tool set were similar to those being discussed at the time in a start-up company called Forté Software. Barry's combined entrepreneurial skills and technical expertise won approval for his proposal to create a unique partnership with Forté that has put DIGITAL in a leadership position in advanced production client/server solutions. As a consultant and manager of a joint project for the Forté product, Barry strongly advocated and influenced the implementation of advanced integration facilities using OLE/DCOM, the Internet, and the Web.

Attention Engineering Managers! The CERB Has a New Web Site

The Consulting Engineer Review Board (CERB) Web site has been renovated and presents a user-friendly interface to managers and engineers interested in the "technical ladder" to promotion.

An engineering manager considering the promotion of an engineer to the consultant level will find a real-life example of a nomination package among the helpful new links at the site. The example presents the five pieces necessary in a package: transmittal letter, nominating manager's synopsis, recommendation letters, and supporting documents.

Overall, the site offers

- The "big picture" of the CERB process and its importance to DIGITAL
- The CERB calendar of meetings and review of nominations
- Links to resources
- Frequently asked questions and answers
- A new section for the DIGITAL Services Division
- People to contact about the process

Arlene Lamsa, CERB secretary, can help with questions not addressed on the Web site: arlene.lamsa@digital.com. ✳

web*site*

intranet

http://www-server.mso.dec.com/hr/cerb/cerb.htm

A key strategist, who articulated an object technology strategy for DIGITAL, in collaboration with other consulting engineers, Barry outlined an object infrastructure for distributed applications, taking a number of existing technologies and combining them into a coherent middleware strategy. Barry was the technical director for the implementation of synchronous and asynchronous (queuing) communications across a CORBA object brokering mechanism, object development environments (Forté and others), and an object-oriented process workflow product. He provided significant technical direction for the ObjectFlow product including the graphical flow design interface, the workflow engine, and the integration of organizational databases into the workflow security system.

For the past 18 months, Barry has led the AltaVista Search site and product engineering activities. He hired a team in California and has overseen a successful technology transfer from the research stage to an engineering and operational organization. Barry has provided significant technical leadership in several areas establishing the Search Network, bringing mirror sites around the world online, and extending the reach of the search site beyond pure text indexing and search capabilities.

Hugh Wilkinson Promoted to Senior Software Consulting Engineer

Hugh Wilkinson, an architect in the Networks Product Business Unit, was promoted to senior software consulting engineer in recognition of his contributions to the financially and technically successful VNswitch program. The VNswitch is both a stand-alone and network switch/router hub product capable of translating between ATM, FDDI, Ethernet (10-Mb, 100-Mb, 1-Gb) datalinks. Hugh has extensive knowledge of networking protocols and network architectures including VLANs, switching, hub, and chassis-based products. His work on the VNswitch was recently recognized outside of the Networks Product Business Unit when he was chosen as a finalist for the 1997 Chairman's Award for Technical Achievement (see *Forefront*, Winter 1997–98, p. 5) because of his outstanding contributions and leadership throughout the VNswitch product development cycle. Hugh provided system-level design leadership to the software, hardware and ASIC design teams.

As the product architect for the VNswitch, Hugh used his knowledge of software/hardware interfaces to provide technical leadership for the VNswitch development team. In a recent independently conducted switch performance test, the VNswitch outperformed similar Fast Ethernet products from Cisco and 3COM. The VNswitch architecture allows the product to evolve and future versions will have higher density Fast Ethernet and GIGAbit Ethernet support.

In his 17 years at DIGITAL, Hugh has made numerous contributions to networking, first as a member of DIGITAL's Distributed Systems Advanced Development organization and then as a member of the High Performance Networks group. Hugh has developed high performance firmware and hardware routing engines. He designed the first wireless LANbridge and consulted in the development of the RoamAbout Access product. Hugh was also a member of the system architecture team that developed and designed the DECswitch 900 product which has been shipping since 1994, generating over $30 million per year. Hugh was the technical leader for the DECserver 700 and 90 series terminal servers.

Hugh holds a BS degree from Boston University. In addition, he has completed courses of study at both Harvard and Tulane.

Correction: Stephen Sicola Promoted to Senior Consulting Engineer

In the Winter 1997–98 issue of *Forefront* (p. 32), Stephen Sicola's promotion was incorrectly stated. He has been promoted to senior consulting engineer. The editors regret any inconvenience this error may have caused. ✻

Joe Boyack Promoted to Consulting Technical Writer

Joe Boyack's promotion to consulting technical writer acknowledges his major contributions to DIGITAL Semiconductor documentation. Joe came to DIGITAL 20 years ago, and he began writing chip documentation with the preliminary manual for the 21064 evaluation board. Later he wrote the preliminary documentation for the low-cost 21066 and 21068 Alpha chips. One of Joe's greatest contributions has been the creation of documentation designs and a suite of FrameMaker templates to support those designs. Joe's page-layout expertise and in-depth knowledge of technical requirements helped him produce highly effective templates. Other writers now use these templates for user guides, technical reference manuals, data sheets, product briefs, and licenses for all product lines.

Joe's current assignment—writing for the newly formed StrongARM Systems Development Group—evolved from his work on the graphics and multimedia chips (21030 through 21231), video codec evaluation boards, and DSmedia software.

Joe came to DIGITAL 20 years ago after a 20-year career in the US Navy. His first job at DIGITAL was in course development. Then he began to write technical documentation about large systems and became project leader for the Jupiter documentation.

Roger Dame Promoted to Hardware Consulting Engineer

Roger Dame has been promoted to hardware consulting engineer on the basis of his outstanding contribution to the Rawhide and Laser programs in the field of signal integrity (SI).

The SI discipline has played a key role in the development of leading edge mid- and high-end DIGITAL servers. While a system architecture defines *how* a system will work, it is SI that determines *how fast* the system can run reliably under various environmental conditions and under changing component tolerances. It also ensures that the system will perform as predicted in numerous configurations.

Roger, one of the few SI experts in DIGITAL, has been a force behind continuously improving DIGITAL's SI practices and in keeping the SI technology in step with increasing system performance demands.

Most recently Roger was the lead SI engineer for the Rawhide product family (i.e., the AlphaServer 4100, AlphaServer 4000, and AlphaServer 1200). Roger was responsible for the SI design of the system clocks and distribution, the system bus, the CPUs, memory, and the overall SI of the I/O subsystem. He established the SI design rules and conducted numerous reviews to ensure that each piece of the system obeyed the rules. Rawhide met and exceeded the performance and configuration goals established at the start of the project. This, to a large extent, was a consequence of Roger's SI design and verification.

From the beginning, one stated goal of Rawhide was to revolutionize the development process. The team had accepted the challenge of achieving first revenue shipment (FRS) within 6 months from system power-on. (The previous average was about 12 months.) To achieve this goal, thorough SI modeling and analysis were essential. Under Roger's SI leadership, Rawhide shipped within six and a half months after power-on, which is now considered a benchmark to beat.

In addition to his Rawhide project work, Roger consulted with the MEMORY CHANNEL project and with the Tsunami project on SI issues.

Prior to Rawhide, Roger was the lead SI engineer on the AlphaServer7000/ VAX7000 CPU design team. Additionally, Roger's detailed planning of DVT work was instrumental in shipping Ruby and Neon on time.

In his early years, Roger made increasingly significant contributions to several programs including XMI, XMI-2 and ISIS.

Roger holds a BSEET from Central New England College. He has been awarded one patent and has published in the *Digital Technical Journal*.

Eugene Earlie Promoted to Software Consulting Engineer

Eugene Earlie's promotion acknowledges his contributions to DIGITAL during the past 24 years and, most recently, to the corporation's Alpha microprocessor logic verification capabilities. Specifically, Eugene was a leading architect, project leader, and key developer of the Merlin RTL logic simulator used by EV6 to successfully perform tens of billions of software-simulated microprocessor cycles at the RTL level. Eugene was responsible for a many innovations in MerlinXX as it was applied to EV6, since he proposed and co-developed the MXX RTL language and primitive set, implemented the RTL front-end, spawned a variety of novel productivity enhancing tools, and led the MerlinXX development project. Eugene was instrumental in the evolution of the corporation's microprocessor design methods when he led the early efforts to persuade the EV6 project to use the new Merlin, demonstrating the simulation performance and static analysis advantages which could be gained by EV6.

Eugene's career has evolved from principal hardware engineer and IC designer to his present role as a leading CAD tool developer in the Alpha CAD and Test group. As an IC hardware designer in DIGITAL's Storage Systems advanced development group from 1978 until 1992, Eugene was responsible for the architecture-through-silicon implementation of disk controller designs. He also provided key methodology leadership to the Storage organization as a CAD/verification strategist and was awarded a patent in testing asynchronous processes. Since 1992, when he joined the Alpha CAD group at DIGITAL Semiconductor in Hudson, Massachusetts, Eugene has successfully applied his vast experience as an IC designer to the Merlin logic simulator's development and production application.

Both in his roles as hardware designer and as a dedicated CAD developer, Eugene has frequently demonstrated the exemplary technical leadership, initiative, and outstanding engineering talent in significantly improving DIGITAL's VLSI design and verification methods.

Charlie Greenman Promoted to Consulting Technical Writer

Charlie Greenman's promotion to consulting technical writer recognizes his outstanding work on Alpha architecture documentation.

Charlie began working with the *Alpha System Reference Manual* in 1991, producing revision 5, the first distributed SRM. From that SRM, Charlie wrote the first edition of the *Alpha Architecture Reference Manual,* which won an Award of Excellence from the Society for Technical Communication (STC). He has continued to work on the internal SRM and the published ARM, through the third edition of the ARM, which just went to press. Shortly after producing the first ARM, Charlie wrote the *Alpha AXP Systems Handbook,* which also won an Award of Excellence from the Society for Technical Communications (STC).

While working for AMT, Charlie wrote the documentation for the early Linux/Alpha port (the three BLADE releases). He also wrote documentation for the DEC Softwindows port to DIGITAL UNIX.

Charlie currently works in the Alpha Migration Tools Group leading the FX!32 documentation effort. His *On-line Help for FX!32* won an Award of Merit from the STC last year.

Charlie joined DIGITAL in 1983 as a writer for the MDE/J-11 project at DIGITAL Semiconductor. Shortly afterwards, he joined the RT-11 group and, in 1984, became the project leader and lead writer. (RT-11 is a real-time operating system that runs on PDP-11 systems.)

Before joining DIGITAL, Charlie wrote technical manuals for Identicon Corporation. He holds a BSAS from Youngstown University.

Ray Hookway Promoted to Software Consulting Engineer

Ray Hookway has been promoted to software consulting engineer on the basis of his technical accomplishments and leadership of the FX!32 project. FX!32 is a binary emulator and translator which enables off-the-shelf, 32-bit Intel Windows NT applications to run on Alpha Windows NT systems.

Ray has been the overall project technical leader of the FX!32 development team even during the initial FX!32 development leading to the V1.0 release. In addition to being the project leader, Ray developed key pieces of the Offline Optimization technology including x86 image processing, instruction-to-intermediate representation translation, instruction patterns and optimizations, and Alpha image generation. He designed and delivered much of the infrastructure in the optimizer and low-level interfaces and was one of the principal developers of the binary translator.

Ray is currently the project leader for FX!32 V2.0 integration with Microsoft's runtime WX86 in WNT 5.0. This is another major step towards achieving seamless, transparent x86 application support with improved performance as an integrated part of the WNT V5.0 release. Ray has been involved from the beginning as a proponent and technical consultant within DIGITAL and as key contact with Microsoft management and developers to identify and specify the work needed and how it is to be apportioned.

Ray earned a PhD in computing and information sciences at Case Western Reserve University where he also earned an MS in computing and information sciences and a BS in engineering. He has applied jointly with other developers for two patents based on FX!32 innovations and has authored or coauthored many papers including a recent *Digital Technical Journal* article on FX!32.

Karen Noel Promoted to Consulting Engineer

Karen Noel's promotion principally reflects her significant contributions to the OpenVMS VLM (very large memory) project and 64-bit addressing, but also recognizes her other important and ongoing contributions to OpenVMS and DIGITAL.

Karen had primary responsibility for the OpenVMS VLM project, which was essential for maintaining the viability of OpenVMS as a premier database server and data warehousing platform now and in the future. VLM support, added in OpenVMS V7.1, allows applications to efficiently scale into the enormous 64-bit virtual address space on large memory systems by creating huge memory-resident sections and sharing page tables. As part of this effort, Karen worked closely with engineers from Oracle Corporation, a key DIGITAL business partner, both consulting on their use of OpenVMS features and ensuring that the VLM support would meet their needs.

The VLM project was built upon the earlier 64-bit addressing project, in which Karen also played prime roles in both design and implementation. This project required a unique combination of innovation and care in understanding and revising fundamental OpenVMS memory management algorithms in an upward-compatible way. Karen is a co-author on eight patent disclosures and two *Digital Technical Journal* articles as a result of her 64-bit addressing and VLM work.

Most recently, Karen has been a major contributor to the OpenVMS Galaxy project. While responsible for the memory management design, she also helped shape the overall architecture and influenced many other aspects of this important OpenVMS innovation.

Previously, Karen contributed to the OpenVMS Exec in a variety of ways, focusing on memory management support. She joined the OpenVMS Group in 1990 to participate in the initial port of VAX/VMS to Alpha. She came to DIGITAL in 1985 and worked for the RSX-11 Operating System group. Karen received her BS in computer science, with an EE minor, from Cornell University.

Stuart Soloway Promoted to Consulting Engineer

Stuart Soloway's promotion to consulting engineer acknowledges his work as principal contributor to the GIGAswitch /FDDI firmware team since the project began. He has served as firmware project leader for the past several years. Most recently, he designed and implemented the code that provides hunt-group capability (the ability to treat a collection of ports as a single logical port), as well as other unique features making this switch one of the most popular enterprise switches on the market.

Stu came to DIGITAL in 1987. He holds degrees from Harvard University and Boston University. Stu is a DIGITAL representative to the IEEE 802.1 standards committee.

Randall White Promoted to Consulting Engineer

Randall White's promotion to consulting engineer acknowledges his unique skills in integrating CMOS process knowledge, product design, and advanced failure-analysis expertise. He is known for his ability to apply this knowledge to highly complex problems in CMOS-7 (0.25-micrometer) process development and introduction.

Randall, who joined DIGITAL Semiconductor in 1988, began working on failure analysis of CMOS-2 devices, demonstrating his capability over five successive CMOS generations. Working directly with Fab module development teams, Randall's failure-analysis efforts continually focused on solving problems identified through yield and electrical test data analysis. His unique ability to evaluate yield, electrical test, failure analysis, and logical test data when solving process problems made him instrumental in the development and qualification of CMOS-6 in Fab 6.

Randall's contributions in educating the failure-analysis community is also noteworthy. His 4-day course on fault isolation is considered one of the most valuable courses offered in failure analysis.

Richard White Promoted to Software Consulting Engineer

Richard White of Multivendor Systems Engineering (MSE) has been promoted to software consulting engineer based on his understanding of OpenVMS implementations in complex computing environments. Using this knowledge, Dick has stabilized numerous large and complex computing infrastructures. As the architect of the OpenVMS portion of the MSE Site Assessment process, he has provided technical leadership in the areas of problem solving, proactive system consulting, and risk reduction.

Before joining MSE, Dick held many technical positions in Multivendor Customer Services. During the past 20 years, Dick has continuously demonstrated a unique understanding of computing-platform technologies and the business-related availability needs of our largest customers. ✳

Collaborative Team Wins Regional Communications Award

In a recent competition in New England, the online *Network Products Guide* was lauded by professional communicators for ease of navigation and timeliness.

The Web version of the *Network Products Guide* recently won a Society for Technical Communications Award of Merit in the Boston and Northern New England chapters' competition. Judges appreciated the guide's content, design, and ease of navigation.

A collaborative effort of groups within DIGITAL Information Design and the Network Product Business (NPB) Unit, the *Network Products Guide* is the premier marketing tool for resellers and others in the field. The Web version of the guide will be updated whenever new information is available. The print version is available now.

Information Design Team Members

Pat Salvatore, project manager
Bill Dubie, project leader
Phil Dussault, graphic designer
Dave Hamel, production

Network Product Business Unit Team Members

Dawn Rohrbacher, NPB Clients
Greg Dwyer, NPB Clients
Chuck Carroll, systems manager ✳


D. Willett

Information Design Team Members. Seated, from left: Bill Dubie, project leader, and Dave Hamel, graphic designer. Standing, from left: Patricia Salvatore, project manager, and Phil Dussault, graphic designer.

web*site*

internet
http://www.networks.digital.com/cgi-bin/index.cgi?/dr/npg/index.html
Check out the *Network Products Guide* on the World Wide Web.

Cambridge Research Laboratory Begins Second Decade

DIGITAL's Massachusetts-based research lab has been exploring the human-computer interface and extending parallel and scalable computing beyond present-day technological confines in an effort to stake out DIGITAL territory as the world's ubiquitous network takes shape.

By Beth Magura, Corporate Technical Publications, Acton, Massachusetts

Photos: D. Willett

Sporting his old DIGITAL badge, guest of honor Vic Vyssotsky, CRL's first director, is flanked by Bill Strecker, chief technology officer and senior vice president of Corporate Strategy and Technology, at left, and Sam Fuller, chief scientist and vice president of Corporate Technology Strategy and Services.

In mid-December, more than 90 invited guests gathered at a commemorative luncheon in Cambridge, Massachusetts, to mark the beginning of a second decade of research at DIGITAL's Cambridge Research Laboratory (CRL). Bob Iannucci, CRL director, welcomed guests and speakers, who included the lab's founding fathers and current Corporate Strategy and Technology officers. Vic Vyssotsky, the lab's first director, attended and had a chance to mingle with past and present CRL staff.

Establishment of the Research Labs

"In the early 1980s, I had the opportunity to begin building a research organization at DIGITAL," said Sam Fuller, chief scientist and vice president of Corporate Technology Strategy and Services. "In 1983, we saw an opportunity to create in Palo Alto, California, the Western Research Lab, where a great deal of RISC microprocessor work eventually took place. Shortly thereafter, the Systems Research Center also was set up."

"However, by the mid-1980s," continued Fuller, "we began to think about establishing a research center nearer to product-development sites in the Boston area to increase the flow of ideas to generate products and services. We concluded that, in Cambridge, we'd be able to attract creative newcomers to DIGITAL."

It took about a year to find and recruit Bell Labs' Vic Vyssotsky to head the lab and to find a suitable lab location, Fuller added. Upon Vyssotsky's retirement in 1992, Mark Brown became CRL director. In 1995 Brown was succeeded by Bob Iannucci.

Contributions to DIGITAL

Bill Strecker, senior vice president of Corporate Strategy and Technology and chief techology officer, pointed out the key product contributions resulting from research and advanced technology development undertaken at CRL:

- Multithreaded Alpha
- Formal verification of scalable systems
- Rendering technologies

> **'We are talking about the next *billion* network connections—planetary audiences—and the delivery of computing on a scale never seen before. DIGITAL needs to create structures that work, are self-managing, and are universally available.'**
>
> **—Bob Supnik, vice president, Research and Advanced Development**

From left, Brian Reid, director of the DIGITAL Network Systems Lab; Bob Iannucci, CRL director; Bob Deroy, manager of CRL Technical Operations; and Bob Supnik, vice president of Research and Advanced Development.

- AltaVista Media Search (See related story on p. 42.)
- Facial animation
- The DIGITAL "Smart Kiosk" (See related story on p. 38.)

Strecker also noted that CRL, which serves as a model for cross-lab, cross-organizational, and industry-university collaboration, continues to contribute to:

- DIGITAL's patent portfolio
- Scalable computing
- Formal verification of scalable systems
- Development of wearable computers
- Ongoing work with MIT revolving around a 28-processor AlphaServer system donated to MIT by DIGITAL in 1997 (See *Forefront*, Winter 1997–98, p. 18.)

Integral Part of DIGITAL's Future

"CRL is a vibrant, contrary, and energetic lab that has infused research with its own distinctively entrepreneurial and decisive nature," enthused Bob Supnik, vice president of Research and Advanced Development, in his address.

"Working at the macro and micro scales of the computing spectrum, CRL is making important contributions to the vision and delivery of an information utility—a network structure that will be as ubiquitous as today's electric power companies," Supnik elaborated. "We are talking about the next *billion* network connections—planetary audiences—and the delivery of computing on a scale never seen before. DIGITAL needs to create structures that work, are self-managing, and are universally available. Do not underestimate your impact.

"It is CRL's constant commitment to change that distinguishes it," he concluded. "I can't think of a more exciting place to be. The opportunities are unparalleled." ✳

web*site*

intranet
http://www.crl.dec.com
An overview of the Cambridge Research Laboratory

'Smart Kiosk' Talks Back

The DIGITAL 'Smart Kiosk' uses advances in vision recognition to sense the presence of a user, facial animation and synthetic speech to greet and engage users in scripted conversations, and Internet technology to provide information.

By Andrew Christian and Brian Avery, Cambridge Research Laboratory, Cambridge, Massachusetts

andyc@crl.dec.com; bavery@crl.dec.com

You walk into the café, shaking off the cold. "Where is the coffee?" you wonder as you peer around the interior, dimly lit by recessed halogens and flickering computer monitors. A slight movement to your left catches your attention. The red-headed woman on the computer screen almost seems to be looking at you. She watches until you stop just a few feet away. "Hello, and welcome to Cybersmith!" she says with a smile. "Would you like to learn about our store?"

You've just met the world's first "Smart Kiosk," developed by the Smart Kiosk research team at DIGITAL's Cambridge Research Laboratory. The project was initiated to explore how advances in human-computer interaction (HCI) technology could be applied to improve public kiosks. The kiosk that until January 1998 had been installed at Cybersmith Café was our first prototype kiosk running in a commercial location. (See accompanying story about Cybersmith usage data.)

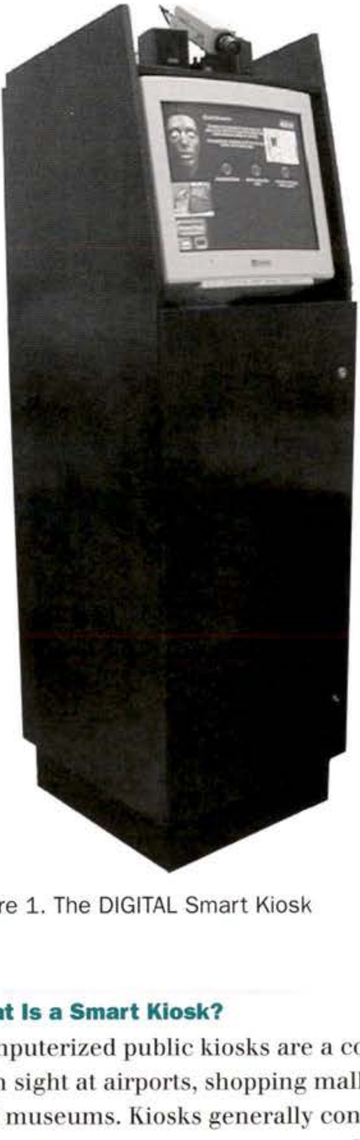


Figure 1. The DIGITAL Smart Kiosk

What Is a Smart Kiosk?

Computerized public kiosks are a common sight at airports, shopping malls, and museums. Kiosks generally contain a PC or Macintosh that displays multimedia content and gets client input from a touchscreen. But current kiosks sense the world only when someone presses a button or swipes a card. Then they launch into their programmed presentation whether or not anyone is actually watching the screen. They continue until the lack of button-pushes indicates that the viewer has left. Current kiosks are blind and deaf to the world.

The goal of the Smart Kiosk project is to use sensing technology to identify the presence of interested people to engage them in personable interaction. It's not sufficient to determine whether a person is near the kiosk; we need to determine whether the person is interested in using it. For example, in an early experiment, we had a kiosk that would begin talking whenever someone was near it. Having the kiosk say "Hi!" every time a person passed annoyed everyone and quickly taught staff members to walk just outside of the kiosk's visual sensing range.

Good environment sensing allows a kiosk to "personalize" the interaction with a customer. We believe that people will respond positively to kiosks that are aware of their presence and demonstrate that awareness in a friendly fashion. This goal can be accomplished by placing an animated face on the kiosk and using it as a focal point of attention. The kiosk becomes more personable with a face on the kiosk that watches people, smiles in a friendly manner, and talks to them.

What Does the Kiosk Look Like?

We've built several prototype kiosks to try out ideas on sensing technology and methods of displaying awareness. Physically, the kiosk is approximately 6 feet tall and contains a 21-inch touch-

The project was initiated to explore how advances in human-computer interaction technology could be applied to improve public kiosks.

screen with a single camera mounted directly above the touchscreen (Figure 1). It is a self-contained unit, with all of the software and content stored inside the box on two AlphaStation 500 computers running DIGITAL UNIX.

A sample screen from the kiosk display is shown in Figure 2. The touchscreen display contains four elements: a talking head, or avatar, a large area for displaying content, an image of the view from the camera, and a set of navigation buttons. The avatar watches the person using the kiosk by turning to face the user. The avatar also speaks appropriate phrases as the person navigates the kiosk content. The large content display area is actually a Web browser that displays standard HTML. All graphical content for the kiosk is stored in the form of HTML pages, simplifying creation and administration. The image of the view from the camera shows people what the kiosk "sees"; though not necessary, people seem to enjoy seeing themselves, and it helps people understand what the kiosk is doing.

Internally, the kiosk software model consists of a vision system, an avatar, a Web browser, a Web server, and a controlling "behavior" system that decides what should be done.

Consider this possible kiosk interaction. First, the vision system detects a person walking in the vicinity of the kiosk. The vision system tracks the person and directs the avatar to turn towards that person. If the person approaches the kiosk, the vision system notifies the behavior system that a prospective client is near, which then commands the avatar to greet the person. If the person remains near the kiosk, the behavior system switches to "client" mode and displays a home page on the Web browser. Each button-press by the client is passed to the behavior system, which decides what the avatar should say and what the browser should display. If the client doesn't press a button within 1 minute or so, the behavior system commands the avatar to prompt the client with helpful suggestions, e.g., "Please select a button." Throughout the interaction, the vision system tracks the client and directs the avatar to face the client. When the client walks away, the vision system notifies the behavior system that the client is out of range, which then directs the avatar to politely say "Good bye" and switches the browser to display "attracting" pictures.

Sensing

The kiosk vision system tracks people near the kiosk using a single camera mounted above the touchscreen. The camera is equipped with a wide-angle lens and is inclined downwards from the horizontal approximately 30 degrees. This field of view is deliberately arranged so that the kiosk can see the feet of people standing near it. The kiosk can determine how far away a person is standing by locating his/her feet and calculating how far away the person's feet are from the base of the kiosk.

The kiosk vision system detects the presence of a person by recognizing changes in the image recorded by the camera. Initially the vision system grabs an image of the background with

This prototype "Smart Kiosk" was created by the good guys at the *Cambridge Research Laboratory*, a part of Digital Equipment Corporation.

Figure 2. Screen capture from the Smart Kiosk showing "Nethead Red," a character created by Cybersmith Café

no one in front of the kiosk. Each new frame is subtracted from the background image, and a mask image is formed by marking pixels that have changed (Figure 3). Large activated regions in the mask image are examined to see if they correspond roughly in size and shape to one or more people; a short object, which could be a dog or small child, can be safely ignored. Whenever people are not found in the scene, the stored background image is progressively averaged with the latest image captured. This periodic background updating allows changes in lighting conditions or a new piece of furniture in the background.

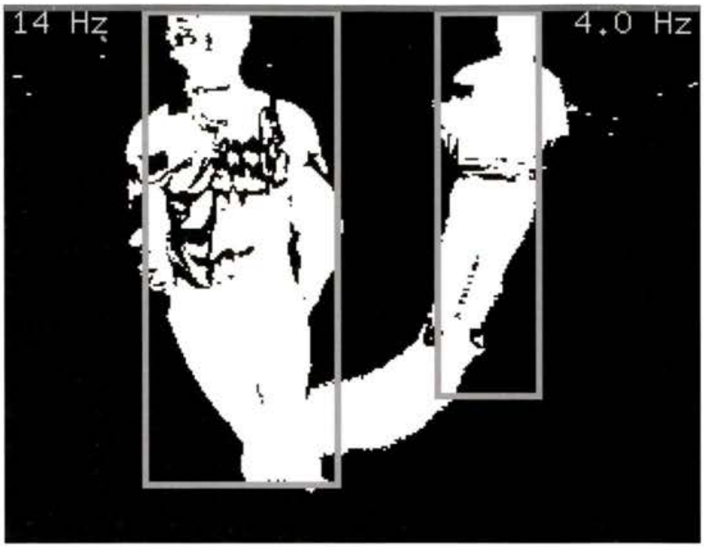


Figure 3. Mask image from the vision system

Speaking

The avatar is a modified version of the DECface software, originally developed by Keith Waters. DECface (Figure 4) is a three-dimensional model of the front of a head. DECface "speaks" by synchronizing mouth movements with either the DECtalk speech synthesizer or with recorded audio files that have been processed by a speech-recognition engine.

In addition to moving the mouth, DECface has articulated eyeballs, eyelids, and a set of facial muscles that allows the avatar to both talk and display human-like expressions. The eyes, eyelids, and facial muscles can be controlled by annotated speech files. For example, the following command:

```
<smile>Hello, my name is Paul!
<wink> How are you? <~smile>
```

will cause DECface to smile, say "Hello," wink, say "How are you?" and finally stop smiling. The more dynamic speech command:

```
<nod slowly>Yes, I agree
with you.
```

will cause DECface to say "Yes" while the avatar nods up and down slowly. The kiosk version of DECface comes with approximately 50 common human facial gestures. Additional facial gestures may be defined by the person creating kiosk content.

Creating Your Own Kiosk

Advanced technology such as vision systems and animated talking faces do not guarantee a successful kiosk. Kiosk content is critical; if the information on the kiosk is old, irrelevant, or poorly presented, people will not use the kiosk. Our experimental kiosks were designed so that people outside of the research laboratory could easily create and maintain kiosk content.

A content creator must specify three types of information for the kiosk: what to say, what to show, and when to say and show it. The files used by the

Cybersmith Usage Data: Poking Fun at the Avatar

The Smart Kiosk had been installed for over 4 months at the Cybersmith Café in Harvard Square, Cambridge, Massachusetts. Cybersmith staff, who had graciously volunteered to test the kiosk, spent many hours creating timely content. The kiosk greeted customers at the front door, informed them of activities and events, and assisted them with the store layout. About 900 people used the kiosk each month. An average interaction lasted about 2 minutes, but many people used the kiosk for more than 5 minutes.

The avatar attracted attention, and people usually responded favorably. Some users remarked that "it caught my attention when it looked at me," but they rarely noticed the vision system nor did they realize that the kiosk senses their presence.

Users also enjoyed poking the avatar. Sooner or later, users of the Smart Kiosk touched a feature on the screen, such as the eyes. The head is programmed to say a randomly selected phrase when it is touched, such as "Stop touching me!" or "Ouch! My eye!" Surprisingly, some people poked at the talking head for as long as 10 minutes!

Now that experimentation with this version of the kiosk is complete, a next-generation Smart Kiosk prototype is being developed. Testing at a commercial location is planned for later in the year. ✳

avatar are either recorded audio files or plain text files for speech synthesis (with expression annotations). The recorded audio files are processed by a speech recognition system that annotates the audio file with phonemes. The files displayed by the Web browser are standard HTML. The final type of file is a script file that specifies the behavior of the kiosk. For example, the script:

```
html opening-page.html
say <smile>Hello, and welcome
to Cybersmith!<~smile>

pause 20 seconds

say Go ahead, push a button!
. . . .

label help-button-pushed

html help-page.html

say Let me tell you how to use
this kiosk.

. . . .
```

displays an opening page in the browser and has the avatar speak a greeting. If the user hasn't pushed a button within 20 seconds, the avatar will prompt the user to press a button. If the user pushes the help button, the help page will be displayed in the browser, and the avatar will proceed to tell the user how to operate the kiosk.

All three types of kiosk content (speech, HTML, and control scripts) are stored on a local Web server. Standard Web site tools are used to create and edit the content. A person with experience in Web-site design usually needs 3 or 4 hours to become comfortable with the mechanics of creating kiosk content. However, it is critical to have the content designer sitting next to a kiosk when developing content; immediate feedback with content on the kiosk significantly accelerates the content development process. Because a single kiosk unit complete with machine vision is (currently) an expensive piece of hardware, we provide our content developers with "staging" kiosks that don't have a machine vision system. A large "exit/enter" button located on the touchscreen provides the "client here/gone" functionality.

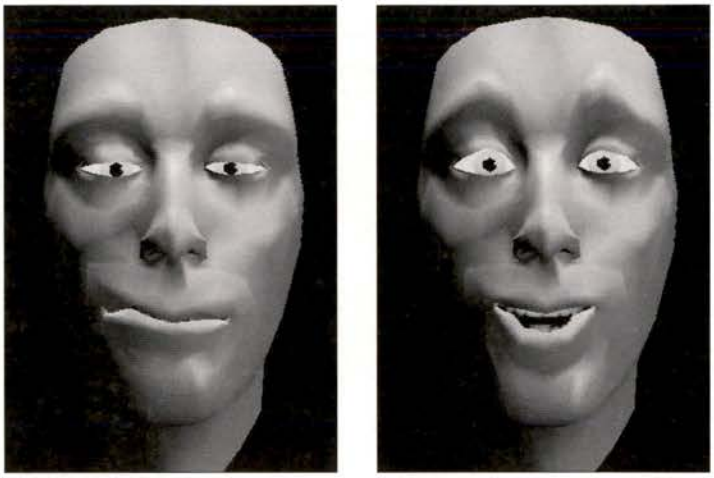


Figure 4. DECface

Commercializing the Smart Kiosk

Current work on the Smart Kiosk project is directed towards enhancing our sensing technology and reducing the cost and size of an individual kiosk unit. We also are exploring business opportunities for commercializing smart kiosks; we believe that the rapidly growing US kiosk market, which is forecasted to be $830 million in 1998 and to grow 40% per year, is an exciting opportunity for DIGITAL.

In addition to long-running experiments at Cybersmith and our laboratory, we have been taking the kiosk to conferences: SIGGraph '97, the DIGITAL Business Partner Executive Seminar '98, and the DIGITAL Industry Analysts Conference '98. This has enabled us to evaluate its utility at trade shows and short-term installations.

Smark Kiosk project team members are Brian Avery (software development), Andrew Christian (software development and team leader), Dick Greeley (business development), and Mike Essig (business development).

Acknowledgments

We wish to thank Lauren Winter-Bigelow of Cybersmith for enthusiastically supporting this project from its conception and spending so much time developing the Cybersmith content and the CRL staff for their help and tolerance in listening to the kiosk babble forth daily. ✳

web*sites*

internet
http://www.crl.research.digital.com/projects/kiosk

intranet
http://www.crl.dec.com/projects/kiosk

internet
http://www.cybersmith.com
Visit Cybersmith Café on the Web.

AltaVista Media Search: Delivering Indexed Audio and Video on the Web

Based on technology originally acquired from outside the corporation, the AltaVista Media Search system is materializing within DIGITAL as a multifaceted challenge involving large-scale systems performance, networking, vision, speech recognition, databases, and information retrieval.

By Brian Eberman, Cambridge Research Laboratory, Cambridge, Massachusetts, and Gil Brezler, External Technology Group, Maynard, Massachusetts

bse@crl.dec.com; gil.brezler@digital.com

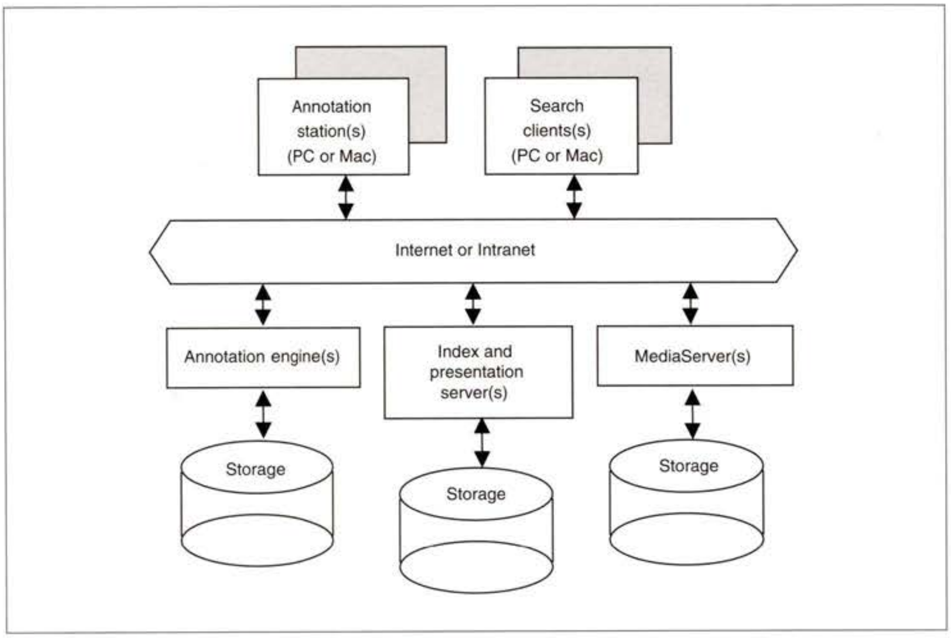


Figure. AltaVista Media Search architecture

As activity on the World Wide Web increases, new tools have been created to search and retrieve information in a variety of forms: first text, then audio and images. Now, with the availability of low-bit-rate video servers from RealNetworks and Microsoft, accessing video on the public Internet and private intranets is becoming more commonplace. However, several problems still exist regarding the mechanisms for: 1) annotation, 2) management, 3) searching, and 4) large-scale delivery.

Involving participants from the DIGITAL Cambridge Research Laboratory (CRL), the UNIX Business Segment, and Software Engineering Australia, the AltaVista Media Search project, formerly known as MediaVista, is developing both research technology and pilot-quality software to address these problems and test them in the marketplace.

Project Background

The AltaVista Media Search project evolved from the INFORMEDIA project at Carnegie Mellon University (CMU). INFORMEDIA was part of the larger National Science Foundation (NSF) Digital Library Initiative. The INFORMEDIA project was designed to establish an extremely large online video library and create intelligent, automatic mechanisms to populate the library and allow for full-content, knowledge-based search and segment retrieval via desktop computer and local area networks.

In late 1993, DIGITAL was asked to support CMU's proposal to the NSF. Thereafter INFORMEDIA became the responsibility of the External Technology Group (ETG) with Gil Brezler serving as project manager for DIGITAL. An "INFORMEDIA summit meeting," organized at the behest of Bob Iannucci, CRL director, and Alan Nemeth, technical director of the UNIX Business Segment, brought together interested parties from CRL, ETG, and the UNIX Business Segment—marking the start of the AltaVista Media Search project at DIGITAL.

The summit resulted in two project plans: one submitted by Brian Eberman to CRL and another submitted by David Kovalcin to the UNIX segment. Brian and David joined forces in January 1997 at which time software and demonstration technology was transferred from INFORMEDIA to CRL. Since then the project has grown considerably. CRL now has several research, engineering, and business staff working in the area. Additionally, Mike Burrows of DIGITAL's Systems Research Center has provided contributions. With the recent start of a commercial pilot effort, funded by the Internet Business Unit, the number of people from UNIX has substantially increased. Since fall 1997, Software Engineering Australia has been contributing engineering talent. Several groups within DIGITAL also have provided advice, code, and information: the Euromedia project of CEC Karlsruhe in Germany, the media effort within Computer Special Systems, and, of course, AltaVista engineering.

Multimedia Indexing

Why are so many people excited by AltaVista Media Search? The ongoing revolution in the way that video and audio information is stored, managed, edited, and browsed will create tremendous opportunities for DIGITAL in storage, systems integration, and products. Indexing and universal media access can help unlock this opportunity and help DIGITAL become a dominant technology provider.

Reductions in the cost of technology, the proven feasibility of certain critical technology, and strong market forces have fueled this revolution. The price of digital storage, now competitive with analog storage, and the additional utility of digital media is becoming very attractive to owners of large multimedia archives.

The emergence of commercial players of audio and video for use on the public Internet also has advanced this revolution. The RealPlayer product set, released in the last 2 years, has experienced tremendous growth. Now Microsoft (with its NetShow system) is rapidly expanding its presence in the low-bit-rate video field.

Lastly, at least for large archives, there is a compelling business reason to pursue this technology. In the last several years distribution channels for multimedia content have burgeoned. Not long ago there were only three major television broadcast networks in the US; now there are five, and soon there may be more. Cable and satellite television are making serious inroads in the distribution of original content. Games, music videos, and the Internet itself provide additional channels. This has created pressure on the content producers to create content faster and at lower costs, possibly by using old materials for new purposes (repurposing) or resurrecting these resources to create new material (reuse). Digital retrieval and storage make this significantly more cost-effective.

One fundamental problem with a video archival system is that the video cannot be viewed faster than real-time. Imagine searching for a specific paragraph in a large book by paging through it one page at a time! This problem faces organizations that want to reuse archived materials and people who want to use online multimedia for on-demand training or research. A means for indexing and search is needed.

AltaVista Media Search System

The AltaVista Media Search project has built a demonstration system to investigate means that fill the fundamental requirements of a solution to this problem. The system would have to provide

- **Direct, indexed access into any part of a video or audio stream.** This is required to handle the real-time nature of video and audio files.

- **Basic management, access, and annotation services.** Management of this type of data is complex. The video can appear in multiple forms, each form appropriate for a different user. Many types of functions can be applied to the video to produce new types of views of the content. The content must be distributed throughout an organization to achieve adequate bandwidth and to allow a distributed organization to create content. Finally, annotation of content for indexing is costly and difficult, and any automatic or semiautomatic tools that can be developed would be helpful.

- **Universal access.** Several customers have made a clear demand: it must be possible to get to the content from anywhere and using any platform.

- **Open approach.** System growth must be possible. Technologies in this area are immature and evolving rapidly, both in the delivery area and in methods for automatic creation of annotations. The system must be designed in an open way so that new programs and techniques can be easily incorporated.

With these design goals, both an initial prototype and the current system were constructed. The Figure shows the architecture of the current system. The important components are servers to distribute media (referred to as the MediaServers), the indexing and presentation server(s), and the annotation engine(s).

The ongoing revolution in the way that video and audio information is stored, managed, edited, and browsed will create tremendous opportunities for DIGITAL in storage, systems integration, and products.

Searching the Archives via AltaVista Media Search

The DIGITAL Corporate Archives is using AltaVista Media Search to access and retrieve hard-to-find information stored on audio- and videotape. Finding an elusive piece of information on analog tape can take hours. The archives needed a way to deliver specific, filtered information from this material direct to DIGITAL employees via the corporate intranet.

AltaVista Media Search is helping the archives search and retrieve information from two valuable but underused collections:

- The oral history collection. An extensive set of audiotaped interviews with early DIGITAL employees.
- Employee Forums produced by the DIGITAL Video Network, which contain a wealth of company policy and financial information.

Both collections will soon be available for research on the AltaVista Media Search demonstration database via links from the Corporate Library Group's WebLibrary. By doing an AltaVista Media Search at their desktops, users will be able to search for subjects ranging from PDP-1 to Alpha and then listen to or view only the information they need.

For information about the archives project, contact Craig St. Clair, DIGITAL Corporate Archives.
craig.stclair@digital.com ✳

The goal is to make possible the indexing of all audio and video on the Web without the need for associated transcripts.

The MediaServer system stores and serves up the actual content and provides a uniform interface to all forms of the media. In addition, it handles storage and access control, if implemented. It is used to store MPEG files, RealVideo files, and our own internal low-bit-rate video format. The MediaServer provides a simple URL–based protocol for accessing these different forms of the same content.

The index and presentation system has three major subcomponents.

- A meta-database (currently Oracle), which is built on top of a relational database. This system provides structure access to all the meta-information about a video or audio. The meta-information consists of the usual information (the title, author and source), but more importantly it stores all the annotations about the media. These annotations take the form of a lattice, or sequence. For example, using speech recognition technology, we can align transcripts with the audio component of the video. The lattice then consists of the starting and ending time of each word in the transcript and the word itself. The system is sufficiently flexible so that a wide variety of annotation forms can be stored, although currently we only store aligned transcripts and images (called keyframes) that represent parts of the video.
- Modification to the SRC's AltaVista engine NI2. In video and audio indexing, it is essential to index not only the words that were spoken during the video, but to determine where a particular word, phrase, or combination occurred in the video. AltaVista returns the HTML page that matches the query, and from the HTML page the "find" capability of the browser allows navigation of the document to the location that actually matches the query. What is needed for video is this find capability, and Mike Burrows was instrumental in giving NI2 this capability.
- The presentation system. This is a collection of CGI scripts, written in Perl5, which can be used to navigate the information space that has been indexed. The scripts communicate with the various services offered by the meta-database, NI2, and the MediaServer, allowing the user to perform searches, see responses, and view parts of the video stream.

Ongoing Related Research

There is keen interest in this area of work because of the potential business opportunities, as well as the rich vein of research that these opportunities present. Building such a system exposes many problems in large-scale systems performance, networking, vision, speech recognition, databases, and information retrieval. The CRL team is working to enhance the system's capabilities by performing research in many of these areas.

Currently, researchers in the CRL Speech group are investigating the complexities of building systems that can recognize words directly from audio tracks. The goal is to make possible the indexing of all audio and video on the Web without the need for associated transcripts. An ongoing project in "speaker spotting" is striving to determine when a collection of target speakers is speaking in an audio track.

Meanwhile, the Vision group at CRL is working on image analysis to improve the user interface, by looking at better algorithms for "shot-cut" detection and keyframe analysis. Another exciting area is large-scale image matching, which could be applied to navigating the information space using similarity of images. One of the most important types of information concerns people. The Vision group is investigating the detection of people on the basis of color information and motion, with the intention of making this a form of automatic annotation.

Lastly, we believe the structure of the system lends itself to interesting experiments in performance of large-scale systems. It may provide a framework for building loosely coupled indexable information systems consisting of a structured memory component provided by the database, a collection of high-performance indexes, and a presentation/query front-end that uses these services to provide information relevant to end users.

It is expected that other ETG projects will contribute to future products and services just as the INFORMEDIA project contributed to AltaVista Media Search. External investments in technology provide another avenue for DIGITAL's long-term technological progress. ✱

web *sites*

The following URLs address the corporate intranet.

http://www.crl.dec.com/projects/mvista
Find background information about the project.

http://mvista.crl.dec.com/
The AltaVista Media Search demonstration includes content from National Public Radio, WGBH Boston, the DIGITAL WebIR group, the DIGITAL archives, and other DIGITAL organizations. **User feedback is welcomed!**

Cashmere: Software Coherent Shared Memory for Clusters of Workstations

Cashmere extends to a cluster the shared memory programming model found in symmetric multiprocessors. It exploits intranode hardware coherence and very fast internode communication supported by MEMORY CHANNEL to provide efficient transparent shared memory across a cluster of multiprocessors.

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Low-latency remote-write networks, such as MEMORY CHANNEL, allow transparent, inexpensive, large-scale parallel computing on clusters of either uniprocessors or shared memory multiprocessors (SMPs). One potential problem with such systems, however, is the relative difficulty in harnessing their performance potential using a message passing programming model. To simplify the task of programming such clustered architectures, we have developed a system that supports a shared address in software across a cluster. While our system runs on both uniprocessor and multiprocessor clusters, this paper focuses on the multiprocessor implementation, which allows for several important optimizations that enhance the system's performance. The challenge with a multiprocessor implementation is to take advantage of hardware shared memory for sharing within an SMP and to ensure that software overhead is incurred only when actively sharing data across SMPs in the cluster. Our system—Cashmere—achieves this by implementing a "moderately lazy" release consistency memory model, with multiple concurrent writers, directories, home nodes, and page-size coherence blocks across nodes. We also employ a novel mechanism for updating working copies of data within a node that allows a high level of asynchrony by eliminating the need for TLB shootdown.

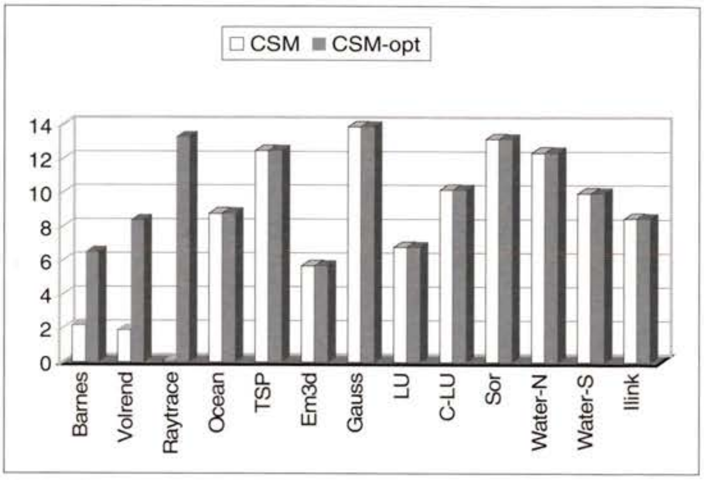

Figure. Speedup of unmodified (CSM) and tuned (CSM-opt) applications on 16 processors

A number of other software coherent systems have been implemented on top of clusters—many of them yielding excellent performance for different applications. The novel aspects of Cashmere lie in the careful design of the coherence protocol, which attempts to maximize performance by taking advantage of the special properties afforded by the MEMORY CHANNEL network, such as remote writes, total write ordering, and cheap broadcasting. Performance studies for many scientific applications on a cluster of DIGITAL AlphaServer 4100s indicate that shared memory programming on a medium-sized cluster can yield excellent performance results.

Protocol Overview

Cashmere is a *two-level* coherence protocol that extends shared memory across a group of SMP nodes connected via a MEMORY CHANNEL network. The system implements a multiple-writer, release-consistent protocol with applications required to adhere to a data-race-free programming model. Simply stated the data-race-free model requires conflicting shared memory accesses to be protected by locks and/or barriers that are explicitly visible to the run-time system. Our protocol treats the local memory on each node as a cache for shared data and is reminiscent of a cache-only memory architecture (COMA). Each shared memory page is initially assigned to a *home* node in the system. The home node provides other nodes with a copy of the page should those nodes choose to reference data in that page. Initially all nodes, with the exception of the home node for a page, have no permission (as indicated by the TLB) to access that page. Protocol actions are triggered in response to four types of events: read page faults, write page faults, release synchronization operations, and acquire synchronization operations. A read page fault forces the faulting processor to contact the home node for the page and make a copy of the page data in local memory. The faulting processor can then resume operation. A write fault fetches data if necessary and also records the event on a local per-node list, called the dirty list. It also makes a copy (called a twin) of the page before writing it. This copy will be used later to determine which parts of the page have been written by processors within the node. During a release synchronization operation, the processor performing the release operation peruses the dirty list and notifies all sharing nodes about modified pages. Notification takes the form of appending the page number to a list (called the write notice list) on the remote sharing nodes using MEMORY CHANNEL's special remote write capabilities. In addition to sending notifications, the releasing processor also compares the working copy with the twin copy and sends the differences between the two to the home node. This operation is called diffing. Finally, on an acquire synchronization operation, the acquiring processor peruses the write notice list and invalidates copies of all pages found in that list. The home node never invalidates a page; it always has an up-to-date copy, since it is the repository for all other nodes' modifications.

The protocol exploits hardware coherence within a node by sharing the physical page frame for a shared frame. This optimization allows transactions from different processors within a node to be coalesced, resulting in reduced data communication, as well as reduced consistency overhead. Through additional novel optimizations, the protocol ensures that processors within a node can execute with a high level of asynchrony. One example of such an optimization comes into play during a page-update operation. If a processor wants to get a newer copy of a page already present on its node, it cannot simply copy the data it receives from the home node on top of the destination page frame, since the new data may overwrite the modifications performed by other local processors on its node that are also writing the page. A common solution to this problem is to *shootdown* the other processor's mappings (within the SMP), preventing them from writing the page. To avoid this overhead, Cashmere employs a novel *reverse-diff* operation. The processor simply compares the incoming data to the existing twin (if one exists) and then writes the differences to the working copy as well as to the twin. Since applications are required to be data-race-free, these differences are exactly the modifications made on remote nodes and will not overlap those made on the local node. Updating the twin ensures that only local modifications are sent to the home node at the time of the next release.

The Cashmere Programming Model

Like most other software DSM systems, Cashmere supports a parallel execution model based on processes that share data through explicitly allocated shared memory regions. A limited amount of support for pthreads also exists, but pthreads are not allowed to move between nodes in the cluster (though they are free to migrate between the processors of a node). During initialization, the runtime system creates a user-specified number of processes on a user-specified set of machines on the cluster. A special memory allocator allows for the allocation of shared memory, while synchronization between processors has to use system-defined primitives. Cashmere currently supports locks, barriers, and flags but can be easily extended to incorporate other synchronization primitives if deemed necessary.

Writing a Cashmere program imposes few restrictions on the programmer. A Cashmere-specific initialization routine must be called before any accesses to shared memory can be done. Another Cashmere-specific routine must be called at the end of initialization to indicate that the parallel part of the program is about to start. Shared memory should be allocated and freed using a separate set of malloc and free routines provided by the runtime, and synchronization has to be implemented using the supplied synchronization primitives. The remaining parts of the program look exactly as they would on an SMP.

Methodology

Our cluster at the Cambridge Research Laboratory (CRL) consists of four AlphaServer 4100 systems connected by a MEMORY CHANNEL network. Each AlphaServer 4100 has four 400-MHz 21164 processors, each with 8-KB on-chip instruction and data caches, a 96-KB on-chip combined second-level cache, and a 4-MB board-level cache. The system bus bandwidth is a little over 1 GB/second.

The MEMORY CHANNEL network allows a process to transmit data to a remote process without any operating system overhead via a simple store to a specially mapped page. The latency for a message is approximately 3.3 microseconds, while the bandwidth for a point-to-point link is about 70 MB/second. The aggregate network bandwidth is close to 100 MB/second. We have measured performance for 13 applications; the first 8 are taken from the Splash2 suite, while the remaining come from a variety of sources. We have run the largest datasets available to us and sequential execution times are well over 100 seconds and, in some cases, over 1,000 seconds for most of our applications. The application suite includes LU, Contiguous LU, Ocean, Raytrace, Barnes-Hut, Water-Nsquared, Water-Spatial, Volrend, Sor, Gauss, TSP, Ilink, and Em3d.

Results

The Figure shows the speedups of our applications when run on our cluster. Speedups are computed with respect to the time to execute the original sequential application. The white bars show the speedup for the applications as they were originally written. The gray bars show the performance for the same applications after they have been tuned to best take advantage of the cluster environment. Only three tuned applications exhibited unacceptable performance in their original form: Raytrace, Volrend, and Barnes-Hut. It may be possible to improve performance through tuning for the remaining applications as well, but we have not attempted this since their performance ranged from acceptable to good. Our applications exhibit good speedups especially after modifications have been applied. Although it is likely that most of these applications would do better on a 16-processor server with full support for shared memory in hardware, the performance exhibited by the cluster implementation is quite competitive. The low communication overhead and high bandwidth of MEMORY CHANNEL are crucial in achieving this performance. Future MEMORY CHANNEL generations with higher per-link and aggregate bandwidths are likely to provide further performance improvements as well.

Conclusions

Cashmere is a distributed shared memory system that supports a shared address space in software across a cluster of machines. It uses a sophisticated two-level protocol that provides a coherent view of memory across nodes but exploits the hardware coherence within a node. This optimization significantly reduces the software overhead that has to be paid for coherence maintenance. The exploitation of MEMORY CHANNEL's special features makes the remaining cases relatively inexpensive, resulting in a system that can provide an efficient shared-memory programming model.

The availability of shared memory, however, does not imply that one should ignore the clustered nature of the underlying architecture. Application tuning to reduce the frequency of communication and synchronization can have a dramatic effect on performance, as evidenced by our results. Cashmere provides an environment that allows for rapid, easy development of correct applications relative to pure message passing. Tuning can then be applied to the few routines or inner loops that dominate the computation.

Acknowledgment

This work was done in collaboration with the Cashmere group at the Department of Computer Science, University of Rochester, Rochester, NY. ✻

web*sites*

internet
http://www.cs.rochester.edu/u/kthanasi/cashmere.html

intranet
http://www.crl.dec.com/personal/kthanasi/csm_manual/csm_manual.html

SimOS-Alpha: Complete Machine Simulation of Alpha Multiprocessors

A flexible, full-system simulation tool, SimOS supports operating system development, performance characterization, and computer architecture development, enabling users to make the 'speed/detail' tradeoff depending on their simulation needs.

By Edouard Bugnion, Stanford University, Palo Alto, California; James Hicks, Cambridge Research Laboratory, Cambridge, Massachusetts; and Luiz A. Barroso and Ben Verghese, Western Research Laboratory, Palo Alto, California

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SimOS is a machine-simulation environment designed to perform detailed studies of complex computer systems, operating systems, and applications. Unlike most other simulators, SimOS simulates the complete hardware of a computer system, since it contains software models for all the different hardware components of a modern computer system (Figure 1). In contrast, most other environments simulate only a subset of the hardware and only the user-mode instruction set. Therefore, they emulate only the behavior of the system software while simulating the instructions of application software.

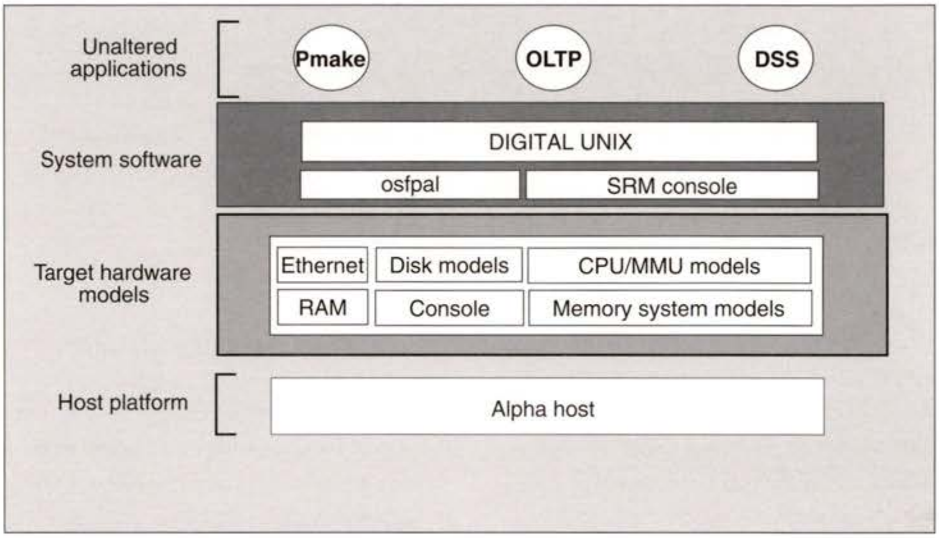

Figure 1. Complete machine simulation

Although machine simulation is a well-established technique, it has traditionally been limited to small-system configurations and relatively short tasks, such as booting the operating system. In contrast, SimOS executes with sufficient speed and detail to simulate full system software and complex application programs.

SimOS originated at Stanford University with SimOS-MIPS, a version that modeled MIPS-based multiprocessors. The SimOS-Alpha project was started at DIGITAL's Western Research Laboratory (WRL) to simulate servers composed of DIGITAL Alpha AXP processors.

A Tool for Research and Development

Machine simulators have traditionally been developed for very specific purposes, for example, to help boot an operating system on a new processor architecture or to model the performance of a new CPU architecture. SimOS models hardware with enough detail that it can run virtually any application, including the commercial applications that dominate today's server marketplace. It can even model a cluster of SMPs and yield deterministic results. SimOS was designed to service three different communities—computer architects, system software engineers, and application engineers—allowing them to make informed design tradeoffs for next-generation systems on the most important workloads.

Computer architects have used SimOS to evaluate design tradeoffs for next-generation processors and systems. SimOS easily supports the addition of new processor pipeline, cache, and memory system models. This allows computer architects to use an execution-driven machine simulator to run complex workloads and evaluate their overall performance, including the often subtle interactions between applications, the operating system, and the I/O subsystem.

Operating system developers have used SimOS to debug and tune the performance of kernel code. The determinism, visibility, and non-intrusive anno-

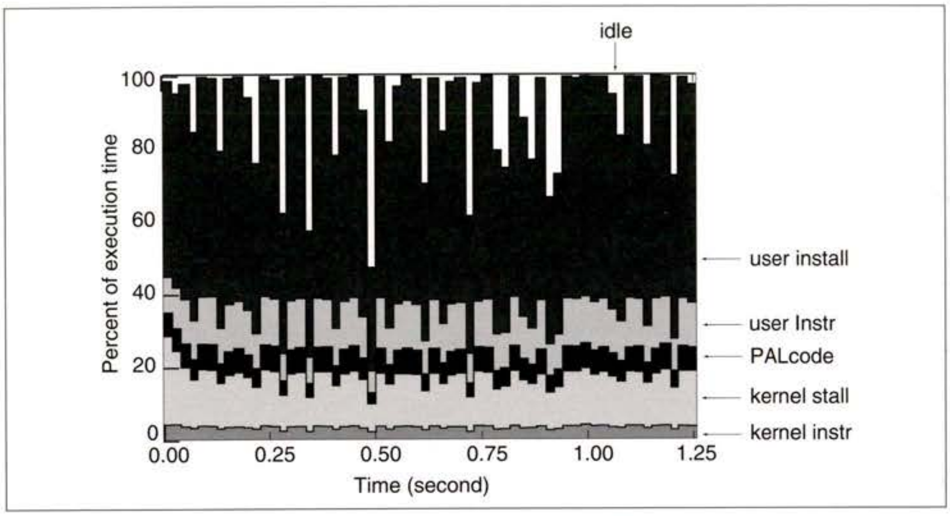

Figure 2. Dynamic execution profile of a four-processor configuration

tation mechanism of SimOS make it an ideal development platform. Additionally, SimOS can be configured to match next-generation systems before the hardware is available, narrowing the time gap between the release of the hardware and the system software.

Application developers have used SimOS to characterize the overall performance of complex applications ranging from transaction processing workloads to compiler-parallelized programs. The flexible data collection and cache miss classification mechanisms provided by SimOS make it an effective tool to locate primary performance bottlenecks and to suggest corresponding optimizations.

Key Features of SimOS

SimOS addresses two particularly difficult challenges, thus making the study of complex workloads possible. The first challenge is to both achieve the high simulation speed needed to execute long-running workloads, and to simulate the system in enough detail to produce accurate results. To address this first challenge, SimOS includes a set of compatible models of the different components of the machine. Some of these models enable high simulation speed and are used to position the workload at an interesting point. SimOS can then switch to more detailed but slower models to study the particular portion of the workload in greater detail.

The second challenge is to effectively organize the voluminous raw data produced by the simulator in ways meaningful to the user. To address this second challenge, SimOS includes novel mechanisms that map simulation data back to concepts such as processes, synchronization routines, and transactions. Since the hardware-simulation models of SimOS do not take account of these various concepts, SimOS uses a flexible and non-intrusive mechanism, called annotations, to build higher-level knowledge about the state of the simulated system. Annotations are user-defined scripts that are executed when hardware or software events of interest occur. For example, an annotation placed on the operating system's context switching code tracks the name and process identifier (PID) of the currently running process. This annotation, when fired, reads the appropriate internal processor registers and kernel data structures to determine the current PID and process name.

Use of annotation scripts yields non-intrusive access to the entire state of the machine, and enables the SimOS user to control the collection of simulation statistics. For example, to gather the execution time breakdown results six annotations were placed to determine the dynamic execution profile of a transaction-processing workload (Figure 2).

SimOS-Alpha

SimOS contains both instruction set architecture–independent (ISA–independent) and ISA–specific components. ISA–independent components include hardware models for cache hierarchies, memory systems, and I/O devices, as well as the entire data collection subsystem. ISA–specific components model the processors and memory-management units. SimOS-Alpha is the version of SimOS that simulates Alpha-based servers. It adds an Alpha-specific CPU component to the original SimOS-MIPS version and provides support for 64-bit operating systems.

SimOS-Alpha is structured to model different I/O spaces and different implementations of the processors. However, SimOS-Alpha currently models the I/O space of the AlphaServer 8400 (Turbolaser) and the privileged instruction set of the DIGITAL Alpha AXP 21164 processor (EV5). The implemented hardware models are detailed enough to run essentially unmodified versions of both the PALcode (osfpal) and the operating system (DIGITAL UNIX 4.0). The simulator loads a simple SRM console, the PALcode and the kernel into memory. Our SRM console has been simplified to enable the use of less complex hardware device models in addition, a new SCSI device-driver was added to the kernel. The boot sequence initializes the console, which in turn boots UNIX as far as to the login prompt. At this point SimOS is ready to run standard applications.

SimOS-Alpha Processor Models

SimOS-Alpha contains three compatible processor models: The Delta simulator, the Epsilon simulator, and the Kappa simulator. The Delta simulator uses on-the-fly dynamic binary translation techniques to achieve high simulation speeds. Indeed, Delta can run workloads with only a tenfold slowdown over the underlying system. Even for complex applications such as a parallel compilation, Delta can simulate 25 million instructions per second on an 500-MHz EV5 and boot an eight-processor configuration to the single-user prompt in 30 seconds. For a database workload, its high simulation speed produced 8 TPC-B transactions per second.

The Epsilon simulator includes a detailed and configurable pipeline model of a dynamically scheduled processor. For example, Epsilon can be configured to resemble the pipeline of a 21264 (EV6) processor. Epsilon splits the execution of instructions into multiple phases: fetch, issue, and commit. It supports speculative execution by allowing uncommitted instructions to be aborted.

The Kappa simulator is a compromise between Delta and Epsilon in both speed and accuracy. It models only a simple processor pipeline in which instructions take a single cycle in the absence of a cache miss. It is, however, detailed enough to drive sophisticated models of cache hierarchies and memory systems.

Case Study: Memory System Performance of Commercial Workloads

Aside from the ability to evaluate operating system activity, perhaps the most distinguishing feature of SimOS is its ability to handle arbitrarily complex applications "out-of-the-box." This feature was critical in a recent study of the memory system performance of database applications under the Oracle 7 database management system.

After an extensive study of the memory system behavior of both on-line transaction processing (OLTP) and decision support (DSS) applications through hardware monitoring, it was clear that monitoring alone could not resolve all the issues. These issues included the effects of architectural parameters of the cache hierarchy and the classification of the cache misses. Working with real hardware, only the performance of that particular hardware configuration could be measured; the effects of varying parameters such as cache size and cache speed could not be studied. Understanding cache miss behavior requires both the visibility of on-chip cache transactions and the maintenance of additional state information, neither of which is feasible with current levels of integration.

Using SimOS-Alpha, the same database, benchmark scripts, and configuration could be used as in the monitoring studies on real hardware. Figure 2 shows an example of the execution profile of an OLTP application for a four-processor configuration. Validation studies comparing simulated and measured results showed a close match.

The simulations confirmed our expectations that OLTP benchmarks can benefit from very large board-level caches (Bcache). Although the hardware monitoring studies indicated that OLTP workloads were much more communication-intensive than typical scientific benchmarks, the relative importance of true sharing (actual communication) and false sharing (sharing of cache blocks while no data is transferred) remained unknown.

The SimOS data collection subsystem contains state machines that classify cache misses so that users can determine the cause of individual cache misses in a shared-memory multiprocessor. Cache misses are classified as cold, replacement, true sharing and false sharing misses. Using this cache miss classification algorithm, it was found that communication misses in OLTP are virtually all true sharing misses.

A Brief History of SimOS

Professor Mendel Rosenblum started the SimOS project in 1992 at Stanford University as a software simulation environment capable of studying operating system behavior. The original version of SimOS modeled MIPS–based multiprocessors and the Stanford FLASH machine. SimOS has grown to approximately 100K lines of code and now simulates the MIPS, Alpha and x86 architectures. SimOS is available from Stanford University and has been used in work resulting in about 20 major research publications.

The SimOS-Alpha project was started at the Western Research Laboratory (WRL) in November 1996. UNIX was first booted using a simple processor simulator in spring 1997. The development of Delta in June 1997 made it possible to study large workloads. The Cambridge Research Laboratory (CRL) developed the Epsilon simulator to evaluate processor design tradeoffs.

SimOS is being actively used at WRL for research in database performance and memory system architectures. It is used

SimOS is expected to be a valuable tool in the development of DIGITAL UNIX for next-generation AlphaServers.

at CRL, and at DIGITAL Semiconductor to study microprocessor architecture tradeoffs for future processors. It is used in the Server Business Segment group to make cache coherence protocol tradeoffs and hardware design tradeoffs.

The DIGITAL UNIX Base Product Group is actively pursuing the use of SimOS as a kernel development and performance analysis tool. SimOS is expected to be a valuable tool in the development of DIGITAL UNIX for next-generation AlphaServers. Upon successful completion of this trial, SimOS will be maintained as an additional internal DIGITAL UNIX kernel tool.

At Stanford, Ben Werther is working on booting Windows NT on top of SimOS-Alpha. At the Univerity of Michigan, the RIO project uses SimOS-Alpha for fault-injection studies.

Acknowledgments

We first wish to thank Mendel Rosenblum of Stanford University, whose vision started the project 5 years ago and who built the original version of SimOS with Steve Herrod, Emmett Witchel, Scott Devine and Edouard Bugnion. We also wish to thank Kourosh Gharachorloo and Basem Nayfeh at WRL, early users and testers; Drew Kramer, who provided valuable system configuration tips; and Lance Berc of the Systems Research Laboratory who provided the SRM console source used with SimOS and explained some of its mysteries. ✳

web*sites*

intranet
http://www-wrl.pa.dec.com/wrl/projects/SimOS
The SimOS project home page at the Western Research Laboratory

http://www.crl.dec.com/projects/scalable/simos
The SimOS project home page at the Cambridge Research Laboratory

internet
http://www-flash.stanford.edu/SimOS
The Stanford University SimOS Web page

internet
http://www.crl.dec.com/projects/scalable/simos/TOMACS96-simos.pdf
Download the ACM TOMACS paper by M. Rosenblum et al., "Using the SimOS machine simulator to study complex computer systems," which describes the design of SimOS and summarizes experiences with the tool.

intranet
http://www-wrl.pa.dec.com/~barroso/mem_sys.ps
Read the results of a case study on the memory system performance of commercial workloads.

Introducing Multivendor Systems Engineering

Expertise in problem management and engineering enables Multivendor Systems Engineering to solve customers' technical problems by serving as a link between customers, services, and engineering.

By Dianne Mahany, Multivendor Systems Engineering, Littleton, Massachusetts

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D. Willett

Multivendor Systems Engineering staff. Standing, from left: Lee Mulvey, MSE executive assistant; Peter van Roekens, MSE vice president; Mark Sulliven, MSE Engineering manager. Seated, from left: Dianne Mahany, MSE Business Operations manager; and Angela Smith, MSE Problem Management manager.

Within the DIGITAL Services Division lies a critical technical resource for customers of DIGITAL and other vendors. Multivendor Systems Engineering (MSE), led by Peter van Roekens, vice president, helps DIGITAL resolve the complex interoperability problems of some of the corporation's largest customers. Peter reports to Jean Hoxie-Wasko, vice president of Multivendor Customer Services' (MCS) Product Management and Development.

The fundamental goal of MSE is to help DIGITAL solve customers' escalated technical problems quickly and prevent them from recurring. To perform this mission, MSE works closely with engineering groups as well as with account teams and field technical support people. MSE operates on a 7 × 24 basis and frequently troubleshoots serious production systems issues in critical situations.

During the isolation and solution of difficult technical problems, MSE provides a critical technical link between the customer and the DIGITAL services and engineering groups. MSE delivers problem management and systems-level technical support for interoperability problems, as well as selected, proactive MSE site assessments upon request from the field, when resources are available.

MSE is often in a position to work with account managers, MCS, and engineering groups to retain key customer accounts. The group generates significant revenue for DIGITAL, directly through MSE site assessments and indirectly through customer implementation of MSE's upgrade and purchase recommendations over time.

MSE Organization

Peter van Roeken's staff includes his executive assistant, Lee Mulvey, and the managers of three MSE functional groups: Angela Smith heads MSE Problem Management, Mark Sullivan manages MSE Engineering, and Dianne Mahany oversees MSE Business Operations. The members of the Problem Management and Engineering groups are the key to delivering MSE's unique services.

Multivendor Systems Engineering (MSE) engineers work on a customer problem in the MSE Interoperability Laboratory. From left: John Atkins (seated), Jack McCrossan, Rick Heile, Pete Manzella (face obscured), Carl Patterson, and Steve Fortuna (seated).

MSE Problem Management

Customers' technical problems are prioritized and referred to MSE Problem Management because they are complex, have unclear engineering ownership, or contain interoperability or multivendor issues. Problem managers ensure that problems are assigned to the right engineering groups and provide communications on problems escalated to MSE. Problem managers also pull account teams and engineering support people to expedite action planning and manage the process of resolving complex problems as soon as possible.

MSE Problem Management monitors cases using the Integrated Project Management Tool (IPMT), provides analyses, and generates reports. It represents MSE in forums focused on problem escalation and management process improvements. A regular deliverable, retrospective analysis of particularly difficult customer situations is aimed at helping DIGITAL participants improve the quality of their contributions.

MSE Engineering

MSE Engineering is a group of highly skilled systems engineers whose core work is to isolate and resolve complex system and interoperability problems. In support of this work, MSE maintains a leading-edge computer laboratory of DIGITAL's and other vendors' hardware, and software environments can be re-created and complex problems can be isolated for study.

On field request, when resources are available, MSE Engineering also delivers MSE site assessments and recommends changes to selected customers. This work has fostered MSE's Site Assessment Certification/ Mentorship Program, designed to replicate MSE's technical skill level and create MSE site assessment "franchises" in the territories. In conjunction with the program, MSE uses the interoperability lab as well as actual site assessment assignments to help train field technical personnel and to certify individuals to perform the work.

For more information on MSE site assessments, contact Corinne Morrette at DTN 226-3664. For general information about MSE, contact Dianne Mahany at DTN 226-3784. ✳

web*site*

intranet
http://www.mse.tay.dec.com

Standards: A Lesson in Business and Quality

Contrary to the view that standards are restrictive—imposing conformity and uniformity, this article argues that, at DIGITAL, standards provide a framework in which invention and innovation can flourish.

By Eric Falkof, Standards and Methods Control, Corporate Strategy and Technology Group, Acton, Massachusetts

eric.falkof@digital.com

Recently, I heard a short-wave radio broadcast from the BBC about standards. The interviewer was asking about the business reasons for adhering to standards and the interviewee responded by describing several of the ISO standards, European Union standards, and other regulatory standards. The next day, I began a Web search using the BBC's own search engine for "standards" and found a page from "The Small Business Programme"[1] that provided a different view of standards.

The Small Business Programme is a series of broadcasts that describes how to start, run, and manage a small business, and it provides examples of such businesses ranging from sole proprietorships through partnerships and businesses that, although seemingly large, are still considered small for reasons defined according to law and custom in the United Kingdom. The series includes business plans, location selection, bookkeeping, and management. It is in the seventh installment that standards are mentioned, and they are not mentioned in the context of manufactured products, but in the context of how to manage a business successfully.

The program guide for this installment is entitled "Cashflow/payments & quality," and standards are mentioned in the segment called "Becoming a boss." After grappling with credit terms, customer references, and late payments, the program enters a unit about being a boss. To the developers of the program, we, the viewers, are the bosses. We are the managers who are responsible for making businesses operate according to the way we envision them, and we are responsible for ensuring that the business functions smoothly and efficiently, managing problems and avoiding pitfalls. The program guide says, "Most standards are management standards and are less about what you do than about how you do it."

Standards—The Means to an End

In this part of the course, standards are described neither as numbers that define a quantitative performance factor nor as procedural steps that must be followed without wavering. Instead, standards represent a means to an end; they are about how a goal is achieved, not how to achieve a goal.

There are many ways to build a table lamp, for example. Nobody developed a unique definition of "lamp" that everyone must follow. Nevertheless, the idea of "small, portable light-shedding device" gained popularity. Each lamp was developed using a different base, column, harp, shade, and finial. Yet all shed light! Because the socket for commonly available bulbs was already standardized, each lamp—each different from the other—could meet various customers' decorative requirements and still shed light, which was the original goal. The customer, the ultimate authority on survival of a business, decided whose standard of beauty and decor would win in the illumination marketplace. That there are so many lamp and lighting stores is a tribute to the diversity of tastes and choices. The goal was to shed light upon a table area, and the goal has been achieved in many ways. What uniformity and conformity there would be if there were but one or only a few ways to meet the goal! The freedom to invent within the framework of a goal allows such diversity to flourish.

The successful boss, according to the BBC program, sets goals but does not rigidly adhere to a single solution to achieve them. "In deciding whether to pursue a standard, you should ask yourself whether you will get a return on the investment of time and energy which will be involved. For instance, will customers you want to deal with be more likely to buy from you if you have [a] particular quality standard?" With this lesson, the freedom to invent merges with repeatability. Standards link to quality as repeatability of that creative performance sets customer expectations. Several decades ago,

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[1] *British Broadcasting Corporation Web site, The Small Business Programme, "Cashflow/payments & quality," 1997 (no longer posted on the Web).*

repeated experience with Japanese products set the expectation that all Japanese products were of low quality. Now the expectation is that Japanese products are of high quality; but this expectation is so only because the Japanese industries worked long and hard to bring it about. Their goal was the same as it had always been: to produce products. But they changed their methods without changing their goal. They showed that management standards affected how functions were to be done and were not about what to do to change a product.

When Managers Let Go

A lesson within the BBC lesson for any manager is the concept of letting go. "It requires mutual trust and a willingness on your part to let people make mistakes and to find ways of doing things that are not necessarily your own." In DIGITAL, standards are about how things get done, not about what to do. As standards are developed, a review process allows concerned persons from many disciplines the opportunity to participate in the development, review, and discussion of what the final document will say. Standards set goals, and it is up to responsible individuals to do whatever is required to meet those goals. There is no one defined path to the end. There may be recommended procedures or guidelines, but these are developed from the best practices and technology known at the time and are based on input from experts and practitioners. DIGITAL and the BBC program are consistent in practice and advice: each prescribes standards that are concerned with how the business is managed, how it produces goods and services of demonstrable and repeatable quality, and how it provides for the collected wisdom and ability of the employees as a way to develop and improve their offerings.

Meeting and Requiring Standards for Quality

DIGITAL's practices are consistent with the next lesson point: "Many big companies prefer their suppliers to have [standards] as a guarantee of consistency in the product they are purchasing." DIGITAL does have requirements for the quality of the goods it purchases from other companies. Similarly, DIGITAL understands the value of meeting standards of quality, so it sells quality products to other companies. Therefore, DIGITAL expects and sells products that are of consistent, repeatable quality. Furthermore, DIGITAL can provide documentation in advance that describes what the performance will be, so expectations of performance can be established even without a tangible demonstration. Often, DIGITAL's reputation for providing quality products is sufficient to convince purchasing parties that the quality guarantee will be fulfilled. Quality is expected and delivered with DIGITAL.

Commitment to High Standards

The BBC tells us that "Most quality standards involve an ongoing commitment—they are not one-offs, but will require constant monitoring and updating. You need to be prepared for the long-term investment before starting out. What message will it give to your customers if you have a quality standard and then lose it?"

DIGITAL began manufacturing computers and allied equipment 40 years ago, and it has always planned to provide a high level of quality to its customers. Indeed, it has fulfilled the concept of commitment by planning to stay in business and by doing so. Also, it has constantly monitored and updated its services and goods by monitoring and updating its standards as technology has advanced and as customer expectations demanded a higher level of quality. DIGITAL has never deviated from its path of following standards, and that path has provided success to the company and its customers. The promotional message from the lesson prior to the one described here said, "We look at... the challenge of becoming a boss for the first time and ask whether quality standards can help your business."[1] DIGITAL has shown that, yes, quality standards can help your business, and these same standards help your customers' businesses as well. ✳

web*site*

internet
http://www.bbc.co.uk/education/
View recent BBC business education programs.

DIGITAL and Mitel Bring Unified Messaging to Life

The DIGITAL Integrated Telecommunications Server transforms a Windows NT server into an integrated email and voice-message system with telephone-switching capabilities for local and remote access service.

By Mike Cassily, CTI Engineering, Nashua, New Hampshire

cassily@cti.zko.dec.com

D. Willett

The DIGITAL Integrated Telecommunications Server Team. Front row, from left: Rama Pachipulusu, Mary Russo, Deborah Bourquard, Helen Francini, Chin-Sim Kang, Ann Wong, and Diane Morin. Back row, from left: Manzur Hussain, Steven Chung, Peter Stopera, Anil Kapoor, Bruce Miller, Paul Sawyer, Paul Kotschenreuther, Gil Morris, Michael Cassily, Bob Alperin, Judy Sharos, Samir Amin, and Jean Armstrong. Not in the photo: Debbie Smith and Thomas Graves.

In the summer of 1994, a group of DIGITAL and Mitel engineers were brainstorming about workflow. Questions such as these arose:

- Have you ever missed a phone call because you forgot to check your separate voice-mail system?
- Have you ever been on a business trip and wished you could check your email once more before a meeting, but have no place to plug in your laptop?
- Has anyone ever called you to verify receipt of a fax, but the fax machine is down the hall, and you've been too busy to leave your desk all day? Or have you impatiently waited at the fax machine for a confidential message?

Their answer to these problems was the Integrated Telecommunications Server (ITS), an integrated messaging system that transforms a DIGITAL Alpha- or Intel-powered Windows NT server into an integrated email and voice-message server. It is a computer telephony solution that provides unified messaging (email, voice messaging, and optional facsimile) and telephone-switching services for local and remote access service (RAS).

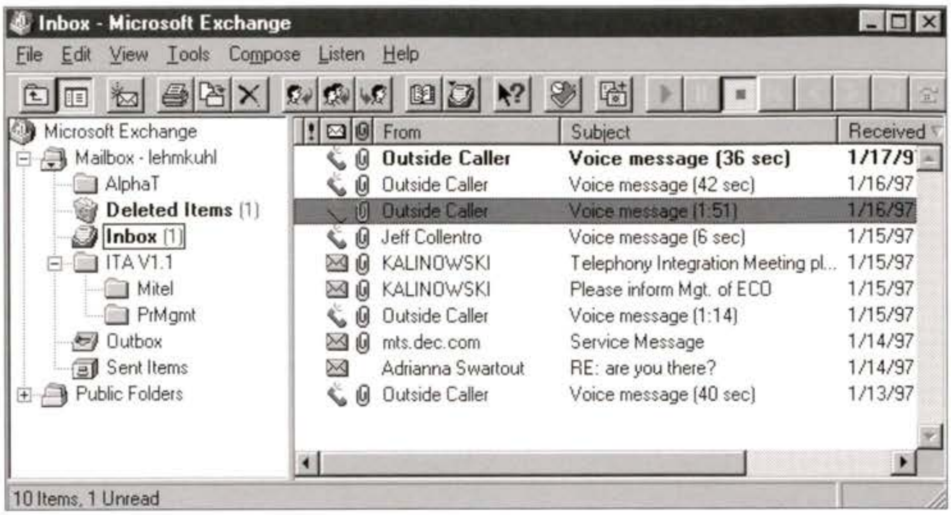
The Microsoft Exchange client manages voice and, optionally, fax messages in the same way as it handles electronic mail—with folders, drag-and-drop operation, and other familiar features (Figure 1). The Mitel MediaPath platform offers capabilities such as call hold, call forward, speed dial, incoming caller ID, call diversion, and call park; it is integral to the solution and can be managed from a desktop computer. Remote users telephoning into the server without a client computer can listen to voice messages, access their email messages through text-to-speech or fax capabilities, and reply to email with a voice message.

Collaboration Key to Development

After Mitel and DIGITAL agreed to combine hardware and software expertise, DIGITAL CTI Engineering staff members, Mike Cassily (group engineering manager) and Anil Kapoor (technical director and engineering development manager), assigned Peter Stopera, ITS project lead engineer, to build a core team: Mary Russo, Manzur Hussein, and Dick Annicchiarico (a.k.a. Rico).

Organizational Benefits of the DIGITAL Integrated Telecommunications Server

- **Enhances productivity.** Employees no longer need to juggle different telephone, email, and fax systems.
- **Improves service and support.** Employee productivity increased; faster response to customer queries because of full use of ITS features with associated customized applications.
- **Low cost of ownership.** Single point of focus for managing email, phone, and fax; PBX no longer required. Fast adaptation by MS Exchange users. ✳



!	✉	📎	From	Subject	Received
	☎	📎	**Outside Caller**	**Voice message (36 sec)**	**1/17/9**
	☎	📎	Outside Caller	Voice message (42 sec)	1/16/97
	☎	📎	Outside Caller	Voice message (1:51)	1/16/97
	☎	📎	Jeff Collentro	Voice message (6 sec)	1/15/97
	✉	📎	KALINOWSKI	Telephony Integration Meeting pl...	1/15/97
	✉	📎	KALINOWSKI	Please inform Mgt. of ECO	1/15/97
	☎	📎	Outside Caller	Voice message (1:14)	1/15/97
	✉	📎	mts.dec.com	Service Message	1/14/97
	✉		Adrianna Swartout	RE: are you there?	1/14/97
	☎	📎	Outside Caller	Voice message (40 sec)	1/13/97

Figure 1. The Microsoft Exchange client manages voice and, optionally, fax messages with folders, drag-and-drop operation, and other familiar features.

> **'Forming a partnership to build a quality product is about being responsive.'**
>
> **—Peter Stopera, ITS project lead engineer**

During ITS development, DIGITAL engineers in Nashua, New Hampshire, and Mitel engineers in Kanata, Ontario, maintained daily contact via telephone, voicemail, and email, forging a solid working relationship. "Forming a partnership to build a quality product is about being responsive," said Stopera. The complementary skills of team members enabled smooth collaboration and a shorter development time.

"It was a great experience," affirmed Kim Letkemen, director of engineering, Mitel Client Server Telecom Division. "It wasn't long before we began to envision the solution as a *product*, not just a project."

Testing the Integrated Solution

DIGITAL CTI Engineering has been implementing ITS throughout its organization for more than 2 years. "We know it works," Stopera said.

Other groups using ITS include OpenVMS and UNIX Engineering in Nashua, Marketing and Product Management personnel from the NT Business Unit at the Parker Street facility in Maynard, Massachusetts, and Multivendor Customer Services in Shrewsbury, Massachusetts.

Rigorous Scrutiny

Before being publicly announced in October 1996, ITS had been thoroughly tested for 6 months. Using a powerful, automated client/server testing system from Segue Software and specialized computer telephony software from Hammer Technologies, the development team put ITS through a series of exhaustive trials. Simulating a user environment, they tested a variety of real-life scenarios, such as 60 users simultaneously calling in for voice mail.

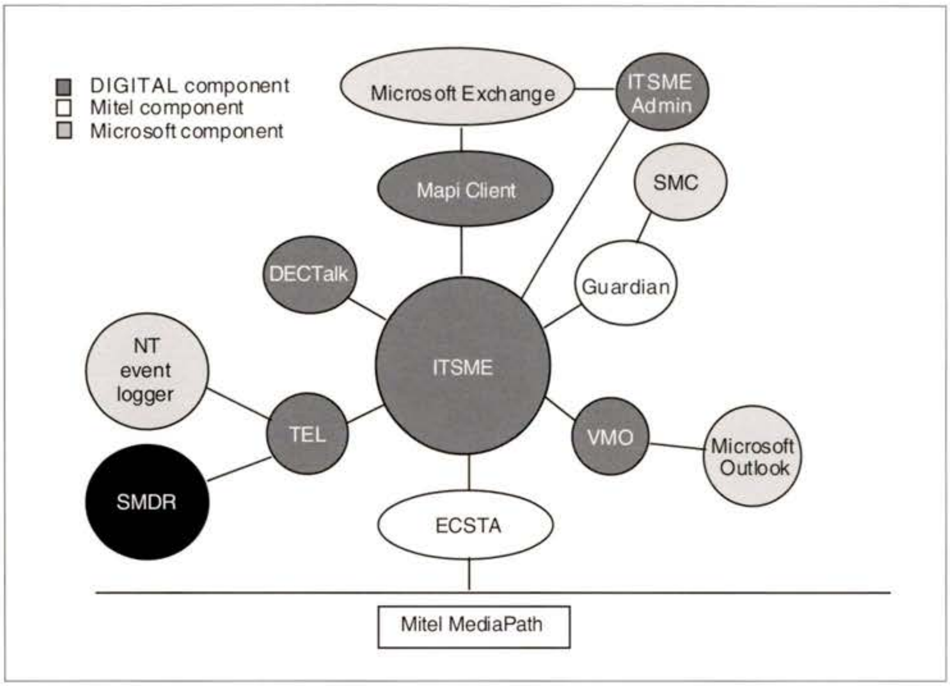


Figure 2. Components of Mitel MediaPath. (See "Solution Components" at right.) ITSME = Integrated Telecom Services for Microsoft Exchange. TEL = telephony event logger. MapiClient = ITSME interface to Exchange. SMC = NT service control manager. VMO = voice messaging object. ECSTA = extended computer-supported telephony application. SMDR = system message detail recording.

"Because of rigorous testing, the overall quality engineered into the product is considerable," affirms Cassily. However, the team will continue to refine the system to include the development of new features and enhancements such as voice-recognition capabilities.

Last year the ITS, incorporating Mitel MediaPath, won a 1997 *BackOffice Magazine* BOSS (Best of Show Selects) Award as a creative unified messaging solution for Microsoft Windows NT. ✳

web*sites*

intranet
http://isg25.zko.dec.com/ctiserver
DIGITAL Telephony Partners Engineering Group

internet
http://www.windows.digital.com/solutions/tele/ITSwhitepaper.asp
White paper on implementing a unified messaging strategy

Solution Components

DIGITAL Integrated Telecommunications Server components (see Figure 2) include

- DIGITAL Alpha- or Intel-based server running Windows NT to route and store messages. Includes Mitel MediaPath Server software, Mitel telephony trunk and station cards, DIGITAL DECtalk, Integrated Telecommunications Services for Microsoft Exchange, and optional fax server software and hardware.
- Windows NT or Windows 95 clients for end users to send, receive, and manage mailbox messages, and for point-and-click telephone operations. Can be connected to the server over an Ethernet LAN or via dial-up (RAS) using TCP/IP and MS Exchange or Microsoft Outlook client software; sound card optional.
- Telephones to act as I/O devices. Provides user access to voice messages, email, and faxes. ✳

More Power to the Client: A Java Attribute

This overview of client-server interaction, typified by the Web, explains how Java deviates from this model.

By Richard Bonneau; Systems Application Integration Engineering; Nashua, New Hampshire

Rich.Bonneau@digital.com

In an earlier article in *Forefront* (Winter 1997–98, p. 59), the Java language and environment were described. This article deals with Java and the World Wide Web, but first a brief review of how the Web works might be useful. The Web can be thought of as a collection of computers able to interact over a network. Some computers act as Web browsers, or clients, which request information; others function as Web servers, which respond to these requests, exemplifying the computing model known as *client-server* (Figure 1).

If two computers are to communicate, they must "speak" a common language. On the Web, this language is known as the *HyperText Transfer Protocol* (HTTP). A Web client sends HTTP requests to a Web server, which returns pages of information typically in the form of ASCII text displayed in the *HyperText Markup Language* (HTML) format. (The HTML page source can be seen via the View menu of most Web-browsing programs.) The Web browser interprets the information provided in the HTML page and displays that information to the user in a Web-browser window. In addition to plain text, formatting commands that affect the font, color, and size of text, and some primitive graphic files, the HTML page may contain *hyperlinks* to other Web pages. When a user selects a hyperlink, the browser again sends a request (using HTTP) to a server (not necesssarily the same server originally accessed by the user) to retrieve the Web page designated by the hyperlink. This activity constitutes "surfing the Web."

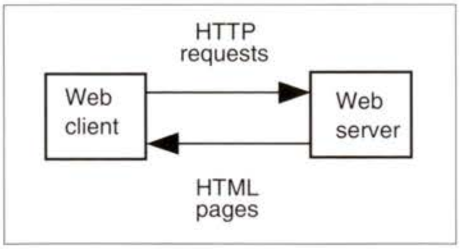


Figure 1. The World Wide Web client-server model

Pinpointing Addresses on the Web

Locating Web pages in the seemingly infinite Web network requires a naming or addressing mechanism. HTTP and HTML use the *Uniform Resource Locator* (URL) mechanism to identify pages anywhere on the Web. A URL first supplies the *host* system designation and then a *path* on that host leading to the actual Web page or a relevant directory. A typical URL might be

http://www.javasoft.com/index.html

The host is www.javasoft.com; the home, or opening page, of the Web site is index.html.

```
<title>My Java Applet!
</title>
<hr>
<applet code=MyJavaApp.class
width=100 height=100>
</applet>
<hr>
<a href="MyJavaApp.java"> The
source file. </a>
```

Figure 2. HTML source code for a Java applet

Expanding Web Functionality via Java

As developers and users demanded more from the Web, the method of delivering information has evolved to include greater functionality and complexity. Links between static Web pages, animated graphics images, the ability to produce a form and send it back to the server, and server-side programmability—all these were inadequate as originally conceived.

Java provides an improved Web programming environment using *applets*, Java programs that execute only within the context of a Web browser. Using these applets, improved browser interaction is possible because the code actually runs on the client via the resident Web-browsing program and does not depend on continual interaction with a distant Web server for processing.

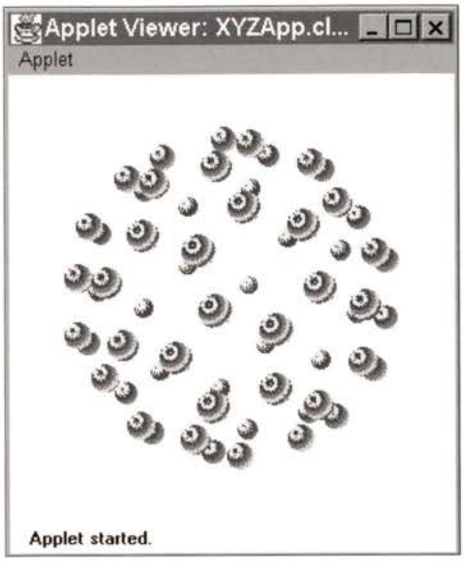


Figure 3. Molecule Viewer, a graphical Java applet

How Java Applets Work

A special request (or *tag*, as it is defined in HTML) on the HTML page tells the Web browser to load and run a Java applet. The browser locates the applet file and downloads it in a condensed form known as *bytecode*. The applet, which is loaded into the Java virtual machine (JVM), executes locally (i.e., on the client side). (Applets are platform-independent because all popular browsers compatible with the major operating systems incorporate a JVM.) Using these downloadable bytecode-based programs allows automatic software distribution: every time a user logs in, the latest version of the program is downloaded to the client! Java's so-called "sandbox" security model limits the possible impact of Java applets on the client system.

The Java programming model includes language primitives (basic building-block functions) and object components that make programming Web interactions fairly straightforward. For example, within Java a windowing model (the Abstract Windowing Toolkit, or AWT) employing buttons, slider bars, text boxes, and graphics boxes supports input from and output to the user, enabling text and numeric processing and the creation of graphically enhanced displays. When necessary, simple-to-use mechanisms can be used to send information back to the Web server for further processing.

Calling a Java Applet from the Server

Figure 2 presents a simple example of an HTML tag that can invoke a Java applet across the network. Here the browser is expected to locate and run a Java program (stored as the file named `MyJavaApp.class`) within the Web browser. (This example also allows the user to click on the last hyperlink to see the actual Java source-code file—a nice touch!)

Using Java applets, improved browser interaction is possible because the code actually runs on the client via the resident Web-browsing program and does not depend on continual interaction with a distant Web server for processing.

Appearance of a Java Applet within a Browser

Figure 3 is the screen display of a demonstration Java applet called Molecule Viewer provided in the Java Development Kit. This applet not only displays the atoms of a molecule, but allows the user to turn the model using the mouse to direct the rotation! This sort of animation would not be possible if each interaction required that the Web server send additional information back to the Web client.

Learning More about Applets

Use your Web-browsing program and any search engine (such as AltaVista) to search on the term "Java." You will find more information than you can imagine. In addition, numerous books contain applets that can be loaded into Web pages without your knowing how to program. ✳

DIGITAL Japan Takes Y2K Leadership Role

The urgency of achieving Y2K compliancy, compounded by the complexity of their language, has spurred DIGITAL Japan's Y2K team and business units to take an aggressive approach to handling conversion issues.

By Colleen Higgins, Information Services Year 2000 Program, Sydney, Australia

colleen.higgins@digital.com

From right, K. Nishi, J. Morisue, and other Japan Y2K pilot project team members.

The differences and complexity of the Japanese language necessitate considerable customizing of business applications and tools adapted from versions originating outside Japan. The corporate-wide implementation of major business-application renewal programs, such as SAP, increases the sense of urgency felt by Y2K team members in Japan. Current business applications must continue to operate into the year 2000 while the migration to the renewal systems takes place.

"The DIGITAL Japan Y2K team, led by Kyoichi Nishi, is demonstrating an exemplary level of commitment in addressing the Y2K challenge," commented Catherine Hnidec, manager of the Asia Pacific Information Services (IS) Y2K Program Management Office.

In addition to internal business applications, the Japan Y2K team must implement verification processes for:

- internal third-party software
- desktop systems
- telecommunication systems
- building infrastructure
- automated manufacturing systems
- electronic data interchange (EDI) with trading partners

Early Start

DIGITAL Japan aggressively began its Y2K assessments as far back as Q2 FY96, before the formal, corporate-wide establishment of the Y2K process, the Y2K "centers of expertise," and the global IS Y2K team. Within a year, the Japan IS team submitted a Y2K awareness report to the DIGITAL Japan management team and received their support. This early assessment led, in early Q3 FY97, to an initial pilot undertaken by Takuji Sawada, using a traditional process.

Pilot Project

In Q1 FY98 under the project leadership of Junji Morisue, the Japan Y2K team began a large pilot program, the Accounts Payable application. This application was selected for several reasons:

- It was high priority
- It consisted of several programs and complexities, such as external interfaces
- It was "customer-facing"
- It would provide proof-of-concept for other applications requiring conversion

DIGITAL Japan aggressively began its Y2K assessments as far back as Q2 FY96, before the formal, corporate-wide establishment of the Y2K process, the Y2K 'centers of expertise,' and the global IS Y2K team.

There were major challenges to this program. All the source code had to be examined and converted without automated Y2K tools for the Japanese-language environment. In addition, the necessary test environment had to be established. Because the Accounts Payable application touched many systems throughout the organization, the work required close teamwork and communication.

In October 1997, the pilot program was successfully completed. The Japan Y2K team published, for worldwide review, a Y2K pilot conversion document of Y2K process and control points based on an actual, full-scale conversion. It also supplied data for more accurate refinement of future project estimates.

Future Challenges

The Japan Y2K team is working closely with the global Y2K program office to meet all necessary "due diligence" and audit requirements for the Y2K program. It plans to complete all mission-critical applications by the end of 1998.

The Japan team also is actively involved in ongoing planning and implementation of renewal systems such as JDE and ECLIPSE, which must interface with applications that are not yet Y2K-compliant. As pioneers in Y2K activity, the Japan Y2K team truly understands the conversion process and plays a leadership role in the Asia-Pacific region. ✳

web*site*

intranet
http://y2k00001.pko.dec.com/isyear2000
Read more about the Information Services Year 2000 Program.

Asia-Pacific Region: Y2K Program Spans Cultures

As the clock ticks toward the new millenium, the DIGITAL Information Services Y2K Program, led by Dick Scarborough, vice president, is making steady progress in checking more than 100 million lines of code in 80 countries across the globe. The now fully functional Asia Pacific Y2K Program Management Office is managed by Catherine Hnidec in Sydney, Australia. They are assisting DIGITAL in meeting its internal readiness challenges for the year 2000.

The DIGITAL Asia-Pacific region consists of the following territories:

- Asean (the southeast Asian nations)
- Greater China
- India
- Korea
- South Pacific
- Japan
- Singapore and Taiwan (location of manufacturing plants)

Besides tackling the formidable technical task of Y2K conversions, the Asia Pacific Y2K team must deal with diverse languages and cultures. Some business practices are unique to certain countries; these may govern how languages are applied to systems and applications.

"Success in business demands that such diversity be addressed very closely," stresses Hnidec. ✳

Special Interest

Hear Industry Leaders and Innovative Thinkers

Fiber-optic technology linking DIGITAL's King Street facility in Littleton, Massachusetts, and MIT, enables the DIGITAL technical community to hear computer-industry leaders, technical experts, and noted academicians participating in the MIT Laboratory for Computer Science Distinguished Lecturer Series, the MIT Microsystems Technology Laboratory VLSI Seminar Series and the MIT Electrical Engineering and Computer Science Colloquia.

A sampling of recent topics:

- surviving information warfare
- linking satellite and terrestrial networks for digital connectivity
- design and technology challenges for sub-100-nm CMOS transistor scaling
- low self-noise, silicon-micromachined microphone for jet noise measurements

For up-to-date information, refer to the Technical Competency Development Group's Web site. ✳

web*site*

intranet
http://tcdg.zko.dec.com/seminars/mit.htm
Register for events in these lecture series.

Women at Work Seminars

The DIGITAL Women at Work seminar series addresses the experiences that women and men face in the workplace. Seminar registration begins 4 weeks before each scheduled event.

Seminars for the next few months are as follows:

- **Diversity—Exploring the Benefits and Challenges**
  Speaker: Charlene Shea
  When: April 8, 1998; 1:30–4:30 p.m.
  Where: Maynard, Massachusetts (PKO3), Cafeteria

- **Overcoming Gender Differences and Other Obstacles to Communication**
  Speaker: Izzy Gessell, MSEd
  When: May 6, 1998; 9–12
  Where: Hudson, Massachusetts (HLO2), Cafeteria Annex

- **Health from A Woman's Perspective**
  Speaker: Debra Waterhouse, MPH, RD
  When: Thursday, May 21, 1998, 9–12
  Where: Nashua, New Hampshire (ZKO3), Cauchy Conference Room

- **Giving Away Success**
  Speaker: Susan Schenkel, PhD
  When: Thursday, June 4, 1998, 9–12
  Where: Nashua, New Hampshire (ZKO3), Cauchy Conference Room

web*site*

intranet
http://www-cad.hlo.dec.com/waw/waw.html
The Women at Work home page

Digital Technical Journal, Volume 9 in Review

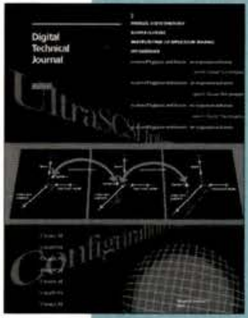
DIGITAL's engineering groups continually deliver innovative products. What are they? And what hot technologies will they build on in the future? See recently published and soon-to-be published engineering papers in the *Digital Technical Journal*.

Volume 9, Number 4

- ✓ The PowerStorm 4D60T Graphics Program, **"Cateyes,"** powered by Alpha to capture the lead in graphics performance and price/performance
- ✓ Spike, a profile-directed **optimizer for Alpha/NT executables** for "spiking" the performance of NT applications
- ✓ Experimental Atom **program analysis tools** that simplify the complexity of memory access pattern comparison
- ✓ OpenVMS version 7.1, extending 64-bit **Very Large Memory** (VLM) capabilities
- ✓ DART, **fast application-level networking** via data-copy avoidance

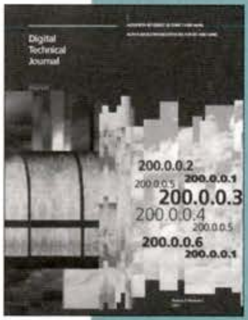
Volume 9, Number 3, Latest Issue, January 1998

- ✓ OpenVMS version 7.1, extending 64-bit **Very Large Memory** (VLM) capabilities
- ✓ DIGITAL, the force behind break-through extensions to the basic **SCSI** architecture
- ✓ New **Router Clusters** for customers needing fast failover mechanisms in IP networks
- ✓ Shared Desktop **collaboration software** enabling real-time sharing of applications, including 3-D graphics and audio, across multiple operating systems
- ✓ Experimental **debugging** technology, Aardvark, for High Performance Fortran parallel programs



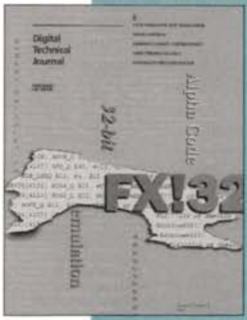
Volume 9, Number 2

- ✓ From DIGITAL's high-energy AltaVista group: Security on the Internet—**tunneling** and **firewalls**
- ✓ A learning experience at the heart of a case study about Internet **software development,** AltaVista Mail
- ✓ The DIGITAL Personal **Workstations,** designed with a single-chip core logic ASIC for the Alpha microprocessor



Volume 9, Number 1

- ✓ The award-winning **FX!32** software that enables 32-bit applications running on Intel x86 to run on Alpha
- ✓ DIGITAL **Visual Fortran,** software selling like hot cakes
- ✓ The interconnect that makes clusters sing—**MEMORY CHANNEL 2**
- ✓ State-of-the-art security functions integrated with **ObjectBroker**
- ✓ The **StrongARM** microprocessor that balances high performance and low power for products of the future



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Katherine Haramundanis Publishes Second Edition of Technical Documentation Book

Katherine Haramundanis

Katherine Haramundanis has published two books with Digital Press, one of which—*The Art of Technical Documentation*—is now available in a new edition.

Katherine has years of experience in technical writing and publishing and is currently a consulting technical writer in the Networks Capability and Capacity Center. Her book is a distillation of her knowledge and experience, and is targeted for technical writers new to the business or those with a moderate amount of experience. She aims to help readers understand how to apply analytical thought to gather, dissect, and understand technical information and how to present the information in print and online media.

The new edition takes an updated look at documentation design, indexing, editing, help systems, Web presentation, use of color, animation graphics, SGML, and HTML.

The Art of Technical Documentation, ISBN 1-55558-182-X, 282 pages, is available from Digital Press at 1-800-336-2665 (note that the Press offers DIGITAL groups a 27.5% discount for multiple-copy orders by calling Pam Boiros at 781-904-2623); at SoftPro in Burlington, Massachusetts, and Barnes and Noble Bookstore in Nashua, New Hampshire; and through http://www.amazon.com. ✳

Bob Morgan Publishes New Book on Compiler Technology

Bob Morgan

Bob Morgan, senior consulting engineer, recently published a new book titled *Building an Optimizing Compiler* with Digital Press. Bob is an industry-recognized expert in compilation techniques for parallel and advanced architectures, and evaluates external technologies for use in DIGITAL's production compilers as part of his role in the Core Technology/High Performance Technical Computing Group.

Approaching his subject from a practical perspective, Bob provides a high-level compiler design for the optimization and code-generation phases on a generic modern RISC processor, including the ordering and structure of algorithms and efficient data structures. The presentation offers sufficient detail for the reader to implement the components should he or she choose to do so.

Few books have been published on the subject, and this one will find its way into the classroom as well as into the hands of compiler writers. As Bob notes in his preface, "Practically, the largest use for this book will be informing the curious."

Building an Optimizing Compiler, ISBN 1-55558-179-X, 450 pages, US$59.95, is available from Digital Press at 1-800-336-2665 (note that the Press offers DIGITAL groups a 27.5% discount for multiple-copy orders by calling Pam Boiros at 781-904-2623); at SoftPro in Burlington, Massachusetts, and Barnes and Noble Bookstore in Nashua, New Hampshire; and through http://www.amazon.com. ✳

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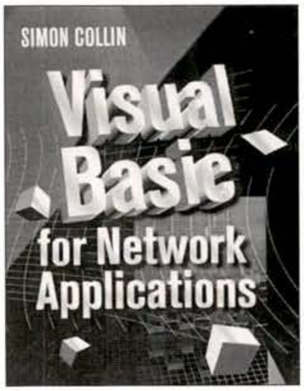
Digital Press, the authorized publisher for Digital Equipment Corporation, is an imprint of Butterworth-Heinemann, a major international publisher of professional books. The following are descriptions of computing titles available from Digital Press.



Visual Basic for Network Applications
by Simon Collin is an indispensable resource for any Visual Basic developer who needs to produce utilities and applications that will work on a network, including programmers working in a corporate MIS department, support teams, and general programmers.

January 1998, paperback, 200 pages, ISBN: 1-55558-173-0, EY-W931E-DP (US$29.95)

X Window System Toolkit, Second Edition, *by Paul Asente, Donna Converse, and Ralph Swick* has been completely updated for releases 5 through 7. The book contains over 100 pages of example programs and a specification section that has the full text of X Consortium's official X Toolkit Intrinsics standard.

January 1998, paperback, 1,130 pages, ISBN: 1-55558-178-1, EY-V428E-DP (US$99.95)

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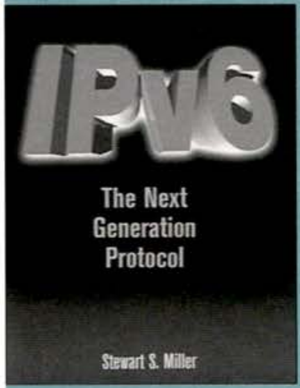
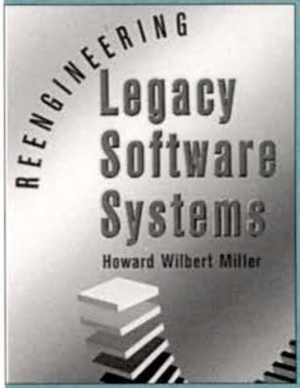


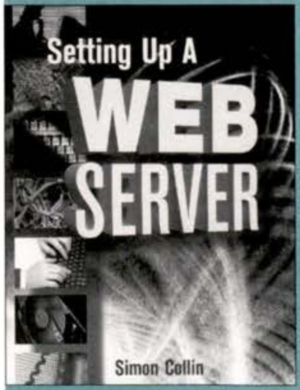
IPV6: The Next Generation Protocol
by Stewart S. Miller is a complete overview of IPv6. It begins by covering header format, extensions, addressing, and routing. Once the overview of the protocol is explained, the book looks at several implementations involving both the host and router.

December 1997, paperback, 392 pages, ISBN: 1-55558-188-9, EY-W909E-DP (US$39.95)



Reengineering Legacy Software Systems
by Howard Miller provides techniques for reengineering legacy systems to make them more cost effective, easier to maintain, and easier to use. The book mixes theory and practice and includes case studies.

December 1997, paperback, 250 pages, ISBN: 1-55558-195-1 (US$44.95)



Setting Up a Web Server
by Simon Collin covers support for a Web site, including communications and software. The book provides details of servers for e-mail, FTP, Telnet, gopher, and finger, and of the latest push information servers.

November 1997, paperback, 275 pages, ISBN: 1-55558-174-9, EY-W894E-DP (US$29.95)

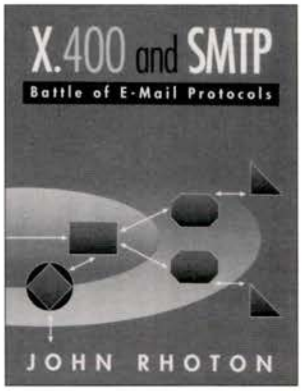
continued on page 68

Special Interest

continued from page 67

X.400 and SMTP: Battle of the E-mail Protocols

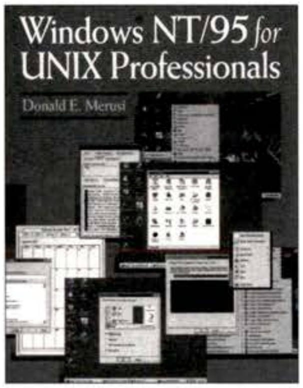
by John Rhoton outlines the similarities and differences between the two predominant e-mail backbone protocols: X.400 and SMTP. X.400 and SMTP are examined with respect to addressing, routing, and topology, as well as security and directory support. The description covers their evolution, use in practice, and the relationship with other industry protocols such as POP3, IMAP4, X.500, and LDAP.



October 1997, paperback, 200 pages, ISBN: 1-55558-165-X, EY-V429E-DP (US$34.95)

Windows NT/95 for UNIX Professionals

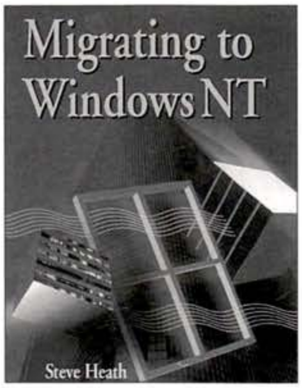
by Donald Merusi is written at an introductory to intermediate level to help UNIX users migrating to Windows NT or Windows 95 environments get up to speed quickly. The author compares and contrasts comparable methodologies between UNIX Solaris and Linux, and Microsoft Windows NT and Windows 95.



June 1997, paperback, 200 pages, ISBN: 1-55558-181-1, EY-W071E-DP (US$29.95)

Migrating to Windows NT

by Steve Heath shows users of other operating systems how to perform the same tasks in Windows NT. The book includes details on utilities and drivers of other operating systems and shows a screen shot for every command. The CD-ROM contains utilities and software to help users transition to Windows NT.



October 1997, paperback, 450 pages plus a CD-ROM, ISBN: 1-55558-185-4,EY-V448E-DP (US$39.95)

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Winter issue: October 1, 1998

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Forefront

A magazine for the technical community

Summer 1998

HIGHLIGHTS

- Web Software Development from Engineering Australia
- SportsWeb: Joint Venture at the Internet's Service Frontier
- Next-Generation Internet Protocol Technologies
- Alpha Systems Summit Hosted by Cambridge Research Laboratory

DIGITAL Worldwide Services

'REQUISITE VARIETY' AS AN IMPERATIVE FOR EXCELLENCE

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Summer 1998 Issue

Forefront magazine is a forum for the worldwide DIGITAL technical community to share information, technology and strategic directions, and key accomplishments.

Forefront welcomes contributions of interest to the DIGITAL technical community. The submission deadline for the Q199 edition is July 1, 1998. Contact Managing Editor Dick Willett for information.

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IN THIS ISSUE

On the Cover

DIGITAL Worldwide Services is "home" to thousands of highly competent technical people who tackle difficult problems every day for diverse customers whose business interests span the globe. See story beginning on p. 2.

DIGITAL Worldwide Services: 'Requisite Variety' as an Imperative for Excellence

Cybernetics theory—Ashby's Law of Requisite Variety—suggests that the capability of DIGITAL's service delivery work force and the scope of its service offerings and tools must be as sophisticated as any customer's environment and IS solutions.

By Dianne Mahany, Multivendor Systems Engineering, Littleton, Massachusetts

dianne.mahany@digital.com

D. Willett

Members of the Product Management and Development (PM&D) staff. From left: Peter van Roekens, vice president, Multivendor Systems Engineering; Dave Farabaugh, manager, Multivendor Customer Services Service Menu management; Sue McKeown, director, Enterprise Systems Services; John Hogan, director, Software Product Services; Jean Hoxie-Wasko, PM&D vice president; Bob Brown, manager, Warranty Reengineering; Rick Leslie, PM&D chief of staff; Gary Mayo, director, Client and Desktop Services; George Kauffman, director, Product Service Engineering; and Don House, manager, PM&D Communications. Not present for the photo were John Caulfield, director, DIGITAL Assisted Services; and Ron Milano, director, Service Infrastructure Engineering.

Why should the DIGITAL engineering community be interested in DIGITAL Worldwide Services? Because the energy and talent of both Engineering and Services are focused on meeting the same customer needs. Although DIGITAL Services staff members witness and appreciate DIGITAL engineering excellence at customer sites, learning about Services' capabilities may not be as straightforward for members of the product engineering community. This overview is intended to help.

DIGITAL Worldwide Services, like the DIGITAL Products community, is home to thousands of highly competent technical people who tackle difficult problems every day. As our customers experience explosive growth in IT complexity, Services faces the same technical challenges confronted by Engineering: customer requirements for high availability and uptime, multivendor interoperability, and global production systems capable of evolving and growing without breaking down.

This overview of DIGITAL Worldwide Services will focus on the linkage between customer complexity and the need for corresponding breadth and depth across the Services portfolio and delivery workforce.

Editor's note: When the author was writing this article, plans to merge with Compaq Computer Corporation were well under way and, by publication time, may be finalized. Our customers' requirements and the excellence of the DIGITAL Services staff and service offerings remain unchanged.

Services Imperative: 'Requisite Variety'

Most engineers are familiar with the various theories and analytic models that stem from cybernetics, the "science of control and communication in the animal and in the machine" which was launched by Norbert Weiner in the late 1940s [1]. In the language of cybernetics, the number of distinguishable items (or distinguishable states of some item) in a system is called the "variety." From cybernetics theory came Ashby's Law of Requisite Variety, which asserts that "only variety can destroy variety" [2]. One outcome of this law is that "control can be obtained only if the variety of the controller ... is at least as great as the variety of the situation to be controlled" [3].

Since "complexity" is a synonym for "variety," this law gives us a useful and interesting imperative for Services: *to successfully control* (i.e., fix, maintain, implement, stabilize, manage, optimize, evolve, etc.) *complex customer comput-*

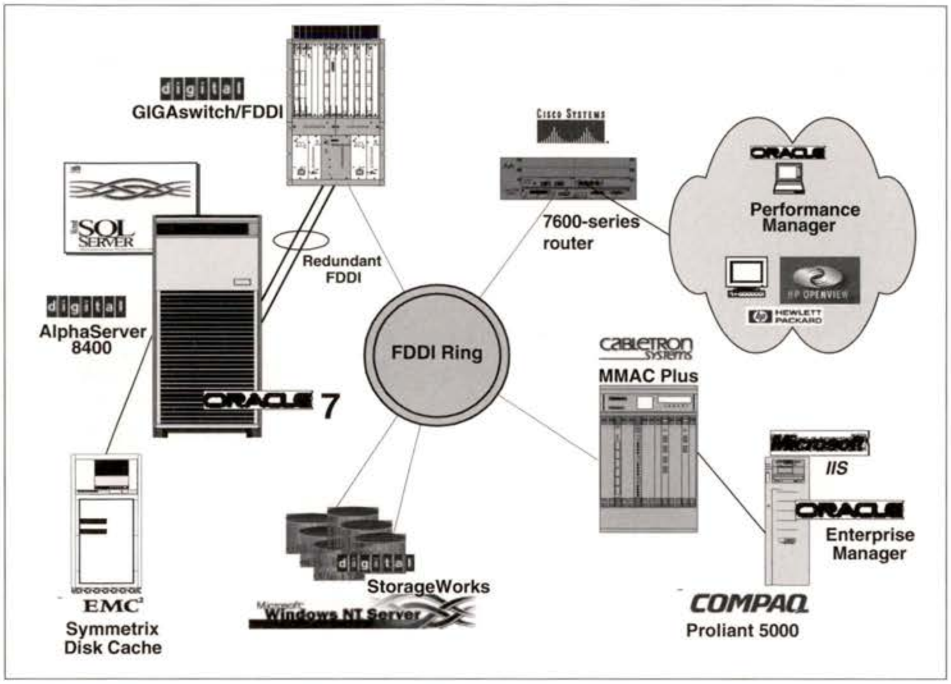


Figure. A typical DIGITAL customer's multivendor environment

ing systems, the requisite variety/complexity of intelligence, knowledge, tools, and services must be available.

In other words, Ashby's Law of Requisite Variety underscores how critical it is for Services to deliver levels of expertise and service offerings that meet or exceed the level of complexity of the customer's computing environment.

Ashby's law is widely cited in theoretical work dealing with physical, human, and political systems. For DIGITAL, the law applies at all the control junctures among product, service, customer system, and industry.

Customer Complexity: What's Going On?

According to Gary Hamel, chairman of Strategos and well-known business academic, "profound change in the competitive environment has produced a Cambrian explosion of new organizational forms, institutional relationships, and value-creating possibilities.... Only companies that are capable of reinventing themselves and their industry in a profound way will be around a decade hence" [4].

With this change in competitive environment (and the disaggregation of the industry) come complicated and intense business dynamics, extensive changes in the way corporations operate, and a corresponding complexity of information systems requirements.

Added to our customers' need for rapid response to changes in the competitive environment are the unrelenting pace of developments in computing technology and the large pool of potential vendors offering a wide range of possible enterprise solutions.

According to the Gartner Group: "Budgets are tight, technology complexity continues to increase dramatically, and senior management wants a measurable return on investment... from IT investments.... Consequently, chief information officers ... and IS managers are under enormous pressure concerning IT strategies, deployment, and investments" [5]. Obviously, we want them to choose DIGITAL.

The Figure illustrates a typical DIGITAL customer's multivendor environment. The array of vendors (DIGITAL, Microsoft, EMC^2, Oracle, Compaq, Cisco, Cabletron) and technologies is daunting. The production system requirement for absolute stability and near-perfect availability presents a potential nightmare for both the customer and the service provider.

DIGITAL Worldwide Services: Everything a Customer Could Ask For

Enter DIGITAL Worldwide Services to handle all of a customer's IT needs with offerings such as:

- Consulting services for IT operational assessments, multivendor systems site assessments, multivendor enterprise architecture design and implementation, and network and system integration and optimization
- Remedial and proactive maintenance services, including Business Critical services
- IT management services (e.g., help desk, security)
- Operations Management Services to support networked applications (e.g., the Internet, messaging and collaboration systems)

Considering the customer environmental dynamics and the clear requirements of Ashby's Law of Requisite Variety, it is obvious that technically competent Service professionals are essential to our ability to succeed across this life-cycle range. Dave Ulrich, a professor at the University of Michigan Business School, notes that "intellectual

Some Facts about DIGITAL Worldwide Services

The global and comprehensive scope of DIGITAL Worldwide Services is amply illustrated by the following facts:

- 23,000 employees worldwide in 113 countries—one of the largest service organizations in the world
- 450 service locations
- 14 customer-support centers
- 10 network-support centers
- 70 operations management and help-desk support centers
- 45% of DIGITAL's total corporate revenue in FY97
- 40 years' experience in providing IT services to customers
- 15 years of providing multivendor services
- 24-hour service and support, 365 days a year
- Provides support for more than 14,000 different hardware, software, and network products from 1,300 different vendors
- 5 million service requests received in a typical year with 75% resolved in 1 hour and 92% resolved the same day
- More than 1,500 Microsoft-certified NT engineers, 3,000 UNIX engineers, and 700 Novell-certified engineers
- One of two Microsoft partners to provide authorized support to its enterprise customers
- Manages the Microsoft Network which includes over 1,100 servers and a help desk that answers 20,000 email messages and calls per month ✳

capital is a firm's only appreciable asset" and that "service generally comes from relationships founded on the competence and commitment of individuals" [6].

DIGITAL Worldwide Services comprises multiple teams of professionals which constitute our intellectual capital, and their "competence and commitment" leverage the relationships with customers that are the foundation of business success. (See "Some Facts about DIGITAL Worldwide Services" at left.)

The Businesses of Worldwide Services

Under the leadership of John Rando, senior vice president and general manager, DIGITAL Worldwide Services comprises three businesses that span the services life cycle. The three businesses are strategically integrated as one clear and compelling service solution. They are supported by partnerships and alliances which help make DIGITAL Worldwide Services one of the world's largest, most comprehensive service organizations, and one of the few industry providers that can act as a single source for a total enterprise IT services solution. (See "A Sampling of Worldwide Services Partnerships" at right.)

The business areas are as follows:

- **Multivendor Customer Services (MCS),** led by Vice President Peter Mercury, delivers to DIGITAL's customers both remedial and proactive services, including Business Critical services and multivendor environmental assessments. In addition to its direct service delivery work force, MCS is home to technical professionals who develop and acquire tools and who engineer the services technical infrastructure. MCS has about 15,000 employees worldwide.

- **Network and Systems Integration Services (NSIS),** led by Vice President Kannankote Srikanth (known as Sri), delivers IT enterprise architecture and operational consulting as well as a portfolio of network and systems planning and integration services. NSIS, with 6,000 employees in five consulting practices, targets large- and medium-sized enterprises where significant business improvement is needed, helping the customer plan, design, implement, and manage the integration of DIGITAL and third-party products and services.

- **Operations Management Services (OMS),** led by Vice President Tim Leisman, delivers IT management services across networks, systems, and the infrastructure that supports enterprise applications. Driving a "FutureSourcing" campaign, OMS focuses on the needs of customers to access capabilities they don't have rather than simply offload, or "outsource," what they do have. The business has 3,000 employees and provides IT experts for distributed client-server environments across four practices.

Multivendor Customer Services

The requisite-variety problem faced by MCS is staggering. MCS deals firsthand with all of DIGITAL's customer sites and the full spectrum of their complex multivendor problems—both ours to solve or ours to prevent. In addition, MCS services other vendors' accounts (Compaq), and these IT environments may or may not include DIGITAL products.

The MCS worldwide technical community delivers a wide range of remedial and proactive services, as well as service-tools development and services-infrastructure engineering.

Service Delivery and Customer Service Centers

Service delivery is classified as either "on site" (performed at the customer's installation) or "off site" (performed remotely). In addition to MCS's widely recognized on-site service delivery personnel, 14 Customer Service Centers (CSCs) around the world provide centralized off-site customer support. Customers with service contracts contact the CSC when they have a problem. CSC specialists and engineers use remote tools to isolate and correct many complex technical problems, including intermittent failures, hung systems, and system crashes, often without requiring an on-site visit. If needed, the CSC arranges for on-site support and gives the services engineer any information already learned about the problem (e.g., which hardware module may have failed requiring that a spare be brought to the site).

When a problem cannot be resolved via standard support and escalation processes, it is treated as an "exception" and is often of crisis proportions. In this case, field "exception managers" mobilize appropriate resources and/or ensure cross-organizational focus until the problem is resolved or stability returns.

Delivery of Business Critical Services

Some DIGITAL Services customers choose to purchase and receive some degree of specialized support (e.g., specific uptime and problem-response guarantees, or dedicated DIGITAL Services support teams). To be successful, DIGITAL Worldwide Services must satisfy these large customers with high-uptime requirements in their business-critical production-systems environments. (See "TYSONS FOODS: High Stakes, High Availability" on page 6.) A flexible portfolio of Business Critical Services is one highly competitive offering DIGITAL delivers to these large-enterprise customers, who depend on complex, critical systems for their daily operations, profitability and even survival. DIGITAL combines highly responsive support with proactive, environment-wide services to eliminate problems that cause downtime. Support may include

- Crisis response within 30 minutes
- Dedicated technical account manager and support teams
- Proactive monitoring services that correct problems before the customer realizes there are any
- Remote system diagnosis, upgrades, and performance assessments
- In-depth reviews and assessments of the customer's entire computing environment, tailored specifically to that customer's systems and needs

The degree of requisite variety needed to satisfy Business Critical customers varies. Different levels of service, providing different levels of responsiveness, attention, and customer-specific tailoring, are available worldwide (though actual service packages may differ by geographic area).

Escalation and Crisis Management

Escalation and Crisis Management drives cross-organizational and often cross-geographic resolution of serious customer problems and outages. Each of the three major MCS geographic areas (the Americas, Europe, and Asia Pacific/Japan) has an Escalation and Crisis Management function, which handles resolution of the most critical customer problems.

A Sampling of Worldwide Services Partnerships

Multivendor Customer Services, Network and Systems Integration Services, and Operations Management Services are supported by the following strategic partnerships and alliances which allow DIGITAL Worldwide Services to provide customers with "best-in-class" solutions. Some of the most important are listed below.

Strategic alliances in software, hardware, and networking:

- Microsoft
- Oracle
- MCI
- Computer Associates

Support and maintenance agreements:

- Compaq
- NEC
- Toshiba
- Cisco Systems
- 3Com
- Cabletron

Design, implementation, and management services:

- SAP
- Oracle
- Baan
- Siebel Systems

Systems integration collaborations on IT solutions:

- Andersen Consulting
- Ernst & Young
- Price Waterhouse ✳

TYSON FOODS: High Stakes, High Availability

TYSON FOODS, headquartered in Arkansas, is the largest poultry processor in the world, shipping 12 million pounds (5.5 million metric tons) of fresh and frozen chicken each week. TYSON FOODS depends on DIGITAL to keep its business running virtually nonstop.

Because 50% of TYSON's volume of chicken is fresh, it must be shipped soon after processing; speedy delivery of orders is critical. Customers track the movement of their shipments through the warehouse, and to the destination.

DIGITAL Multivendor Customer Services delivers all the service and support for continuous fault-free, real-time operations. The company-wide information system integrates sales, inventory, and distribution information in great detail.

On Call Every Day of the Year

Gary Cooper, director of Technical Services, described the process: "A 'pick list' is printed, and trucks are loaded. If the system goes down, the 'pick list' can't be printed, the forklift drivers can't load chickens, the truck drivers can't drive, and immediately it's a huge financial loss for TYSON. With that much at stake, we need someone who knows our environment 100%, and we need one year-round, night-and-day point of contact for multivendor service. By teaming up with DIGITAL, we always have an expert problem manager who can resolve issues fast."

100% Availability: One Team, One Objective

TYSON needs rapid response service to prevent financial loss. With DIGITAL Services, TYSON has a dedicated support team that responds within minutes and fully shares all information. Business Critical Services also provides TYSON full-time, remote diagnosis and proactive monitoring. Engineers are qualified to go into the production environment, while maintaining security, to isolate and resolve any problem quickly without bringing the system down. The goal is to consistently resolve all issues invisibly to the users.

> **'By teaming up with DIGITAL, we always have an expert problem manager who can resolve issues fast.'**
>
> **—Gary Cooper, director of Technical Services, TYSON FOODS**

"In our Colorado Springs remote Customer Support Center, we have 'micro-detailed' electronically all of TYSON's systems using Microsoft tools," says Rodney Ivers, TYSON site manager. "If we need to look at a switch setting on a controller, it's detailed in the Colorado database just as it appears at TYSON's headquarters in Arkansas. Because TYSON has a complex system, everybody must be looking at the same data simultaneously. You can't explain issues over the telephone. The electronic site-management guide mirrors any change that occurs in TYSON's operating environment. Everybody has all the information immediately." ✳

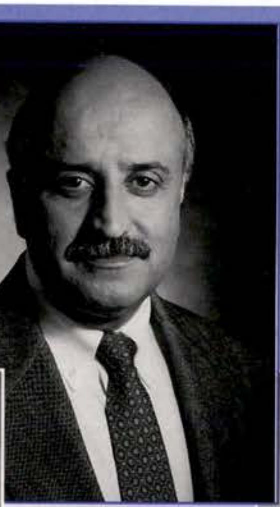
These critical situations may be systemic problems that create some unacceptable performance issues in the customer's computing environment or they may be outages requiring immediate resolution. The stakes are often high.

Juergen Pfister is the MCS European Engineering Escalation Crisis manager. An engineer by training, Juergen is based in Munich. When he is not addressing customer issues, Juergen is leading processes across Europe to increase functional excellence, optimize problem-resolution mechanisms, and ensure that qualified personnel are in place to handle the most difficult customer situations.

Juergen is enthusiastic about working with highly competent teams to resolve some of the most complicated problems of DIGITAL customers. These teams are formed across the five major European CSCs, depending on the expertise required, and involve Multivendor Systems Engineering (MSE) in the US, product engineering groups, and sometimes people from other businesses (most notably from NSIS).

Illustrating how Ashby's Law of Requisite Variety applies in Europe, Juergen notes that DIGITAL has hardware, software, and services in "every mobile phone service provider in Europe, in nearly every country." Names such as TeleDanmark, Tmobil, Vodaphone, Airtel, Belgacom, and Omnitel are only a familiar few. These are, in Juergen's words, "huge accounts, with business-critical computing, 24 × 7 coverage, enormous databases—and they buy systems in huge volumes." Servicing these demanding customers and their complex systems presents multiple challenges, since they are both difficult to service and extremely important from a revenue perspective.

John Rando, senior vice president and general manager of DIGITAL Worldwide Services



Kannankote Srikanth, vice president, Network and Systems Integration Services

Peter Mercury, vice president, Multivendor Customer Services

Tim Leisman, vice president, Operations Management Services

Product Management and Development

Back at the "home office" in Stow, Massachusetts, but also extending to Colorado Springs and several other locations, is the Product Management & Development (PM&D) organization, led by Vice President Jean Hoxie-Wasko. PM&D manages the complete product service life cycle for four businesses: desktop, software support, servers and peripherals, and assisted services. They represent US$4.2 billion of service business, with 20 major service products, or "offers," covering tens of thousands of DIGITAL and third-party products. In addition to these services business functions, PM&D drives several technical activities that support the ability to deliver requisite variety to all our services customers. PM&D delivers the three major technical service functions described next.

Services Infrastructure Engineering

Directed by Ron Milano, Services Infrastructure Engineering (SIE) is responsible for collaborative design and implementation of the broad range of applications, processes, and tools that support the MCS service delivery business infrastructure. Examples follow:

- SIE drives technical work for the comprehensive set of "event management" applications, systems, and processes by which DIGITAL accepts and validates service calls, routes them to the right resources, and tracks progress to conclusion (or to problem escalation). The speed and effectiveness of customer problem resolution depends on these global information systems. SIE provides the engineering and program management for the Event Management Renewal program, which involves development of new system platforms, replacement of the IPMT legacy escalation management system, and integration to other systems and applications from Customer Administration and Logistics.

'Alliances and other relationships with product vendors help us provide consistent, comprehensive, and powerful service tools capacity at the product level.'

—George Kauffman, group manager, DIGITAL Product Service Engineering

- The Automated Skills Inventory System (ASIS) keeps an inventory of the various skills, job roles, and certifications acquired by the members of an organization. Used worldwide by MCS, it is being piloted by NSIS. This NT/SQL–based system with Web-oriented reporting features is used for services work force planning based on business trends and forecasts.

- SIE's customer-facing productivity applications include various non-diagnosis-oriented tools, processes, and applications used in service delivery. These include tools that facilitate customer system configuration collection and contract obligation reconciliation, software license compliance checking, and engineering support of various customer ordering and reporting systems.

- Technical Information Systems is another renewal program, involving the replacement of current TIMA/STARS technical information systems with new technology. This program is closely integrated with event management efforts and will provide new systems, databases, and access methodologies for MCS's large inventory of technical information. It will allow systematic capture of symptom/solution information as part of the call handling process, and will store the data in an easy-to-retrieve, indexed format. Using metadata, it will mark specific information for appropriate access by DIGITAL employees, partners, or customers.

Product Service Engineering

Directed by George Kauffman, Product Service Engineering (PSE) develops and delivers selected tools used by service professionals to manage systems and diagnose problems, both remotely and at the customer's site. These availability, serviceability, reliability, and system management tools are an important aspect of the response to Ashby's Law.

(In the language of cybernetics and Ashby's Law, if the same tool can be used at many different customer sites, it simplifies the complexity problem by being a *repeatable variety generator.* [2])

Service tools strategies are in place that span the base of customer service categories from simple to complex. Base product self-tests, industry-standard tools, and other vendor tools play a strong role in these strategies. Internally, PSE drives the development of UNIX tools and the acquisition or co-development of NT tools, and maintains a portfolio of legacy tools as well.

Examples of PSE tools include DECevent for Alpha hardware diagnosis; CANASTA for UNIX and VMS crash dump analysis; edX for UNIX setup and configuration; RCM/PANO for patch notice and revision information; and System HealthCheck for system operation diagnosis. System HealthCheck forms an important part of the Business Critical Service offer portfolio, allowing DIGITAL to evaluate the general state of the customer's system before putting business-critical levels of service in place.

"It is important to understand that the foundation of IT service is the ability to support individual products," Kauffman explains. "Therefore, at the base level, DIGITAL Services builds its expertise product by product. This is one important dimension of requisite variety.

"As a result of my own organization's focus, with support from product engineering groups, there has been a considerable increase in both UNIX- and Alpha-oriented service tool capabilities. However, we need the help of third parties to cover the full spectrum of product technologies and service deliverables necessary in our customers' complex, multivendor service environments. Alliances and other relationships with product vendors help us provide consistent, comprehensive, and powerful service tools capacity at the product level."

Multivendor Systems Engineering

Led by Vice President Peter van Roekens, Multivendor Systems Engineering (MSE) helps DIGITAL resolve the multivendor interoperability of some of the corporation's largest and most complex customers (see *Forefront,* Spring 1998, p. 53). During the isolation and solution of difficult technical problems, MSE provides a critical link between DIGITAL Services and Engineering groups, and even the customer. It delivers problem management and systems-level technical support for complex interoperability problems. MSE also provides selected, proactive MSE site assessments upon request from the field, when resources are available. MSE personnel thrive on crises and difficult problems, and nearly all of the 87 people in the organization carry beepers!

> **'By ensuring the feasibility and technical integrity of a project before implementation begins, the solution architect protects the customer's investment and helps ensure a high level of customer satisfaction.'**
>
> **—Kannankote Srikanth, vice president, Network and Systems Integration Services**

Van Roekens points out that the group has "some of the finest engineers and complex problem managers in the business, with a combination of energies and skills unmatched in the industry.

"We are currently one of only two sources for MSE Site Assessment teams in the company," he continues. "About a third of our staff are Microsoft-certified. One person has qualified as a Microsoft Certified Solutions Provider (MCSP), a level of certification that only a handful of people in Massachusetts have achieved. I am very proud of this exceptional group."

Network and Systems Integration Services

The Gartner Group notes that "As applications become more network-centric, the enterprise network is becoming the foundation of the IT infrastructure. As they take on this role, future networks will require a new layer of sophistication to protect business-critical applications and deliver the required service levels to users. During the next 5 years, we expect new applications will require a 300 percent increase in network capacity" [7].

This is the foundation for the success of the NSIS business, which ensures customers get the expected benefits from client/server technology in a cost-effective and timely manner. The mission of this business is to give customers a competitive edge by providing them with innovative, best-in-class global IT solutions delivered by the best people and partners in the marketplace. (See "'Requisite Variety' and the Vatican" at right.)

NSIS meets the requisite variety challenge by providing a comprehensive portfolio of IT services and solutions focused on today's most pressing business challenges. NSIS helps implement computing strategies that increase productivity, improve information access, and decrease in overall IT support costs.

Vik Muiznieks, Network and Systems Integration Services (NSIS) technical director, points out that the organization has three technical tracks for its personnel:

- the Engineering track, which focuses on building products
- the Technical Consulting track, which focuses on delivering projects
- the Solution Architecture track, which bridges the technical and business sides of the operation

According to Sri, "The solution architect is, in effect, the master planner for a large, complex solution. He or she must understand the customer's business issues, challenges, and vision in order to translate that into an architecture

'Requisite Variety' and the Vatican

The "requisite variety" imperative is exemplified in the complex Vatican Web site project, led by Fabio Bagatin (see *Forefront,* Spring 1998, p. 17). In October 1995, DIGITAL donated a computer to a Vatican committee considering an Internet presence for the Holy See. A year later, Network and Systems Integration Services delivered assessment services, and a Vatican alliance with DIGITAL began. Today, the Holy See's Internet Office is a showroom of DIGITAL hardware, software, and services, and extensive Internet and intranet implementations are in progress.

The Vatican plan for the Year 2000 includes a 384-megabyte uplink offered by Telecom Italia featuring

- Real-time papal speech broadcasts
- Posting of all papal publications since the Council of Trent in 1545
- Vatican Museum online
- *Osservatore Romano* available in six languages
- Commercial services such as a Pilgrims' Kiosk (i.e., electronic wallet, service for travel reservations, etc.) and a Virtual Library of stamps, coins, and books ✳

web*sites*

http://www.vatican.va
Go straight to the Vatican Web site.

http://tcdg.zko.dec.com/Presentations/Bagatin%20Vatican%20presentation/index.htm
Engineering Summit '97: Vatican Web site presentation

DIGITAL Supports GE Aircraft Engines IT Infrastructure

The leading provider of commercial and military aircraft engines, GE Aircraft Engines, depends on Operations Management Services and DIGITAL Worldwide Services to manage and support its information technology infrastructure for Oracle applications. DIGITAL delivers desktop, server, LAN management, and help desk service to more than 10,000 users. Desktops and servers include both Intel and UNIX-based systems. Servers handle Oracle and INGRES databases and mail and messaging systems such as IBM PROFs, Lotus cc:Mail, and Microsoft Exchange.

"We've expanded our relationship with DIGITAL on the basis of our previous experience and the company's technical expertise," explained Jay Dinwoodie, general manager, IT Services Department.

Three years ago, GE Aircraft Engines selected DIGITAL for technical consulting, system management, and operations support for its multivendor, midrange computing environments including DIGITAL VAX systems at 14 sites in the US.

Dinwoodie added, "Our increasingly complex information systems and applications require us to rely on experienced service providers such as DIGITAL so we can concentrate on design, engineering, production, and services that make us a preferred supplier in the aircraft industry." ✳

document, a technology blueprint that guides the customer's IT decision-making and DIGITAL's solution implementation efforts. By ensuring the feasibility and technical integrity of a project before implementation begins, the solution architect protects the customer's investment and helps ensure a high level of customer satisfaction. At the same time, he or she protects DIGITAL from making commitments that we cannot profitably keep."

The NSIS Service Portfolio is structured around five practices with delivery throughout 16 territories in 45 countries at 260 locations:

- Communications industry solutions
- Manufacturing and enterprise applications
- Finance industry solutions
- Cross-industry applications
- Enterprise networks

Operations Management Services

OMS provides the requisite variety for many complex customer environments by giving them access to new capability, capacity, and coverage. OMS is capitalizing on knowledge that the average CIO faces when simultaneously controlling application implementation and infrastructure management needs. "Bet-your-business" issues such as Y2K, intranet implementation, electronic commerce, and Windows NT adoption, motivate companies to seek outside IT experts about moving to distributed, client/server infrastructures. OMS calls this "FutureSourcing"and delivers it across four practices:

- Distributed systems management
- Applications operations management
- Desktop operations management
- Internet/intranet operations management

Each practice addresses a set of customer needs within the client-server management services market and has its own engagement teams who are responsible for qualifying projects, working with selling partners, leading all bid/win efforts, and serving as the primary interface to customers.

Leisman recently noted that "Rapid changes in technology are leading more enterprises to outsource the next-generation computing environment that supports their business requirements. . . . Companies are now keenly interested in outsourcing when migrating to a distributed computing environment. DIGITAL offers the global, multivendor technical expertise that can address systems, applications, and network requirements of the most demanding customers."

OMS focuses totally on the emerging client-server business rather than on the traditional "glass house," datacenter outsourcing market. After a customer has been qualified, the opportunity is pursued by a team that uses an appropriate mix of service capabilities and key technologies to design and propose a custom client-server management solution. (See "DIGITAL Supports GE Aircraft Engines IT Infrastructure" at left.)

OMS has core infrastructure capabilities across a wide range of key technologies, including Microsoft BackOffice, UNIX, SAP R/3, Oracle, Microsoft Exchange, Windows NT/95, and Web-based applications. The business uses structured methodologies to design solutions and can provide outsourcing services in such areas as help desk, network and system management, asset management, application management, hardware and software acquisition, desktop integration, business continuity or disaster recovery solutions, and security.

Services and Engineering: A Solid Partnership

In keeping with the premises of Ashby's law, DIGITAL Worldwide Services delivers the requisite variety to keep our customers' systems running and stable even as systems grow and change within an incredibly complex enterprise computing environment. Service is available across the customer's entire computing spectrum and life cycle and is engineered and delivered by a work force of thousands of highly qualified people. For all our customers:

- DIGITAL Worldwide Services' MCS business can resolve problems, maintain systems on a 7 × 24 basis, assess the adequacy of multivendor production systems, optimize installations, and take the companies confidently into the future.
- DIGITAL Worldwide Services' NSIS business can deliver consulting services that will optimize networks, help companies expand client/server implementations, and plan for long-term evolution.
- DIGITAL Worldwide Services' OMS business can handle part or all of their client-server infrastructure management and life-cycle planning.

The success of DIGITAL Worldwide Services depends heavily on the solid foundation of excellent products and systems being delivered by DIGITAL's engineering community. Engineering meets a critical requirement of Ashby's law by providing solutions that work no matter how complex the customer's installation. With ongoing collaboration between Services and Engineering, DIGITAL can deliver the requisite variety to address any level of customer complexity.

Acknowledgments

The author gratefully acknowledges help from many people (and their Web sites) across the DIGITAL Services community including those not mentioned in this article.

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web*sites*

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DIGITAL Worldwide Services

http://services.ogo.dec.com/mcs/index.htm
Multivendor Customer Services

http://nsis.ogo.dec.com/
Network and Systems Information Services

http://omsnav.das.dec.com
Operations Management Services

http://wabgweb.eng.pko.dec.com/nsis_ca/index.htm
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Business Critical Services

http://pmd.vbe.dec.com/
Product Management and Development

Software Engineering Australia: Team Players on the Pacific Rim

An integral part of the corporate 'network neighborhood,' DIGITAL's research and advanced development center in Queensland, Australia, is contributing signficantly to numerous successful research projects and product launchings.

By James Hunt and Blair Fidler, Software Engineering Australia, Gold Coast City, Queensland, Australia

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Members of Software Engineering Australia. From left: Angela Baird, Kalvinder Singh, Jenny Kyle, Robert Farago, Roy Flavel, Rami Smair, Sean Hardman, Alex Hennekam, Scott McKay, Gareth Seeto, Blair Fidler, Katrina Maffey, Jim Grohn, Andrew Shepherd, Peter Dettori, James Hunt, John Robinson, David Riley, Scott Johnson, Matt Moores, Charlie Flynn, and Derek Dominish. Not present for the photo: John Court, Greg McCane, Dirk Van Hennekeler, Sue Salamacha, Lyn Smooker, and David Cecil.

Located at the Bond University Research Park on Queensland's Gold Coast, Software Engineering Australia's (SEA) team of 25 has produced one successful software product after another since its inception in 1988.

Specializing in systems software engineering, the group has worked on several significant projects, including X.25 and wide-area networking support for Open VMS Alpha and DIGITAL UNIX, as well as development work on PATHWORKS for OS/2 and related projects. However, it is the center's recent endeavours that have enhanced its reputation.

The only DIGITAL research and advanced development center outside the US, SEA researchers have worked on some of the corporation's most exciting and successful projects during the past 18 months, including:

- AltaVista Personal Search
- MilliCent (the Web-based microcommerce system)
- FaceWorks
- AltaVista MediaSearch
- Network computers

AltaVista Points Inward

Building on the phenomenal success of the AltaVista Search site, AltaVista Personal Search allows users to search the Internet and their own PC using one familiar interface. AltaVista Personal Search can search documents and files in more than 200 file formats.

Under tremendous pressure to get AltaVista Personal Search to market quickly, a team of seven local engineers delivered the first version of the product after only 9 months. They did this by porting DIGITAL's Web interface and working closely with developers of the original AltaVista search technology in Palo Alto, California.

"Although the nucleus of the team was here on the Gold Coast, it really was a global effort," says Greg McCane, SEA engineering manager. "We worked closely with engineering and product management for AltaVista, as well as several third parties whose technology allowed us to index different file formats on a PC."

McCane says that although great effort went into developing AltaVista Personal Search at SEA, it was the elegance of

AltaVista Personal Search team. From left: Angela Baird, Sean Hardman, Andrew Shepherd, Scott McKay, Charlie Flynn, John Robinson, and Derek Dominish. Not present for the photo: Dirk Van Hennekeler and David Cecil.

the original AltaVista design that enabled his team to deliver the product so rapidly.

"We were working off very good base technology," he says. "The core search engine was easy to port because it was written in a portable fashion. Getting the user interface right, being able to search and index multiple file formats, and integrating the whole thing into the Windows 95 and NT environments—those were our real challenges."

What prompted DIGITAL to suddenly enter the consumer software market? "DIGITAL's and the AltaVista group's desire to capitalize on the huge success of the search site is what spawned this product," McCane admits.

However, he's quick to note that the AltaVista developers always envisioned their search technology expanding beyond the online realm. McCane states, "DIGITAL is not in the 'client software game,' but it was part of AltaVista Software's strategy to develop a search capability across the whole spectrum—from the Web to intranets to local workgroups and down to clients."

It may seem slightly out of character for DIGITAL to develop client software, but if public response is any measure, AltaVista Personal Search is a gamble that has paid off.

"The feedback on AltaVista Personal Search has been great," McCane says. "We've received some excellent reviews in the press and have been finalists for several prestigious awards. We were a finalist for the 1997 Codi award in the Best New Business Software Program category and on the short list of *BYTE Magazine*'s best of Fall Comdex '96 awards out of more than 800 nominees."

SEA is currently working on a major new release of this software, which will have many new features and a new name. SEA has partnered with Piper Creek Software from Calgary, Canada, in order to implement major functional enhancements at Internet speed.

Research and Advanced Development Laboratories

A key component in the corporation's worldwide business strategy, the Research and Advanced Development (RAD) program develops strategic new technologies, competencies, and products aimed specifically at turning them into promising business opportunities.

DIGITAL has five RAD centers:

Australia

- **Software Engineering Australia,** Bond University, Gold Coast City, Queensland, Australia

United States

- **Western Research Laboratory,** Palo Alto, California
- **Systems Research Center,** Palo Alto, California
- **Network Systems Laboratory,** Palo Alto, California
- **Cambridge Research Laboratory,** Cambridge, Massachusetts ✳

MilliCent team. From left: Jenny Kyle, Roy Flavel, Jim Grohn, John Court, Gareth Seeto, Kalvinder Singh, and Alex Hennekam.

Queensland may be geographically distant from the heart of Silicon Valley, but Software Engineering Australia's contributions are intrinsic to the excellence of numerous DIGITAL products.

Making 'Small Change' on the Web

While part of the Queensland RAD team is busy transferring one of the Internet's most famous technologies onto desktops, another group within the Gold Coast RAD center is hard at work on a project designed to revolutionize the way commerce is conducted online. Known as MilliCent, the project is a new technology that allows users to buy and sell information on the Web at fractions of a cent and thereby enables "pay-per-click" Web surfing.

By eliminating the minimum purchase requirement of 10- to 25-cent increments imposed by most electronic payment methods, MilliCent has the potential to change forever the way people think about doing business online. Since sites can charge a minimal amount, MilliCent will allow users to pay for data by the page, column, or line.

MilliCent is poised to open the Internet to profitable electronic commerce in traditional publishing (newspapers, magazines, books, academic journals) and emerging new areas, such as Web-centric content providers (Java Applet developers, search engines, ratings services, e-zines, online games). Newly emerging classes of small and specialist publishers will benefit, too.

MilliCent's flexibility will allow vendors to implement incentives such as advertising rebates and loyalty programs more easily.

A public trial of MilliCent is currently under way in parallel with the development of a more complete product-quality implementation.

The SEA MilliCent project team works in conjunction with researchers at the Systems Research Center in Palo Alto, California, and Internet Business Unit software engineers in Reading, UK.

Facing the Future

SEA has been working with the Cambridge Research Laboratory on another exciting new project with the potential to revolutionize the way people think about the Web, namely DIGITAL's new FaceWorks facial animation technology. This innovative technology is DIGITAL's bid to put the "personal" back into communication technology. As the name suggests, FaceWorks is a technique that enables face-to-face communication between computers and users by means of a digitally animated talking face.

FaceWorks maps portraits onto 3D models of a head and allows them to speak. Facial animation software activates the face, synchronizing the lip movements to speech. An internal field test version of the software featured an animated face reading the DIGITAL newsletter *Rapidly Changing Face of Computing.*

FaceWorks provides a set of tools to allow, for example, multimedia content

FaceWorks team. From left: Matt Moores, Robert Farago, and Rami Smair.


AltaVista Media Search team. From left: Katrina Maffey, Blair Fidler, Peter Dettori, David Riley, and Scott Johnson.

providers to produce interesting applications. There's no telling how many areas of the IT industry will find FaceWorks useful. Applications of the technology are limited only by the imagination.

AltaVista Media Search

AltaVista Media Search is a powerful video and audio search tool which enables a user to find and play back part of a video or audio recording using a Web browser and a standard plug-in. (See *Forefront,* Spring 1998, p. 42, for a detailed description of the project.) Many organizations have archived collections of video and audio in analog form, but no means of searching for specific points within a video or audio stream and no means of efficiently delivering the content to staff or customers. By searching annotations (text associated with a particular segment of the media item), AltaVista Media Search can locate pertinent material within minutes rather than hours, days, or weeks. The simplest form of annotation is a transcript of the audio track. Other kinds of annotation, such as annotations that identify particular speakers and images, are being developed and will eventually be used. Easy access to archival materials will surely stimulate new uses of multimedia content and possibly new markets.

The MediaSearch project involves researchers and engineers from the Cambridge Research Laboratory, the UNIX Business Segment, and SEA. The AltaVista Media Search team continues to develop research technology and pilot-quality software to address the significant and interesting problems of annotation, management, searching, and large-scale delivery of multimedia content.

Queensland may be geographically distant from the heart of Silicon Valley, but SEA software engineering contributions are intrinsic to the excellence of numerous DIGITAL products. ✳

web*sites*

http://www.research.digital.com
Corporate Research and Advanced Development Web site

http://www.MilliCent.digital.com
Try out MilliCent.

http://face.crl.dec.com
Facial Animation Suite

http://mvista.crl.dec.com/
AltaVista Media Search demonstration

'Distance Learning' in the Digital Age

The Web's growth as an information utility suggests and demands new models for learning. Explore the opportunities available today ... and continue learning!

By Nick Ugrinow, Technical Community Development Group, Maynard, Massachusetts

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Each time you search the Web for an elusive piece of information, you are tapping into a virtual library that may create "information overload." For today's knowledge worker, access to relevant information, tools, and systems is essential for optimal performance and continuous career growth. The challenge for the Technical Community Development Group (TCDG) is how best to support the needs of the corporation's learning community.

The TCDG's first home page, a collection of static curriculum maps with course descriptions, was subsequently recognized as a "best practice" by the American Society of Training and Development. Since then, the Web site has evolved into an active learner-centered environment.

Online Learning

The Web is a new medium for the delivery of training and education. Aided by a variety of Web-browser "plug-ins," a user can view animated graphics and video clips, and listen to audio presentations. When combined with "chat room" and email capabilities, the Web makes interactive learning possible.

Before implementing online learning, TCDG surveyed vendors and reviewed their online course offerings. The criteria for selecting a vendor included ease-of-use, low-bandwidth accessibility, and "client-lite" software.

LearnItOnline

Ziff-Davis' LearnItOnline program was selected as an economical way to provide online courses primarily via TCDG's Desktop Applications curriculum. Since its inception, more than 200 users have taken advantage of the LearnItOnline program. Course modules average 10 minutes in length, and users can select subjects whenever convenient. Each month, LearnItOnline releases updated applications courses.

Scholars.com

Last fall CBT Systems acquired Scholars.com, a Microsoft online Authorized Technical Education Center (ATEC), which provides online certification training. This afforded an opportunity to expand DIGITAL's program. Scholars.com defined a new paradigm in learning called "active mentoring," which combines in-depth, interactive, computer-based courseware with teams of learning advisors who are available, online, 24 hours a day.

To compensate for the lack of interaction with an instructor and fellow students, TCDG is piloting the use of AltaVista Forum as a platform for students.

CBTWeb Server

Formerly, computer-based training (CBT) used by students seeking Microsoft certification was available only by downloading from the MCS Learning Utility. This method was somewhat difficult for users lacking a high-speed network or the disk space to store files locally.

Acknowledging these barriers to access, TCDG installed a CBTWeb server to deploy CBT Systems courseware over the corporate intranet or the Internet. Now students can easily locate and launch CBT Systems courses using their Web browser, and administrators can track student usage of the training library.

Besides keeping the Microsoft certification curriculum up-to-date, TCDG will continue to add newly released online CBT courses to its curriculum. TCDG will also survey users periodically to determine how well the online curriculum accommodates individual learning styles.

Editor's note: The realities of computer-based training are well known to the author who is pursuing a master's degree in distance learning from Athabasca University, Alberta, Canada.

Building a Learning Community

While redefining *how* and *where* learning occurs, TCDG understands that successful learners need a support system. "Distance education" students often face obstacles—they might be constrained by circumstances at home or work, geographically removed from learning resource centers, isolated from other learners, and uninformed about course administrative issues. These factors give rise to special needs that must be met if distance learning programs are to succeed [1].

To compensate for the lack of interaction with an instructor and fellow students, TCDG is piloting the use of AltaVista Forum as a platform for students who have questions about Microsoft certification. A certified Microsoft instructor will monitor this online community.

Summary

TCDG aims to develop distance learning opportunities in order to:

- Provide DIGITAL employees with an alternative way to improve skills, enhance performance, and advance their careers

- Serve as a proof-of-concept for DIGITAL customers evaluating distance-learning solutions

Though technology can reduce time constraints and distance as barriers to learning, other issues can impede a successful learning experience. Facing and overcoming these challenges will facilitate survival in the Information Age.

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web*site*

http://tcdg.zko.dec.com/Self-Paced/liol.htm
Self-study opportunities: Desktop applications from Ziff-Davis' LearnItOnline

Lend Variety to Your Daily Routine

The Lending Library provides ways to stay up-to-date with new technologies and proven strategies for successfully balancing work and home life.

By Andy Breeding, Desktop Services, Information Research Services, Acton, Massachusetts

Andy.Breeding@digital.com

The Lending Library continues to provide to the DIGITAL technical community access to books, videos, and other hard-copy resources. Topics covered in recent acquisitions include:

- Java
- Windows NT
- IP multicasting
- IEEE networking standards

Take a few minutes to review all of the Lending Library's newly acquired materials in the online newsletter *What's New in the Digital Library Catalog.* (See "An Online Newsletter for Lending Library Sleuths," p.19.)

Take Advantage of the Lending Library!

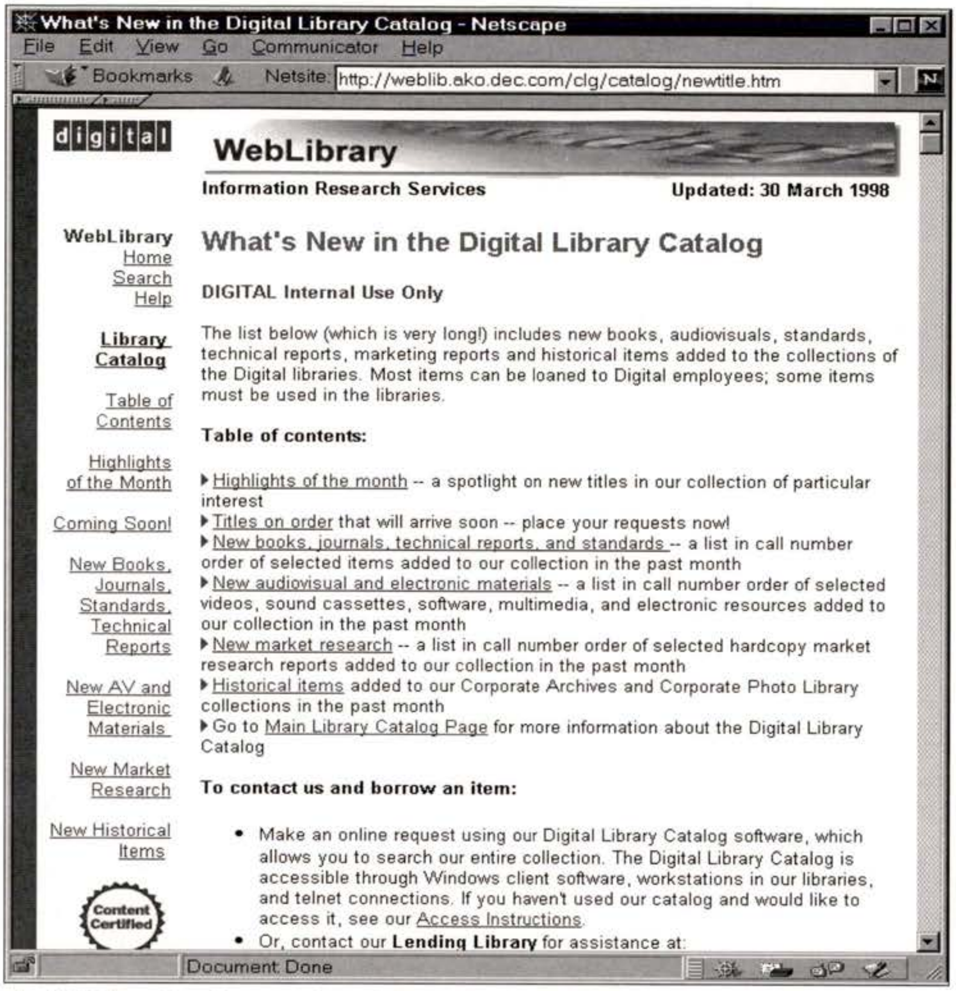
Every challenge in life is a learning opportunity, and the Lending Library holds a wealth of resources. Here are a few ways the Lending Library could help you.

- **Learn something new.** Read current texts on a new programming language or tool. Before buying the book, check the Lending Library.
- **Listen to audiotapes while commuting.** Lengthy commutes can be converted into productive time by listening to audiotapes. Learn about new business practices and techniques, listen to analyst briefings, or brush up on a foreign language.
- **Increase your awareness of health issues.** This information could affect your productivity at work and on the home front. Access the "Healthy Balance" collection from the Human Resources organization. These materials provide information about health and balancing work and home life.
- **Use an instructional video to enliven a staff meeting.** Seek out current business and technical videos. You and your coworkers can greatly benefit from this low-cost way to learn about current business thinking.
- **Borrow items from other institutions.** Don't despair if you can't find what you're looking for in the DIGITAL Library Catalog. Using Inter-Library Loan, you may be able to borrow items from other institutions.

Coming soon! An easy-to-use Web interface for the DIGITAL Library Catalog. Look for it this summer!

How to Obtain These Materials

Conduct an online search of available materials, and make online requests using the DIGITAL Library Catalog. Requested items are shipped directly to you. You can access the catalog using Windows client software (available from the DIGITAL Library Catalog Web page) or by using a Telnet connection. You also can phone the Lending Library at DTN 297-5040 or via email at the DIGITAL Lending Library (CST.Lending.Library@digital.com) for assistance from staff members. ✳



WebLibrary

Information Research Services **Updated: 30 March 1998**

What's New in the Digital Library Catalog

DIGITAL Internal Use Only

The list below (which is very long!) includes new books, audiovisuals, standards, technical reports, marketing reports and historical items added to the collections of the Digital libraries. Most items can be loaned to Digital employees; some items must be used in the libraries.

Table of contents:

▸ Highlights of the month -- a spotlight on new titles in our collection of particular interest
▸ Titles on order that will arrive soon -- place your requests now!
▸ New books, journals, technical reports, and standards -- a list in call number order of selected items added to our collection in the past month
▸ New audiovisual and electronic materials -- a list in call number order of selected videos, sound cassettes, software, multimedia, and electronic resources added to our collection in the past month
▸ New market research -- a list in call number order of selected hardcopy market research reports added to our collection in the past month
▸ Historical items added to our Corporate Archives and Corporate Photo Library collections in the past month
▸ Go to Main Library Catalog Page for more information about the Digital Library Catalog

To contact us and borrow an item:

- Make an online request using our Digital Library Catalog software, which allows you to search our entire collection. The Digital Library Catalog is accessible through Windows client software, workstations in our libraries, and telnet connections. If you haven't used our catalog and would like to access it, see our Access Instructions.
- Or, contact our **Lending Library** for assistance at:

The WebLibrary's online newsletter *What's New in the Digital Library Catalog* provides information about the latest acquisitions of the Lending Library.

web*sites*

http://weblib.ako.dec.com/clg/catalog/dlncat.htm
Access the DIGITAL Library Catalog using Windows client software or by using a Telnet connection.

http://weblib.ako.dec.com/oclcill.html
Request an item via interlibrary loan or send suggestions for purchases to add to the collection.

http://www-hr.ecom.dec.com/wl/
The DIGITAL Human Resources Library

An Online Newsletter for Lending Library Sleuths

Check *What's New in the Digital Library Catalog,* an online newsletter, to find out about new additions to the DIGITAL Library Catalog. Newsletter topics include

- Highlights of the month—special new titles in our collection
- Titles on order—those that will arrive soon
- New books, journals, and technical reports
- New audiovisual and electronic materials
- New market research
- Historical items added to our Corporate Archives and Corporate Photo Library ✳

web*site*

weblib.ako.dec.com/clg/catalog/newtitle.htm
What's New in the Digital Library Catalog

Patent Protection for Inventions Embodied in Software

Few people are aware that an invention in almost any area of software technology can be patented.

By David A. Dagg, Patent Law Group, Maynard, Massachusetts

david.dagg@digital.com

Recent trends indicate that patent protection for software will become more important in the future. Although court decisions have gradually narrowed the scope of copyright protection for software, the law regarding the patentability of inventions embodied in software has become clearer and better defined. In addition, the US Patent and Trademark Office has adopted procedures to improve the process for obtaining software-related patents. As a result, software engineers must consider whether the technology they develop could be the subject of one or more patent applications.

Patentable Types of Software

No particular type of software is, by its nature, unpatentable. Patents have been obtained for inventions in the areas of operating systems, compilers, artificial intelligence, applications, user interfaces, and data structures. Accordingly, an invention in almost any area of software technology can be patented.

Requirements for Patenting a Software Invention

As with any patentable technology, a software invention must be new, useful, and "non-obvious" to be patentable.

The Novelty Requirement

The requirement that an invention be new, sometimes referred to as the "novelty" requirement, is satisfied by showing some difference relative to previous attempts to solve the same problem. When determining what is novel and potentially patentable, technical features that provide significant advantages over competing products should be considered. The extent of the difference and the importance of any advantages it provides will usually affect the patent's licensing or enforcement value.

When deciding whether to file a patent application, it is helpful to view the novelty of the system on a sliding scale. At one extreme, the potential value of a patent covering a completely new way of solving a problem is usually clear. However, an invention need not be a major breakthrough to be valuable if the technology covered is strategic to the company. A patent that is barely distinguishable from the "prior art" may be useful, if a patent protects a high-revenue or flagship product, an area of significant investment by the company or its competitors, or capabilities providing an important competitive advantage.

The Utility Requirement

The usefulness, or "utility," requirement is generally not a problem for software-related inventions, because the specific use of the software is typically clear.

When determining what is novel and potentially patentable, consider technical features that provide significant advantages over competing products.

The 'Non-Obvious' Requirement

Whether an invention is legally obvious is a question best left for resolution during examination of the patent application by the US Patent and Trademark Office. Many experienced software engineers modestly believe that the systems they design are obvious. However, what is technically obvious to such a person may not met the legal standard of obviousness. Accordingly, when there is novelty in the system and the business interests of the company are served by obtaining a patent, an application should be considered.

Describing a Software Invention

When determining whether to file a patent application, the question to ask is: "What is the invention?" Since a software patent provides protection at a level above the literal code, a higher level of abstraction should be selected to reflect the novelty of the invention while avoiding extraneous implementation details. Figures showing the elements of the system, including hardware and software, as well as flow charts describing the operation of each element, can be helpful. A top-down approach should be used, starting with an overview of the system illustrating its benefits and output, followed by more-detailed figures of each element. Using this set of figures, an inventor can work with a patent attorney to determine which elements of his or her invention distinguish it from prior art and the scope of protection that should be sought.

Processes for Identifying Software Inventions Early

Because patent applications take time to prepare and must be filed before public disclosure or commercialization of the invention, early identification of software inventions is critical. To identify areas of a design suitable for patent protection, project reviews should be performed with a patent attorney after the overall architecture of the product is completed. The schedule for submitting invention disclosures should be integrated into the overall project schedule to ensure that it is not left until the last minute. When needed, prior art searches can be done before deciding to file.

The approval process for patent applications varies among engineering groups, but typically includes submission and review by an Invention Review Committee, such as the Systems Software Invention Review Committee, chaired by Drew Mason.

For advice or help, contact the appropriate DIGITAL patent attorney in the Intellectual Property Law Group. ✱

An invention need not be a major breakthrough to be valuable if the technology is strategic to the company.

web *sites*

http://www-server.mso.dec.com/ip/ip.htm
Corporate Patent Program

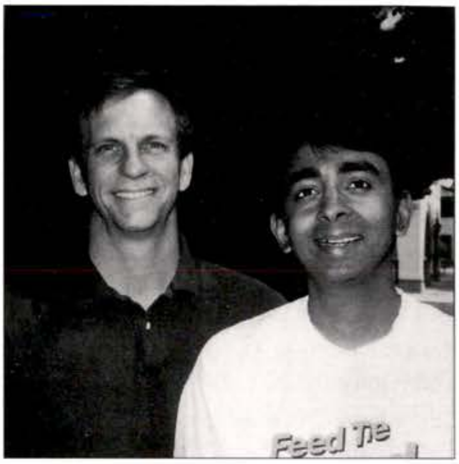
http://www-server.mso.dec.com/ip/awards/home.htm
DIGITAL Intellectual Property Awards

Patent Awards

Nineteen US patents were assigned to DIGITAL by the US Patent and Trademark Office during Q3 for a FY98 year-to-date total of more than 75 issued patents. Cash awards of up to US$500 were presented to these inventors in recognition of their technological innovations and significant contributions to the corporate intellectual property portfolio.

D. Willett

Patent Award Recipients from Massachusetts and New Hampshire
Seated, from left: Bob Faranda; Bill Strecker, senior vice president and chief technical officer, Russell Iknaian, Brad Chapin, John Kowaleski, and Rich Watson. Standing, from left: Bob Reed, Patent Award program manager; Tom Gannon, director, Corporate Technical and Information Services; Harry Copperman, senior vice president and general manager, Products Division; and Scott Cutler, vice president and chief technical officer, Windows NT Business Unit.



Patent Award Recipients from California
From left, Alan Eustace and Sribalan Santhanam

A DIGITAL Standard for Designing 'Green' Products

DIGITAL has documents to aid in meeting requirements, as defined by international regulations, corporate policies, criteria based on market-driven ecology labeling programs, and government procurement guidelines.

By David Spengler, Product Stewardship Group; Environment, Health and Safety; Maynard, Massachusetts

david.spengler@digital.com

Product-related Environment, Health and Safety (EHS) regulations and market-driven requirements that impact compliance, marketability, and customer expectations of DIGITAL products are emerging worldwide. Designing "green" products can be a confusing and challenging task.

Numerous business unit managers and product development teams have requested help in understanding and implementing design-for-environment (DfE) laws, rules, and design best practices. In response to this need, the corporate EHS Product Stewardship group developed a DIGITAL standard plus three simplified DfE checklists to assist DIGITAL product managers and development teams in efficiently delivering environmentally compatible DIGITAL products to the marketplace.

DIGITAL Standard 208-0, *Product Stewardship Life-Cycle Requirements,* identifies EHS product requirements, as defined by international regulations and DIGITAL policies, and summarizes criteria from numerous market-driven ecology labeling programs ("eco-label" programs) and government procurement guidelines.

EHS product requirements vary by region but generally include restrictions on regulated materials, design of the product for reuse or recycling, and environmentally safe disposition. In addition, voluntary eco-label programs often require product energy-conservation features; limitations on emissions of particles, X rays, or electromagnetic fields; restrictions on acoustical noise emissions; and compliance with ergonomic criteria. Meeting voluntary environmental initiatives, such as eco-label programs and government procurement guidelines, helps satisfy customer expectations and, in many cases, may be required as a bid qualifier (see *Forefront,* Spring 1998, p. 26).

web *site*

http://www.aeo.dec.com/ehs/ps/
Product Stewardship Web page

DIGITAL Standard 208-0 is designed as a reference document. Its subheadings are organized according to the major steps of the product-design process and can be used directly in a product specification. To simplify its use, simple three-level DfE checklists were created to use in conjunction with the standard. They included the following three DfE checklists:

1. Product Stewardship Regulatory Requirements
2. Product Stewardship Requirements per DIGITAL Standards and European Computer Manufacturers Association *Technical Report 70*
3. Product Stewardship DfE Best Practices

For further information, please contact David Spengler (DTN 223-7671), the "standard owner" of DIGITAL Standard 208-0. ✳

Product Stewardship Training

Environmental awareness sessions were presented to international NT Systems audiences and representatives of the US Environmental Protection Agency.

By Dick Willett, Corporate Technical Publications, Acton, Massachusetts

dick.willett@digital.com

Frank Rooney, manager, Environment, Health and Safety Product Stewardship Group, presenting "DfEHS" session to design people at the Taiwan facility.

Environment, health and safety (EHS) features have become more important for today's computer products. Customers, especially in Europe, expect these features and competitors are also including these features in their products. If done effectively, incorporating these features can be a source of cost reduction. To create a total quality solution for today's markets, product development professionals need to be aware of how EHS applies to the products they are responsible for.

To address this need and support an NT Systems business objective to institutionalize "Earth Vision," DIGITAL's corporate environmental policy, a basic awareness session was developed. "Design for Environment, Health and Safety," or DfEHS, is about 1 hour in length and is intended as a starting point to raise EHS awareness among those involved in product development, such as engineers, product managers, product marketers, and procurement people.

The session covers a variety of DfEHS issues, explaining what product stewardship is and why it's important to information technology products. It discusses management of regulatory requirements and provides details on voluntary requirements including environmental labeling schemes and environmental declarations such as the European Computer Manufacturers Association *Technical Report 70* (see *Forefront*, Spring 1998, p. 26, for more detail on *ECMA TR/70*). The session is interactive and cites several examples of product-stewardship features already applied to DIGITAL products, e.g., energy efficiency, hazardous materials reduction, use of recycled materials, design for disassembly and recovery, and packaging/documentation reduction.

On a recent Asia-Pacific territory trip, Frank Rooney, manager of the EHS Product Stewardship Group, presented the session to several engineering and development groups in Taiwan and Singapore. The session also was presented by Larry Nielsen to product development engineers from the NT commercial desktop, mobile, and NT server business segments in the US. A modified version of the session was recently presented by Larry to the US Environmental Protection Agency (EPA), Region 1, in Boston as part of an ongoing cooperative exchange between the EPA and local industry.

If you feel your organization would like to learn more about the advantages of including EHS in your product designs, please call Frank Rooney at DTN 223-7647 for further information.

Members of the Product Stewardship staff are available to present the session as needed throughout DIGITAL businesses. ✳

Engineering Promotions

Many thanks for the text and photo contributions from the supervisors and colleagues of the DIGITAL engineers whose collaborative and individual achievements earned them these promotions.

Alan Eustace Promoted to Senior Consulting Engineer

Alan Eustace's promotion to senior consulting engineer acknowledges 11 years of innovative hardware and software research at the Western Research Laboratory in Palo Alto, California.

Alan was one of a handful of people that designed and built the fastest microprocessor of its time, a 1991 VLSI bipolar chip that ran at 300 MHz and dissipated in excess of 115 watts. This chip, along with a BiCMOS follow-up, involved new issues in packaging, power distribution, memory systems, and computer-aided design.

Because it was difficult to understanding the performance tradeoffs involved in the design of high-performance processors, Alan and Amitabh Srivastava designed and implemented ATOM, a revolutionary flexible interface for instrumenting programs. ATOM was used extensively in the design of the 21264 microprocessor. ATOM was also used in many diverse areas including profiling, bug and memory leak detection, and test coverage analysis. ATOM was transferred to the DIGITAL UNIX Development Environment group in 1995, which continues to make enhancements for a large user community.

Alan is also responsible for the design and implementation of a new method for translating Postscript documents into text suitable for indexing by search engines like AltaVista. This method is up to 50 times faster than traditional ones.

Alan received his PhD in computer science from University of Central Florida in 1984. He is a co-author of nine technical papers and has filed 10 patent applications.

Rob Frame Promoted to Senior Consulting Engineer

Rob Frame has been promoted to senior consulting engineer for his key role in developing new technologies and products for DIGITAL.

Rob came to DIGITAL in 1984 as an electrical engineer in the Low End Disk Systems group. During the next few years, Rob was responsible for the hardware architecture and implementation of the new DSSI bus, the design of several ASICs—SII, SWIFT, Apache, Cherokee, and Apache2. Rob's work earned him five patents as well as promotion to consulting engineer. Rob left the ASIC development team and led the disk drive development efforts for the RF73, RZ74, and TPF2 (the drive intended for use in the burgeoning portable notebook market).

Rob was the first engineer hired into the Portable Computer group. He developed the architecture that would be used on the first generation of DIGITAL's internally designed notebook computers. He specified the electrical components, schematics, and power management for the DIGITAL HiNote and HiNote Ultra. Due to the hard work of Rob's team, along with the training and guidance Rob provided to the Japanese manufacturing partner, the organization brought these two new designs from inception to manufacture in roughly 12 months. The follow-on product, the HiNote Ultra II, incorporating larger LCD screens, faster Intel processors, larger capacity removable hard drives, two versions of port replicators, and better quality, was developed in less than half a year.

In addition to the hardware enhancements of the product, Rob worked with DECwest to develop the most comprehensive NT solution ever shipped with a notebook, enabling the Ultra II to win many industry awards. In 1996, in recognition of his efforts on the Ultra line, Rob was named a finalist for the Chairman's Award for Technical Excellence.

During Ultra II development, Rob helped design a new value-line notebook—the VP series. Working with a Taiwanese partner, DIGITAL was able to offer the first value-line notebook in the industry with a preloaded NT configuration.

In 1996, the Portable Computer group began its most ambitious project—the HiNote Ultra 2000. Rob was involved in the specification of this product which incorporates features such as a 14.1-inch LCD screen, PCI docking and associated security, swappable floppy/CD-ROM, and a hidden PCMCIA slot. More than 20 patent applications are expected as a result of this product. Rob was personally involved in 11 of these ideas, and his team, once again, was a finalist for the Chairman's Award for Technical Excellence. At the same awards ceremony, Rob was recognized for his tenth patent application.

Currently Rob is involved in the specification and development of future products such as new versions of the Ultra II and the Ultra 2000, and specification of a new class of portable Windows CE devices.

Hank Jakiela Promoted to Senior Consulting Engineer

Hank Jakiela has been promoted to senior consulting engineer for his contributions to Systems Engineering in performance measurement and analysis, and system designs for scalabilty and high availability. His consulting with major customers in telecommunications and finance has helped DIGITAL provide successful solutions to meet unusual and demanding requirements in those areas. Hank has also developed performance measurement and visualization techniques for distributed systems.

One such project is the NASDAQ Enterprise-Wide Network, which connects traders across the country to NASDAQ's trading systems. This network, engineered by DIGITAL and MCI, has been in operation for the last 3 ½ years. Hank's ongoing consulting on performance measurement and analysis has helped keep the network running smoothly, in spite of NASDAQ's rapidly increasing trading volume. Based on the success of this network, DIGITAL and MCI were awarded the contract to build a second-generation network that will provide greater bandwidth to more traders.

Hank holds a BS in computer science from the University of Michigan and an MS and PhD from Northwestern University. Before joining DIGITAL in 1987, Hank worked at G. D. Searle & Co., a subsidiary of Monsanto, and was an assistant professor at Northwestern University.

Bob Souza Promoted to Senior Consulting Engineer

Bob Souza has been promoted to senior consulting engineer for his contributions to Systems Engineering in the areas of data networking and software design, as well as networked system architecture, design, and repair. Bob consults with major customers in a variety of roles from pre-sales RFP responder to troubleshooter.

Bob contributed heavily to the MCI/NASDAQ NSAEWN project, the nationwide network that connects traders at about 2,000 sites to NASDAQ's central trading systems. Bob led a team to improve the performance of the network management systems, personally implemented mission-critical server software, acted as a technical consultant to the program, and was a major contributor to the proposal for a second-generation NSAEWN. On the basis of this network's success, DIGITAL and MCI have been awarded the contract to build a second-generation network.

Before joining Systems Engineering in 1994, Bob's primary contributions were in the areas of networking, distributed systems, and hardware design tools. While working for Network Product Business, Bob was, as project leader for the GIGAswitch/FDDI switch control processor (SCP), responsible for both hardware and software aspects of the SCP. Bob worked for Corporate Research on MIT's Project Athena, for which he co-authored a remote procedure call (RPC) package for UNIX. While a member of MicroSystems Advanced Development, Bob provided the DEMPR Ethernet repeater design team with both a methodology and tools to support that methodology which made the DEMPR implementation possible.

Bob holds three DIGITAL patents related to network technology and has published papers on networking and distributed system technologies as well as hardware design.

Before joining DIGITAL in 1982, Bob lectured in the EECS department at the University of Connecticut. He holds BS and MS degrees in electrical engineering and a Ph.D. in computer science.

Bill Weihl Promoted to Senior Consulting Engineer

Bill Weihl has been promoted to senior consulting engineer for his major contributions to software technology and computer architecture in reliable distributed systems, transaction processing techniques, parallel programming technology, and profiling technology. Most recently, he has worked on performance profiling tools and profile-driven optimizations. He served as technical lead for the DIGITAL continuous profiling infrastructure (DCPI) project and for the ProfileMe hardware sampling design.

DCPI has been available for use inside and outside DIGITAL by Alpha programmers since late 1996. The resulting detailed profile information is used to tune systems, resulting in speedups ranging from 10% to as much as a factor of 25. DCPI gives Alpha a significant competitive advantage over other systems; no other vendor can provide similar profiling information and some optimizations are not feasible without it.

Before joining the Systems Research Center in Palo Alto, California, in 1994, Bill was a professor of computer science at MIT. Bill has published over 60 technical papers. Since joining DIGITAL he has filed 20 patents on performance technology. Bill holds BS, MS, and PhD degrees from MIT.

Ted Wobber Promoted to Senior Consulting Engineer

Ted Wobber, who works at the Systems Research Center in Palo Alto, has been promoted to senior consulting engineer. Ted has been with DIGITAL since 1985, working in many areas of distributed systems research.

An expert on distributed systems security, Ted was a major contributor to the cryptographic protocols and implementation of the AltaVista Tunnel product (also known as the secure IP tunnel). The AltaVista Tunnel provides secure communication from home into a corporate intranet or between the network of a remote office site and the main corporate network.

Recently, Ted has been a leading member of the team that developed the experimental Pachyderm email system. Pachyderm is a Web-based application that allows its users to read email from anywhere on the Internet using a Web browser for access. The underlying mechanisms, based on the same text-indexing libraries employed by the AltaVista Web site, let users manage large quantities of email (and potentially any other information sources) without manually organizing their data by using queries on a full-text index. (See *Forefront,* Spring 1998, p. 17.)

Martín Abadi Promoted to Consulting Engineer

Martín Abadi had been promoted to consulting engineer for his contributions to DIGITAL's efforts in computer security—in particular, secure network tunneling.

"Tunneling" refers to schemes that allow someone on a public network, such as the Internet, to access the facilities of a private network, such as an organizational intranet. Security is a key challenge in tunneling, since the tunnel provides a path through the private network's firewall. Martín consulted with the designers of DIGITAL's tunneling product, the AltaVista Tunnel. He discovered a flaw in the draft protocol which fortunately was easy to correct. More recently, Martín has worked with Andrew Birrell, Ted Wobber, and Raymie Stata to design the Web Tunnel, a scheme that allows secure Web access through a firewall without any special software on either client or server. The Web Tunnel exploits the SSL protocol, redirection, and proxies in a clever way.

Martín's consulting powers are built on a solid foundation of research in security. A spectacular example is the paper titled "A Logic of Authentication," which was written with Mike Burrows and Roger Needham and was published in 1989. It proposes a scheme for reasoning formally about who knows what, when, and why in a security protocol. That paper sparked much follow-on work; the resulting logics are called "BAN logics," from the initials of the three authors.

Martín's security research is only one of his fields of interest. He has also published extensively on specification and verification as well as on the theory of programming languages.

In the area of programming-languages, object-orientation is particularly relevant today. The first attempts to formally model object-oriented languages, based on the standard lambda calculus, were quite clumsy. Luca Cardelli and Martín recognized that the cure for this clumsiness is to replace the lambda calculus with a similar calculus in which the "self" concept is built in. They published a book about this in 1996, titled *A Theory of Objects.*

Martín joined DIGITAL in 1987, after getting his PhD from Stanford in computer science on temporal-logic theorem proving. He holds four patents, has filed five patent applications, and has published more than 90 papers.

Simoni Ben-Michael Promoted to Consulting Engineer

Simoni Ben-Michael has been promoted to consulting engineer in recognition of his outstanding work in VLSI and networking. His experience in VLSI and networking spans 15 years, of which 13 have been spent working for DIGITAL Semiconductor in the networking product line. The lead VLSI architect at the design center in Jerusalem (ISV), he was heavily involved in the design of the 10-Mbps, 100-Mbps, and 10/100-Mbps network interface card (NIC) devices, which have generated more than US$100 million accumulated revenue for DIGITAL.

His latest contribution was the OctalMAC device. Simoni established an architecture optimized to the switch market, which included a parallel bus definition—the FBUS, a very efficient and flexible concept. Since then, the FBUS concept has been used in two other devices, the GigaMAC and the SA1200; they now form a family of compatible devices.

In addition, Simoni has been the focal person in intellectual property (IP) activities at ISV. Simoni helped to guide others in identifying the right technical achievements and in handling procedures for filing patents. Whenever the need for IP evaluation arises, Simoni handles this critical task.

When the design center begins working with a new technology and needs the most accurate data about its impact on standards, Simoni is also the natural choice. He has participated in standards committees for Fast Ethernet, Ethernet, and Gigabit Ethernet. For the latter, Simoni was selected to participate in the "group of experts" performing early reviews of the drafts.

Simoni holds BS and MS degrees in electrical engineering from Technion (the Israel institute of technology). He has been awarded 12 patents.

Larry Bond Promoted to Quality Consulting Engineer

Larry Bond's promotion recognizes numerous valuable contributions to DIGITAL Semiconductor over the last 18 years. With powerful tools like graphite furnace atomic absorption, micro-Fourier transform infrared spectroscopy, and ion chromatography, Larry has created measurement techniques to acquire the highest quality chemicals, and then has directed their use to produce the world's fastest microprocessors.

Larry's expertise in analytical and organic chemistry has been vital in developing test methods that have enhanced DIGITAL's ability to characterize and quantify ultratrace metallic and particulate contaminants in process chemicals. These cutting-edge techniques have been used through seven successive generations of CMOS technology to troubleshoot process problems, optimize yield and reliability, and significantly improve chip performance while reducing costs. Larry's advice is frequently sought by the DIGITAL technical community and leading chemical and equipment manufacturers as well as industry and government consortiums, professional societies, independent testing labs, and academic institutions. Larry is justifiably proud of his "CheMagic!" presentation for engineers and technicians, which demonstrates the importance of chemistry in semiconductor manufacturing and allows him to pass his knowledge on to others.

Larry has a BS in chemistry from Worcester Polytechnic Institute and formerly worked at Merck. He attended college on an academic/athletic (basketball and golf) scholarship, recently qualified for Mensa, and is an active fund-raiser for several charities.

Jill Card Promoted to Consulting Quality Engineer

Jill Card's promotion to consulting quality engineer acknowledges her leadership and technical expertise in the design, construction, and implementation of neural networks used for effectively controlling semiconductor wafer FAB processes, and for understanding complex data sets.

Jill's most recent accomplishment was developing a fully functional dynamic controller in a major process area in the FAB4 and FAB6 operations in Hudson, Massachusetts. An established industry leader in this field, Jill has made significant technical breakthroughs; for example, she was the first one to build a generic dynamic controller/neural network that could be transferred from one process technology to another with minimal programming effort. (Others had been concentrating efforts on solutions to specific process problems.)

In addition, Jill organized a monthly Neural Network Seminar Series to share her knowledge and mentor others. Her passion for this work and her ability to translate complex mathematical theories into easily grasped concepts resulted in enthusiastic participation.

Gary Freedman Promoted to Manufacturing Consulting Engineer

Gary Freedman's promotion to manufacturing consulting engineer acknowledges his many contributions to DIGITAL during the past 11 years. Gary works in the Modules Manufacturing Operations Group in Manufacturing and Distribution where he has made consistent contributions to the Manufacturing business.

Among several areas, Gary is being recognized for his contributions to the straddle-mount-connector assembly process for the Stage Coach enclosure. Gary's experiments and redesign of the process resulted in almost a total reduction of the solder-short defect rate, which was achieved in the prime plant (Taiwan) during a steep volume ramp-up of the Appaloosa product. DIGITAL has implemented this process in all plants, using it to build more than 2 million PCs.

Gary also investigated inerted atmosphere in DIGITAL Manufacturing's no-clean reflow process. This was a team effort, and the results were also implemented in all plants. While the other team members were focused on individual process equipment implementations and modifications to facilitate the change, Gary's primary technical focus was in the area of gas procurement, handling, and control. DIGITAL's superiority in this area is its ability to specify and measure the usage of nitrogen and thereby control our process. This change has allowed DIGITAL to significantly reduce soldering defects and has been a major contribution to better quality performance in all module plants.

Gary holds a BC in chemistry from Nasson College. Since joining DIGITAL in 1987, Gary has been awarded five patents. He is currently the team leader of the WildFire module assembly process development team.

Mark Holohan Promoted to Software Consulting Engineer

Mark Holohan has been promoted to software consulting engineer in recognition of his technical achievements in designing solutions for Internet service providers (ISPs). His work, which demonstrates outstanding technical leadership, has significantly contributed to DIGITAL's success in this highly competitive market.

Mark is a member of the Internet Solutions Development group, the engineering arm of the ISP Business Group (IBG). He develops solutions for core ISP services, using Web, mail, news, proxy, and directory servers. Solutions are built using both commercial and public-domain software.

Mark has been responsible for corporate technical liaison with Netscape Communications Corporation. He was involved in the joint development of the DIGITAL-Netscape ISP solution based on Netscape Suitespot Hosting software. He assisted in contract negotiations and helps resolve pricing, packaging, and porting issues.

To build awareness and understanding of DIGITAL's offerings for the ISP market, it is critical to train DIGITAL technical support, VARs, and customers about DIGITAL software solutions. To this end, Mark has given presentations in Europe, Asia, and the Americas on a variety of topics, including the Internet AlphaServer (IAS) product, DIGITAL-Netscape solutions, Web servers, virtual Web hosting, and high-end mail solutions.

Mark has been the chief technical contact for many customers, VARs, and third-party solution providers. He has represented DIGITAL in discussions with engineering leaders for UUNET, US West, Bell Labs, Netscape, and Software.com. He works with DIGITAL UNIX Engineering on requirements for high-availability servers, scaleable authentication schemes, Web-based system administration, and next-generation Internet servers.

Previously, Mark was the project leader for the IAS software product. Mark and his team developed a package of easily installed, configured, and administered Internet servers for the DIGITAL UNIX platform.

Mark holds a BS in computer science from Boston University. Before joining DIGITAL, Mark worked on air-traffic control and air defense software at Sanders Associates. He joined DIGITAL in 1987 and has worked on the DECchart, DECwrite, and DECMailworks projects.

Mark Naylor Promoted to Consulting Engineer

Mark Naylor has been promoted to consulting engineer in acknowledgment of his role as system architect for the Celebris FX2 and Venturis FX2 projects. These are DIGITAL's two main PC products, representing 70 percent of the units sold (about 700,000 PCs), and about US$800 million annual revenue. Mark was responsible for concept, feature definition, technology selection, and system designs. By aggressively working with Intel, he launched DIGITAL's TX-based Porsche system almost a full quarter ahead of the major PC competitors—a rare and profitable situation for DIGITAL.

Prior to the Porsche introduction, Mark was the lead system engineer for the Appaloosa program. The Venturis FX PC, code named Appaloosa, was DIGITAL's high volume PC, launched in spring 1996. Both low-profile and short tower versions of this product have sold over 600,000 units. As system engineer, Mark was instrumental in the development and introduction of this PC to meet the system architect's definition.

Mark had worked in the ASIC Advanced Development group and the ASIC Bipolar Component Engineering group before joining the PC group in 1993. He has been with DIGITAL since 1986.

Greg Papadeas Promoted to Hardware Consulting Engineer

Greg Papadeas has been promoted to hardware consulting engineer in the Alpha Test Engineering group in recognition of his outstanding contributions to the company over the past 20 years. In particular, Greg is being recognized for his most recent achievements in the areas of test strategy development and test implementation for DIGITAL Semiconductor's high-performance microprocessors and for test capability development for the very successful EV6 (21264). Greg's leadership in the area of test strategy and test tool development has been vital to DIGITAL's ability to meet the test challenges of the world's most complex and highest performance microprocessors.

Currently, Greg leads the EV6 test development effort. His team has successfully developed and delivered the test methodology and test hardware, as well as the test software for debug, verification, and prototype screening of the EV6 CPU chip, enabling full performance testing of this device.

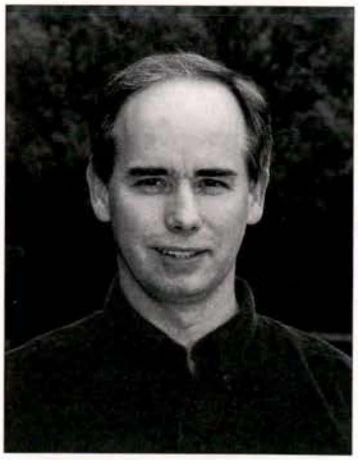
The EV6 is the third generation of the Alpha microprocessor. The performance targets, electrical requirements and architectural complexity for this chip presented significantly greater test development challenges than previous implementations of the Alpha architecture. The project required substantial technical innovation to provide solutions for the large instantaneous power supply current changes, the very-high-speed bus interface, and a complex device initialization sequence. Greg's extensive and thorough understanding of the tester architecture, test methodologies, and test software environment allowed him to successfully develop the test solution for EV6.

Greg also led a cross-functional team to evaluate, select, and deliver the test platform required to meet the product requirements for EV56 and EV6 generation of chips. The selected tester platform has been successfully applied to testing EV6, EV56, PCA56, PCA57, Tsunami, and several StrongARM chips.

Before undertaking EV6 test development, Greg was instrumental in the design and development process for test tools for test program development and test pattern translation. These tools have significantly improved the efficiency and capability of the test engineering group.

Greg's accomplishments on EV6 follow a long history of important contributions to DIGITAL's Test Engineering community. The lasting effects of his work can be seen in almost every aspect of DIGITAL Semiconductor's test development efforts including chip projects such as µPrism, Mariah, NVAX+, and Phoenix; test program standards; new test platform selection and introduction; and test tool development such as CATALYST, On Line Data Collection, and Path-Back-In.

Greg received his BSEE from the University of New Hampshire in 1975 and an MSEE from the University of Massachusetts in 1986. From 1994 to 1996, he was DIGITAL's representative to a SEMATECH industry-wide committee charged with standardizing electrical specifications for VLSI automated test equipment from various suppliers. Greg co-authored a paper titled "An On-Line Data Collection and Analysis System for VLSI Devices at Wafer Probe and Final Test" which was presented at the 1994 IEEE International Test Conference.



Rob Philpott Promoted to Software Consulting Engineer

Rob Philpott has been promoted to software consulting engineer on the basis of the successful delivery of V2.0 DCE (distributed computing environment) for Windows NT, the first jointly developed

IBM-DIGITAL DCE product set. This project was undertaken because cooperating could dramatically lower both companies' DCE for Windows NT development costs and because DIGITAL wanted access to IBM's extensive DCE test suite to improve product quality.

As DIGITAL's DCE technical director, Rob was a key participant in the early talks with IBM, working to determine how DIGITAL's DCE for NT products could meet the needs of their server initiatives. He was also key in resolving several thorny architectural issues between the IBM and DIGITAL DCE engineering teams. Due to Rob's early work to set up a "win-win" scenario, the project moved forward with remarkable ease for an inter-company joint development project. Because of the success of the V2.0 effort, discussions are under way to expand the relationship beyond NT and Windows 95 DCE.

Rob has been involved in the DCE area since 1992, providing technical leadership to DIGITAL, The Open Group, and consortium partners—IBM, HP, Hitachi, and Transarc. Consulting-level engineers from DIGITAL, The Open Group, and IBM supported Rob's promotion. Rob has demonstrated his cross-industry collaborative skills in both the IBM relationship and in projects with The Open Group. Rob's breadth of knowledge about transaction processing and DCE, and how customers use these technologies to build mission-critical applications, has continued to be important in DIGITAL's retention of major accounts. Rob can often suggest small ways that customers could improve their deployment of these technologies to solve large problems.

Rob has held several technical leadership positions at DIGITAL. He joined DIGITAL in 1979 in the Networks and Communications group, working on tools for network protocol verification and performance measurement of DECnet Phase III products. He then led a team developing operating system components for the RSX-11 product family. In 1984, he went to the Saddlebrook Corporation and spent 3 years developing communications software for banking systems and later managed the systems engineering organization. In 1987, he returned to DIGITAL's OLTP group to manage projects such as TP Workbench and Desktop ACMS. Rob returned to a technical role when he joined the OpenVMS organization as a developer on the initial port of DCE to the OpenVMS platform.

Rob holds an MS in engineering and a BS in computer science from the University of Louisville.

Mike Quinn Promoted to Hardware Consulting Engineer

Mike Quinn's promotion to hardware consulting engineer acknowledges his accomplishments in microprocessor projects during his career at DIGITAL. He joined DIGITAL in 1987 in the Advanced Test Engineering group at the Shrewsbury facility. His first projects for DIGITAL Semiconductor were NV5 and EV5 (Alpha 21164).

On EV6 (Alpha 21264), he was leader of the verification effort and became a respected expert in the EV6 microarchitecture and system architecture. Mike's technical leadership and expertise had a direct impact on the high quality of the EV6 design, and his personal contributions were exceptional. The verification effort successfully identified and removed over 800 bugs from the design before its fabrication. Prototype systems have successfully booted multiprocessing versions of VMS, OSF/1, and NT using first-pass parts. Much of EV6's success can be attributed to Mike's technical strategies, detailed problem-solving abilities, knowledge of architecture, dedication, and close working relationships with EV6 designers, architects, and management.

Mike received his BSEE in 1975 from Drexel University and his MSEE in 1978 from the University of Southern California. Before joining DIGITAL, he worked for Hughes Aircraft and Eaton Test Systems.

Harry Rogers Promoted to Consulting Engineer

Harry Rogers was recently promoted to consulting engineer. Among his major accomplishments during the last 3½ years was delivering the DIGITAL Server 7000 four-way SMP Pentium Pro–based system (project Limerock). As lead engineer, Harry was responsible for product definition, development, and management. The detail design work was accomplished at the Taiwan facility with technical direction provided by Harry from the Acton, Massachusetts, facility.

The Limerock project resulted in DIGITAL commercially shipping the first third-party, Pentium Pro–based, four-way SMP system. The product has consistently received top awards in class including several AIM Hot Iron awards. Limerock also has maintained the best $/TPC rating in the industry.

Recently, Harry has been a key participant for DIGITAL in the I_2O SIG. He is directly involved in the BIOS compliance and System Management working subgroup. He is the group liaison to the ACPI consortium. In addition, he has led the internal education effort related to Intel Server Architecture. This has involved several training sessions with Engineering, Marketing, and Sales. He currently leads efforts to define the next-generation System Management Architecture to provide a greater level of server management in the future.

Dave Wagner Promoted to Software Consulting Engineer

Dave Wagner has been promoted to software consulting engineer on the basis of his innovative and extensive contributions to the performance advancements of the Windows NT operating system and its programs on the Alpha platform.

During the past 2 years, Dave has concentrated his efforts on leveraging the superior hardware architecture of the Alpha-system platforms in the emerging Windows NT Server products market. At DECwest, which is located adjacent to Microsoft, Dave has led combined efforts to bridge the gaps between DIGITAL hardware and Windows NT software (primarily designed for Intel platforms). He has emphasized increasing performance gains of the operating systems in areas such as “instruction compatibility,” “resource utilization,” and exploitation of the Alpha 64-bit advantage within a 32-bit operation system.

In one of many special projects, called Vlm-Cache, he helped maximize the performance of Alpha hardware with Microsoft software. Vlm-Cache is intended to allow database or other applications to access physical memory in excess of the 2-gigabyte limit imposed by the NT 32-bit architecture. Understanding how important this was in the DIGITAL UNIX environment, Dave felt it critical to provide a similar form of expanded memory access for NT applications. He designed a unique method to allow an application to transparently access greater amounts of physical memory for disk I/O cache and for data caching without affecting the NT operating system. Through his extensive knowledge of I/O hardware, caching algorithms, and the Windows NT file driver system, he devised low-level disk filters and a set of APIs for application usage. Dave then worked with the DIGITAL Software Partner Engineering group for SQL servers at DECwest and Microsoft SQL Server development teams to test and validate his accomplishments. Substantial and measurable performance gains were realized, and Microsoft is preparing to include this feature in future versions of the SQL server and other products.

Dave also continues to play a primary role in providing technical leadership for the DEC Windows NT Performance group within the NT Systems Software Segment, as NT representative for the Alpha Architecture team, in cross-company consulting for key and sensitive technical discussions concerning hardware and software platform architectures, and by giving formal presentations to various groups such as Server Summit, NT Wizard’s Symposium, and Oracle.

Dave received a BS in computer science from Indiana University of Pennsylvania. Before coming to DIGITAL, he worked at Honeywell (CP-6 OS), HI-Q International, and Teradata. At Cray Research, he was software liaison in the design of massively parallel processing systems, the Alpha 21164–based Cray T3E, and micro-kernel development on Cray’s MPP systems—Cray T3D and T3E. ✳

DIGITAL Products Division Presents Tier III 'Customer First' Award

Peers laud a Products Division coworker for exceptional efforts in resolving problems and solidifying customer satisfaction.

By Ann Sandford, Products Division, Marlboro, Massachusetts

ann.sandford@digital.com

At a ceremony organized in his honor on May 7, Dan Deufel, systems consultant, Servers Engineering and Technical Services, received the inaugural Products Division Tier III "Customer First" Award for outstanding contributions in maintaining and promoting customer and partner loyalty. Harry Copperman, Products Division senior vice president and group executive, presented the award on behalf of the Products Division staff.

D. Willett

At right, Harry Copperman, senior vice president and group executive, DIGITAL Products Division, congratulates Dan Deufel, systems consultant, on receiving the Products Division Customer First Award for his outstanding performance in "creating a positive dialogue among Servers Engineering and Technical Services, Multivendor Customer Services, and our customers."

Award winners are noteworthy for earning their customer's respect by providing service that exceeds the customer's expectations. Stronger customer bonds are forged by timely resolution of serious customer satisfaction problems.

Customer First Recognition Program

A four-tiered program, the Customer First Recognition Program was launched company-wide in January. Full-time and part-time employees are eligible to win awards, which consist of the following:

- Tier I—a Customer First plaque and sports shirt
- Tier II (a group-level award)—US$1,000 and a Customer First plaque
- Tier III (the highest division-level award)—US$3,000 and a Customer First plaque. Bestowed quarterly, this award recognizes demonstrated, exceptional effort in satisfying customers by resolving customer and partner concerns. Segments and functions within the Products Division nominate a candidate from among their Tier II award winners, and the division staff then selects the eventual winner.
- Tier IV (a corporate award)—Honors teams or individuals for outstanding contributions in promoting customer loyalty in a complex, cross-organizational environment. (As of *Forefront* press time, the first quarterly presentation of the Tier IV award has not yet occurred.)

To date, more than 150 staff members have won Tier I awards, and about 25 Tier II Customer First awards have been presented or are in the process of being given to employees, as individuals or as teams. ✻

SportsWeb: Exploring New Business Models at the Internet's Service Frontier

This DIGITAL-Reuters joint venture demonstrates how to respond to new opportunities at 'Internet speed' through principled collaborations between research, business units, and external partners.

By Andrew Cromarty, Network Systems Laboratory, Palo Alto, California

Andrew.Cromarty@digital.com

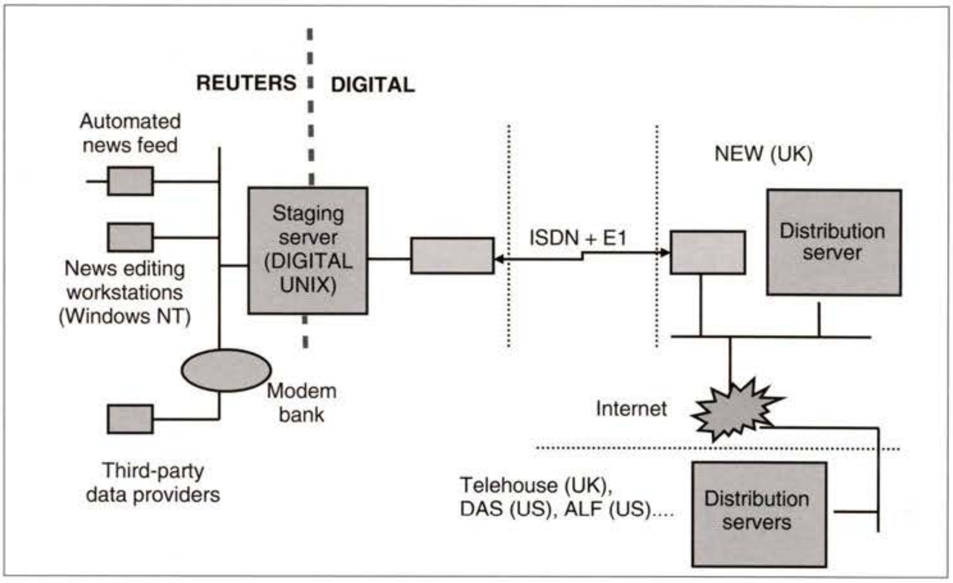


Figure. The distributed infrastructure of the DIGITAL-Reuters SportsWeb. NEW, DAS, and ALF designate DIGITAL locations in the US and UK. Telehouse is the London Internet exchange. E1 is a 2-Mbps telecommunications line.

SportsWeb is an example of a successful collaboration among technology, business, and service interests at DIGITAL. To the consumer public, SportsWeb appears to be a conventional web site, but the underlying technology is designed to distribute high-bandwidth, low-latency internetworked multimedia with global scalability, and the SportsWeb business model applies the best combination of high-quality content and high-quality internetworked distribution infrastructure to ensure the best possible consumer experience with sustained long-term revenue.

SportsWeb is important because the success of the World Wide Web consists principally in providing profitable new high-volume communications and information services to a demanding public consumer audience, and SportsWeb was consciously designed to advance the state of the art in Internet services. From the perspective of the consumers whose market demand has driven the current Internet revolution, computers and software are now secondary—in fact, they increasingly are seen as merely an incidental detail—in the consumer's pursuit of the entertaining and informative new *services* they see themselves as purchasing. This shift in purchasing behavior away from hardware and software and towards services represents a remarkable and irreversible restructuring of the computing market, and it requires the development and adoption of creative new *business approaches*. It also requires that existing *technologies* be recruited, and new technologies developed, to serve these new market values. And, importantly for computing companies, the result of these new market forces will be that successes in the internetworked commercial world of the future will be constructed upon infrastructure platforms designed not using the classical industry vocabulary of hardware and software components, but rather from a new vocabulary that will arise from the effective integration of *technology, business,* and *service* expertise.

Because the "technology transfer" of business innovation is at least as important as the infrastructure design specifics, the description of SportsWeb begins not with a requirements specification, but rather with a chronology. Then the key factors responsible for the success of SportsWeb are identified, to allow them to be applied to future DIGITAL business.

Successes in the internetworked commercial world of the future will be constructed upon infrastructure platforms designed from a new vocabulary that will arise from the effective integration of *technology, business,* and *service* expertise.

History and Background

In late summer of 1997, Reuters privately expressed to the DIGITAL account team an interest in making its international sports news available to the world directly via the Internet for profit. Reuters was willing to fund the content-related labor for such an effort, but it wished to avoid any capital hardware, software, or connectivity expenses. (This constraint, quite unconventional for historical hardware/software sales models of the computing industry, is becoming increasingly common, and is typical of new ventures into uncharted business territory such as Internet commerce.) Reuters solicited approaches and bids from candidate infrastructure vendors, including DIGITAL and several DIGITAL competitors. Their deployment goal was very aggressive, driven in part by the deadlines imposed by the impending Nagano Olympic Games.

The DIGITAL Reuters account team in London contacted the Network Systems Laboratory (NSL) in Palo Alto, on the basis of the NSL's experience with rapid design and deployment of global-scale, high-volume Internet services such as the California election servers, AltaVista, and the multimedia-rich DIGITAL Mars Landing web site. Working together, starting with some recently developed business and technology results from the lab's Networked Entertainment Technology effort, NSL and the DIGITAL Reuters account team sketched out an aggressive plan for the Reuters opportunity: a new revenue-sharing joint venture between DIGITAL and Reuters, with DIGITAL as the infrastructure partner providing and capitalizing all the infrastructure, and Reuters as the content partner providing and paying for all content development and production.

With this plan in hand, DIGITAL was the clear partner of choice, and in early September, a team was formed in London representing NSL, the DIGITAL Reuters account team, and DIGITAL Services' Operations Management Services (OMS). OMS was eager to build this service as a means of gaining experience in delivering this type of operation and developing the Internet/Intranet Managed Services business, and they assumed the role of professional project management for both the near-term implementation and the long-term infrastructure provision tasks. The DIGITAL team met extensively and frequently with Reuters and their content subcontractors (e.g., the advertising and graphic design participants), and after two weeks of intensive work, a detailed business and technical design was completed, including financial and legal details and a development and implementation plan with weekly milestones for the next half-year.

OMS then implemented the plan, and within 12 short weeks of the project kickoff, a complete distributed-infrastructure service (see the Figure) populated with some of the world's highest-quality, most up-to-the-minute international sports content debuted on the World Wide Web as the co-branded DIGITAL-Reuters web site, SportsWeb.

Key Success Factors

How was it possible to progress from exploratory discussions to a revenue-bearing new business within 90 days? There were four essential components in the successful creation of SportsWeb:

1. The *content-partner/infrastructure-partner partnership model,* defining a partnership-role framework under which DIGITAL can earn new service revenue by applying RAD–developed Internet technology and business models in the field working with our long-standing DIGITAL partners. This is a strong, replicable model of how DIGITAL and our partners can profit together in the internetworked future.

2. The *Distributed Web Site model,* with *distributed infrastructure invisible to the consumer* and *scalable performance* for future demand and multiple content types (e.g., multimedia) *designed into the initial architecture* from the start.

3. The *principle of infrastructure transparency to the content partner.* Within the partnership, on a day-to-day basis, the Reuters SportsWeb news production staff enjoy the fiction of merely updating a single web site. They are completely unaware of the considerable underlying complexity involving multiple distributed databases that must be synchronized, multiple latency-reducing performance-enhancing web servers at physically disparate high-bandwidth locations around the globe, and hardware and operating system heterogeneity. The content partner sees content; the infrastructure partner sees infrastructure—and delivers it as a complete turnkey service, rather than as a sale of hardware devices or lines of code.

4. *Effective internal technology and business-model transfer.* SportsWeb was a conscious, planned example of successful collaboration and effective rapid-turnaround transfer of business model and technology (from NSL to the Reuters account team and OMS), moving from opportunity identification to fielded prototype in about 12 weeks, based on recognizing that the future of the Internet is in new content-bearing services. SportsWeb demonstrates that these new services can be brought to market even by large corporations at "Internet speed" through well-designed internal collaborations involving the key service, account, and research/advanced development partners.

Current Work and Contacts

SportsWeb became operational on the Web the first week of December 1997. In addition to continuing content and infrastructure improvements, work is presently under way to integrate SportsWeb into the ReutersWeb service that is used to deliver HTML-based information to Reuters customers.

Contact the DIGITAL SportsWeb design team through these team members:

- Emma Christophers, DIGITAL Reuters account team
  Emma.Christophers@digital.com

- John J. Boyle, OMS
  BoyleJJ@mail.dec.com

- Andrew Cromarty, NSL
  Andrew.Cromarty@digital.com ✱

SportsWeb demonstrates that new services can be brought to market even by large corporations at 'Internet speed' through well-designed internal collaborations involving the key service, account, and RAD partners.

web*sites*

http://www.sportsweb.com/
DIGITAL-Reuters SportsWeb

http://www.digital.com/flash/f182/
The SportsWeb public debut was the topic of a DIGITAL press release in December 1997.

The ***Networked Entertainment Technology*** *project on internetworked multimedia, a Network Systems Lab effort, can be explored via these Web sites:*

http://www.research.digital.com/nsl/
Network Systems Laboratory Internet site

http://nsl-too.pa.dec.com/nsl/
Network Systems Laboratory intranet site

http://entertainment.digital.com/
Entertainment Web site

http://entertainment.digital.com/mars/
Mars Landing Web site

State of the Art in Next-Generation Internet Protocol Technologies

IP version 6, the next-generation Internet protocol, offers features that will promote its deployment.

By Markus Jork and Joachim Schaper, European Applied Research Center,[1] CEC Karlsruhe, Karlsruhe, Germany

jork@kar.dec.com;
schaper@kar.dec.com

Three members of the Advanced Networking Technology Group: from left, Markus Jork, RSVP technical project leader; Rudolf Brandner, technical project leader, Networking projects; and Simone Welle, Networking software engineer.

The global use of the Internet by an ever-growing number of enterprises, organizations, and individuals necessitates development of next-generation network protocols. To support future applications, a next-generation Internet protocol (IPng) must support

- a huge number of natural and "artificial" users. Artificial users might include intelligent Internet appliances implemented as embedded devices in vending machines, manufacturing tracking systems, car navigation systems, or household management components.

- the massive use of multimedia applications triggered by the integrated use of voice, video, animation, simulation, and imaging, which will require a quality of service support within the networking layer. For example, such functions might include reserving bandwidth from application source to destination, controlling delay and jitter of packets associated with certain connections, supporting multiple receivers (multicasting), and allowing a mechanism such as advance reservation to be handled transparently to the application.

- the confluence of current mechanisms within the application and the network layer to provide built-in security features to transparently allow encrypted data for secure transmission and access. This is a basic requirement to advance beyond current applications for electronic commerce, health care, or finance areas.

Following is a short overview of the required technologies, their current state of realization based on our experience with DIGITAL UNIX, and an illustration of application examples that could significantly impact our future environments. Some aspects of IPng, such as network management and deployment strategies, will not be covered here.

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[1] *The European Applied Research Center, CEC Karlsruhe, is part of the Research and Advanced Development group. The center focuses on major areas within informatics, such as professional multimedia systems, advanced networking protocols, virtual enterprise technology, electronic commerce architectures, and distributed authoring and learning platforms.*

IPv6

IP version 6 (IPv6), the next-generation Internet protocol, offers features that will motivate its deployment:

- very large address space (128-bit addresses)
- complete autoconfiguration of end systems
- mandatory security features
- better support for differentiated quality of service

The limited address space of IPv4 (32-bit addresses or approximately 4.3×10^9 possible addresses) restricts and complicates the integration of companies and organizations. Within the foreseeable future, the Internet community needs to migrate to IPv6, which uses a 128-bit address format (or approximately 3.4×10^{38} possible addresses). Throughout the IPv6 definition process, the Internet Engineering Task Force (IETF) has been aware that migration and compatibility between IPv4 and IPv6 would be the key to success. Both IPv4 and IPv6 applications can be used within the same environment.

RSVP and Quality of Service

Increasing and vocally expressed demands for "better" quality of service from the Internet (and corporate intranets or extranets too) are due mainly to two developments.

- Increases in Internet traffic—which cannot be handled in a timely manner by network bandwidth increases alone—are resulting in delays and lower throughput.
- The ubiquitous and relatively inexpensive availability of the Internet has spawned the development of new multimedia applications and pressures to integrate the existing telephone service with other Internet traffic.

Improved quality of service is not guaranteed by an increase in network capacity. In particular, real-time applications, such as audiovisual communications, depend on low delay and some kind of separation from other "best-effort" traffic to avoid being adversely affected by traffic bursts. The old TCP/IP paradigm of evenly dividing the available network resources is no longer adequate for the highly commercial Internet populated by multimedia applications. Preferential treatment of specific data flows will ultimately result in better use of the network infrastructure.

Accordingly, the IETF has developed an "Integrated Services" architecture for the Internet which amends the traditional best-effort service with new kinds of service. By requesting the "Controlled Load" service, for example, applications can ensure short delays and protection from other traffic.

Resource Reservation Setup Protocol (RSVP), a major component of the Integrated Services architecture, signals an application's quality of service request to the network. RSVP works in conjunction with IPv4 and IPv6. However, IPv6 introduces the "flow label" concept, which is the key to a simpler classification of data packets into data flows and thus enables a much more efficient and powerful implementation of Integrated Services.

IPv6 over ATM

The inherent quality-of-service features of asynchronous transfer mode (ATM) enable it to translate requests from the IP level into actual guarantees on the link layer. To exploit this potential requires an adequate IP-over-ATM standard, and IPv6 is superior to IPv4. A progressing Internet draft standard[2] for IPv6 over ATM preserves the advanced features of IPv6 over ATM, such as autoconfiguration, and has integrated multicast support, yet overall is a simpler mechanism than the "classical IP" standard for IPv4.

The old TCP/IP paradigm of evenly dividing the available network resources is no longer adequate for the highly commercial Internet populated by multimedia applications.

Security

IPv6 must have reliable security to allow encrypted transfer of packet workloads. Depending on the key length and encryption methods, different levels of security can be implemented. The basic mechanism will support higher-level applications, such as firewalls, specialized tunnels, and access methods (e.g., in conjunction with smart cards). IPv6 will support a uniform encryption method which will improve network performance and allow easy integration with specialized hardware on network adapters.

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[2] *Markus Jork is a co-author of this Internet draft about IPv6 over ATM. A senior engineer, he is responsible for RSVP design and implementation on DIGITAL UNIX. He is a regular Internet Engineering Task Force participant and the DIGITAL representative in the XNET group of The Open Group.*

Yet to be resolved are the divergent positions of the US and European nations on the issue of encryption.

Embedded Internet Appliances

Users of small, intelligent Internet devices, such as personal digital assistants (PDAs), organizers, and other portable computers including hybrid devices (telephone/PDA systems), will want access to the Internet in order to integrate the specialized functionality of these devices into their overall (personal) computing environments.

Completely new applications will be created for use by:

- Internet-enabled vending machines (e.g., to remotely manage inventory, special offers, and cash handling). In collaboration with SAP Technology, the European Applied Research Center developed such a vending machine, which consists of a Coca-Cola machine, a set of sensors, and an embedded Web server. Based on a network computer (NC) prototype, it allows propagation of the state of the vending machine over the Internet into a central, logistic server based on SAP R/3. Besides SAP access, ordinary Web access permits retrieval of inventory data using a standard browser.

- Internet devices that collect data from manufacturing processes by using "smart badges" for every item in the manufacturing process. The badges will communicate with their environment via radio or infrared links.

- Internet controls that allow the remote processing of equipment within a household. These appliances could monitor energy consumption or serve as "security guards" enabled via the Internet to deploy security services.

The quality-of-service–related features of IPv6 will integrate today's groupware tools, such as conferencing components for synchronous communication of voice, video, and application-sharing among multiple parties, into a data link layer in an independent fashion. Archiving and distributing professional audio and video streams will use bandwidth reservation, allowing synchronous media to be delivered intact by the Internet.

An RSVP implementation, undertaken at CEC Karlsruhe, is now part of a DIGITAL IPv6 early adopter's kit and also will be included in a future version of DIGITAL UNIX. An IPv6-over-ATM prototype, including RSVP support, also was developed at CEC Karlsruhe.

A universal security scheme must be implemented within IPv6:

- to guard confidential information from unauthorized access in order to control and restrict information access when using the public Internet or corporate networks

- to support data exchange between virtual teams (see related story on p. 41)

- to enable electronic commerce using different forms of electronic currencies

Acknowledgments

Members of the Advanced Networking Technology Group (ANTG) at the European Applied Research Center, CEC Karlsruhe, contributed to this article: Gerd Hölzing, a senior technology consultant and DIGITAL's ATM Forum representative, and senior engineer Rudolf Brandner, who is responsible for IPv6-over-ATM and leads joint efforts with research groups working closely with the External Technology Group. ✳

web*sites*

http://www.digital.com/ipv6/
IPv6 InfoCenter

http://www.ietf.org/
Internet Engineering Task Force

http://www.ietf.org/html.charters/rsvp-charter.html
Official Resource Reservation Setup Protocol charter

Foundations for the 'Virtual Enterprise'

DIGITAL is actively involved in international efforts to develop and standardize distributed computing systems that will enable collaborative business relationships across national boundaries and manufacturing or marketing segments.

By Karsten Schulz, European Applied Research Center, CEC Karlsruhe, Karlsruhe, Germany

schulz@kar.dec.com

The Project VEGA team. Standing from left, Karsten Schulz, software developer, and Manfred Köthe, system architect and team leader. Seated from left, student team members: Christian Limberger, Quan Li, and Armin Bernotat.

The "virtual enterprise," or VE, may comprise several persons or organizations working closely together on a distinct project that none could handle individually. This dependence causes the otherwise autonomous VE partners, possibly located worldwide, to rely upon close interaction among themselves, their suppliers, and their customers. After finishing a common project, VEs dynamically dissolve, and the respective partners can enter into new VEs with others participants.

The main objectives of VEs are to

- enhance cooperation and coordination among partners
- shorten product-development life cycle
- reduce costs
- enpower smaller entities to act jointly as one "big company"
- enable a big organization to react dynamically to changes in the market

Consisting of fragmented and geographically dispersed collections of information systems, VEs rely on loosely coupled alliances of heterogeneous operating systems and software tools. As a result, a VE must integrate the following major features:

- information interchange
- data sharing
- replication freeness
- process control
- application interoperability
- concurrent engineering
- long-term storage
- data marshalling

VE Joint Project

Partially funded by the Commission of the European Communities, project VEGA (Virtual Enterprises using Groupware Tools and Distributed Architectures) is working to develop an IT platform to facilitate the establishment of VEs. Started in January 1996, the 3-year VEGA project is represented in Figure 1 (p. 42). The envisioned VEGA platform stands on four pillars:

- highly reliable access to distributed information storage devices—the CORBA Access to STEP Information Storage Architecture (COAST)
- workflow information management
- data representation—product data modeling

- information retrieval in the VE–distributed information services

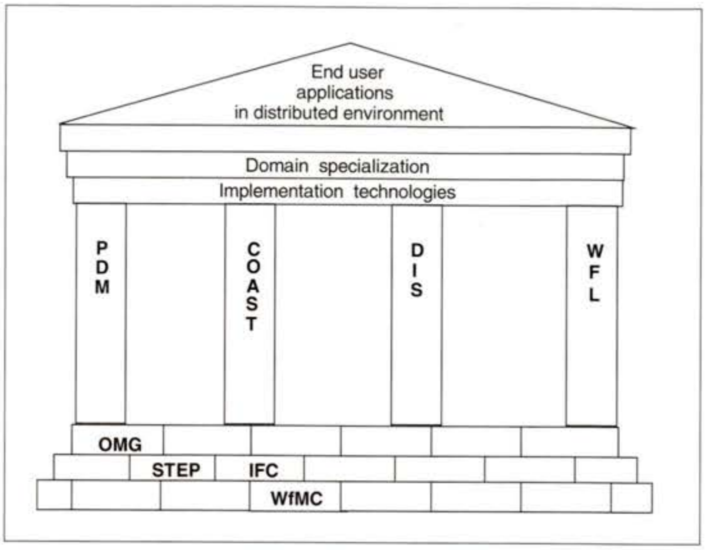


Figure 1. The structure of the VEGA project. PDM = product data modeling. COAST = the CORBA Access to STEP Information Storage Architecture. DIS = distributed information services. WFL = Work and information management and control. OMG = Object Management Group. STEP = Standard for the Exchange of Product Data. IFC = International Association for Interoperability's Foundation Class. WfMC = Workflow Management Coalition.

These pillars are based on international standards [1] defined by the Object Management Group (see "Object Management Group" at left), the International Standards Organization (i.e., the standard for the exchange of product data [STEP]), the International Alliance for Interoperability's Industry Foundation Class (IFC), and the Workflow Management Coalition (WfMC).

IT Solutions

At present, some decentralized IT solutions are available to support VEs. The VEGA project gathers technically feasible components and extends their capabilities to create platforms conducive to flexible, distributed environments.

Applications retrieve data transparently from the information distribution layer (Figure 2). This means that the end-user applications can retrieve the desired information without knowing where it resides or the specific type of information storage architecture (OODBMS or RDBMS) holding the information. With respect to the increasing development of VEs among manufacturing operations, any information to be handled by this layer can be based on the ISO EXPRESS standard for the definition of product data.

Every organization is assumed to have at least one workflow management system, which supports the control and execution of the organization's respective automated processes (i.e., workflows). Together with the workflow management systems of the partner's organizations, they form a distributed workflow service. Based on the reference model of the WfMC, the workflow management systems communicate with each other through the organization's firewalls using Workflow API 4 (WAPI); they can invoke applications by means of WAPI 3. The current state of development has made CORBA the best candidate to handle communications for both workflow and information distribution.

Prototype Implemented

Our group at CEC Karlsruhe has successfully implemented a first prototype that demonstrates the functionality (described above) of the information distribution layer, i.e., COAST and the

Object Management Group

With a membership of more than 800 software vendors, software developers, and end users, the Object Management Group (OMG) promotes the theory and practice of object technology for the development of distributed computing systems. The goal is to provide a common architectural framework for object-oriented applications on the basis of widely available interface specifications.

The OMG advocates use of the Common Object Request Broker Architecture (CORBA), which allows transparent access to information without knowing what software or hardware platform the data resides on or where it is located on an enterprise's network.

Established in 1989, OMG is headquartered in Framingham, Massachusetts, and has international marketing offices in the UK, Germany, Japan, Australia, and India. ✳

web*site*

http://www.omg.org

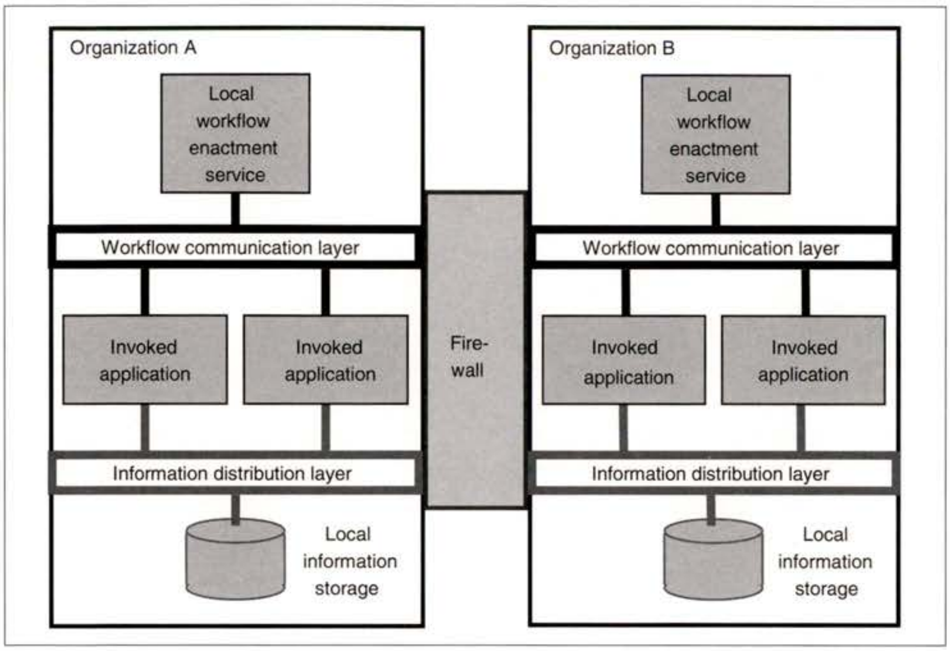


Figure 2. The VEGA platform.

distributed workflow service. We are currently working on the final version, proving the concept with DIGITAL's workflow management systems AltaVista Process Flow, Expeditor, and Linkworks, using the CORBA-based Process Manager as a workflow backbone. With those, we support the various kinds of static and dynamic workflows in the virtual enterprise, also showing the benefits of integrating different workflow management systems that are working together. Object Broker is the implementation of CORBA being used; the platforms are DIGITAL UNIX and Windows NT.

Furthermore, COAST and the CORBA–based distributed workflow service are being standardized. Our group at CEC Karlsruhe is currently involved in two submissions, i.e., requests for proposals, to the OMG. COAST has been submitted in the context of the Joint PDM Enabler Submission to the OMG Manufacturing Domain Task Force by DIGITAL, Fujitsu, IBM, Matrix One, Metaphase, NIIIP Consortium, RRM Consortium, and Sherpa. The distributed workflow service is currently under submission in the context of the Joint Workflow Service to the OMG Business Object Domain Task Force by DIGITAL, Fujitsu, Hitachi, IBM, ICL, Oracle, SNI, NIIIP Consortium, Xerox, and 10 other parties, as well as the WfMC, which supports this activity. ✳

Reference

[1] R. Junge, M. Köthe, K. Schulz, A. Zarli, W. Bakkeren, "The VEGA Platform—IT for the Virtual Enterprise," *Proceedings of the 7th International Conference on Computer Aided Architectural Design Futures,* ISBN 0-7923-4726-9 (Munich, 1997).

web *sites*

http://www.kar.dec.com/iws/vega/vega.html

http://www.kar.dec.com/~schulz

VEGA Partners

VEGA is a 3-year, joint project partially funded by the Commission of the European Communities under the ESPRIT IV Programme, Project EP20408. (ESPRIT is a European Union information technologies program of industrial R&D projects and technology acquisition measures.)

The collaborating partners from five European countries are as follows:

- DIGITAL European Applied Research Center, Karlsruhe, Germany
- CSTB, France (building and construction research)
- EPM Technology As, Norway (IT, database vendor)
- Nemetschek AG, Germany (IT, computer-aided design vendor)
- TNO Building and Construction Research, The Netherlands
- Taylor Woodrow Construction Limited, United Kingdom (building and construction, end user) ✳

A Meeting of Minds and Resources Spurs HPTC Business Growth

A collaborative program that identifies innovative technologies and nurtures relationships with the global research community has helped stimulate a 40% growth in DIGITAL's high performance technical computing business.

By Gary Cantwell, High Performance Technical Computing Grant Program, Maynard, Massachusetts, and Bruce Foster, Core Technology Group, Nashua, New Hampshire

{gary.cantwell; bruce,foster}@ digital.com

The External Technology Group (ETG) and the High Performance Technical Computing (HPTC) group are actively increasing corporate access to the best minds at universities and research institutes worldwide. Tapping into the expertise in these communities also bolsters DIGITAL market visibility, helping to account for a 40% growth in DIGITAL's HPTC business in the last year.

Objectives of the Collaborative Program

These collaborations with external technology sources have the following objectives:

- To gain access to the "best and brightest" minds who will work with DIGITAL engineers in solving advanced development problems. At the same time, DIGITAL can identify talented new employees (e.g., from Rochester and Michigan Tech universities) and energetic summer interns (e.g., from MIT, Rice, Stanford, Brown, and Rochester universities, and the University of Hawaii).
- To highlight DIGITAL's expertise and products in collaborative research projects, thus opening market opportunities. Often DIGITAL contributes equipment for use in these projects, so participants have first-hand experience with DIGITAL engineering excellence.

Projects differ in focus. Some address specific questions, but, in general, include the following areas:

- **Compilers and tools** (Java, compiler optimization, distributed debugging, algorithms, profiling tools, development within Windows NT and deployment on DIGITAL UNIX, race conditions.)
- **High performance technical computing** (Parallel tools and methods, scaleable systems, performance, interconnects, HPTC applications/ software partners in areas such as engineering, bioscience, chemistry, math libraries, physics, and geographic information systems.)

Outline of Projects

Projects generally fall into three categories:

- A specific technology has been identified, and bartering results in access to rights and ongoing technical exchange.
- A collaboration enhances DIGITAL's "mind-share" at an institute and associated disciplines within a particular technical community.
- A project helps develop better joint technology with DIGITAL partners.

Examples of each type of project are given below.

Technology-Driven Projects

University of Rochester (M. Scott)—MEMORY CHANNEL/Cashmere

University of Massachusetts (K. McKinley)—compiler optimization

Stanford University (M. Lam)—SUIF

Harvard University (M. Smith)—SUIF

University of Hawaii (P. Johnson)—Java tools

Carnegie Mellon University (T. Gross)—debugging

University of Versailles (Project MHAOUTEU)—memory and optimization tools

Pittsburgh Supercomputing Center (M. Levine)—Visual Fortran

Mind-Share Driven Projects

CERN (various researchers)—Aleph, RD45

MIT (Laboratory for Computer Science)—Pleiades; S. Ting—alpha mass spectrometer, space shuttle

University of Massachusetts (H. Schultz)—Vision Lab

San Diego Supercompting Center (W. Pfeiffer and M. Vildibil)—sciences cluster, scientific data storage

University of California at Santa Barbara (T. Smith and L. Carver)—Alexandria

University of California at Santa Clara (R. Hughey)—bio-computing

Ecole Polytechnique Federale de Lausanne—SwissTx, Alpha-based NT super-computing

Rice University (R. Bixby)—TreadMarks

Karlsruhe University (W. Tichy)—FORM, high-energy physics

Partner Engagement Projects

CERN (J. Shiers)—Objectivity Inc.

University of California at Santa Barbara (T. Smith and L. Carver); Oracle, ESRI, Microsoft

Establishing Relationships

In proposing a joint relationship, a DIGITAL sponsor and an external research entity need to address topics similar to those required by the US National Science Foundation or the UK National Research Councils, such as research objectives, project summary, research impact, deliverables and milestones, and benefit to DIGITAL.

For assistance in collaborative project development, primary contact persons are

- **Bruce Foster** (DTN 264-2064), Advanced Development manager, CTG, who ensures that the participants served by the proposed project understand their respective roles and collaborate appropriately within the established framework.
- **Gary Cantwell** (DTN 223-8124), HPTC/CTG Technology Exchange Program manager, ETG, who ensures that the process flows smoothly and helps minimize administrative burdens of the participants.

In addition, ETG personnel aid sponsors in monitoring expected outcomes and ensure communication of project results via technical papers and reports to the relevant technical community. ETG staff also ensures that DIGITAL intellectual property rights resulting from collaborations are supported by a legal framework. ✳

web *sites*

http://www-server.mso.dec.com/etg/etg.htm
The External Technology Group

http://www.digital.com/info/hpc/hpc.html
HPTC Infocenter

http://dsm.mro.dec.com/9markets/hptc/
HTPC intranet site

http://sdtad.zko.dec.com/pub/CTG/
Core Technology Group intranet site

Alpha Systems Summit

By Dick Willett, Corporate Technical Publications, Acton, Massachusetts

dick.willett@digital.com

Photos: D. Willett

Wes Melling, vice president of Windows NT and OpenVMS Systems group, set the stage with his perspectives on requirements for future Alpha systems.

The Cambridge Research Laboratory (CRL) ran a very successful Alpha Systems Summit in Maynard, Massachusetts, earlier this year. This was the third in a series of summits organized by the RAD labs, starting with the Compiler Summit in September 1996.

Researcher Bert Halstead, the general chair, outlined three major goals:

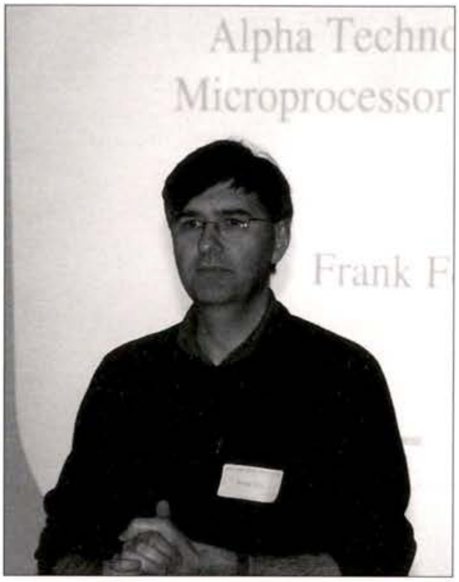
- Communicate the most important ongoing activities involving Alpha systems across product, advanced development and research groups.
- Promote an integrated view of system design, covering issues ranging from processor architectures through operating systems, compilers, and performance tools.
- Take stock of DIGITAL's current position in the systems area and understand what issues need addressing, particularly as we look forward to systems based on future Alpha processors.

The summit attracted about 75 of the company's most senior technical contributors in these areas. A packed schedule of nine sessions had 22 speakers covering: the marketplace and customer needs (what makes Alpha systems attractive to customers); processor chips (the future of Alpha and its relationship to IA64); application- and benchmark-driven performance characterization of current and near-future Alpha systems; issues and outlook for cluster interconnects and system-area networks in the commercial and high performance technical computing arenas; simulation and performance tools for system characterization and optimization; operating system challenges for UNIX, OpenVMS, and 64-bit NT, for large scalable Alpha systems, including NUMA management and multithreading; compilers and performance tools for future systems.

Towards the end of the second day, the summit attendees were split into eight groups chosen such that each group had a cross-section of technical specialists. Each group was charged with identifying the two most important areas needing work in order to ensure the success of Alpha systems. Representatives from each group then reported their findings to the reconvened attendees.

The consensus seemed to be that DIGITAL holds an extremely strong hand when it comes to hardware: excellent current and future processors, a refreshed server line, and excellent new server products on the horizon. There was a strong sense of confidence with regard to competing technically against IA-64, for several years to come. The major concerns revolved around what we must do successfully to exploit this strong hardware hand. A commonly expressed sentiment was that we urgently need to get more mind-share for Alpha, particularly amongst independent software vendors (ISVs) and partners. One major issue here is to provide ISVs with simple, easy-to-use performance analysis and tuning tools so that they can easily deliver *solution* performance. There are a number of excellent tools already in use by our engineers and researchers, but they are nonstandard, and we have not made them easily available and accessible to ISVs and partners; this results in much lower application performance than the hardware is capable of and, consequently, less excitement about Alpha amongst ISVs and customers. An equally strong concern regarding Alpha mind-share was that we are still not paying adequate attention to volume markets: workstations and smaller "sweet spot" servers. This, again, makes Alpha less interesting to ISVs. Finally, another major issue is that large systems are inevitably becoming more complicated (multithreading, NUMA, clustering, etc.) and much compiler and OS work needs to be done in order to manage this complexity well. Still, the overall mood was positive—we have all the pieces in hand, and just need to execute. Tryggve Fossum summed it up as: "The glass is now half full, not half empty."

Organization of the summit was strongly supported by Bob Supnik, vice president of RAD, and by Bob Iannucci, director of CRL. The summit was put together by CRL researchers Bert Halstead (general chair), Jamey Hicks, Chris Joerg, Kath Knobe, Leonidas Kontothanassis, Rishiyur Nikhil, Mark Tuttle, and David Panariti with help from CRL Human Resources specialist Martha Comfort. The team was very pleased with the outcome and hopes that the summit has served as a starting point for both research and product groups in identifying what gaps need to be filled, in determining what approaches might be promising, and in starting to make plans to address these gaps. ✳



Frank Fox, consulting engineer, Alpha Development Group, brings the audience up to date on the status and plans for Alpha processors.

web*site*

http://www.crl.dec.com/alphasummit98
Alpha Summit '98 Web site

Benchmarking Internal Standards

A benchmarking study conducted by Standards and Methods Control reveals that internal standards significantly influence the way companies manage their businesses.

By Eric Falkof, Standards and Methods Control, Corporate Strategy and Technology Group, Acton, Massachusetts

eric.falkof@digital.com

Standards and Methods Control (SMC) recently completed a benchmarking project to determine how other companies use internal standards and to identify the best-in-class practices that enhance their use. It was gratifying to learn how highly valued these internal standards are because, in industry, these documents are typically neither publicized nor promoted. However, many companies *do* develop standards and use them—almost religiously! Standards enforce a discipline that focuses people toward a common goal.

Although our purpose in reporting these survey results is not to emphasize SMC, we learned that DIGITAL is doing many things well. The DIGITAL technical community is part of a successful standards program, which has been evolving for years.

Standards Survey Conducted

On the basis of the DIGITAL standards process, we developed a questionnaire that explored four areas in which standards are developed, used, and distributed. The Table summarizes key points of the survey results. Responses from DIGITAL organizations were consistent with those of the majority of respondents. Historically, companies rarely discuss internal standards and merely acknowledge they exist. However, our survey of leaders from the computer and other industries show that internal standards have been in place for many years and are used in different aspects of their businesses, with engineering and manufacturing accounting for a significant proportion. All companies indicate that standards are highly valued: all said their companies could not function without internal standards, and all indicated that standards lower manufacturing costs.

DIGITAL standards reflect broad considerations that encompass engineering, manufacturing, environmental health and safety, finance, security, and more. A way of life in DIGITAL for many years, standards have become, simply, how things get done. Other computer companies as well as other industries rely on internally generated standards in their daily operations.

'Standards Central'

According to survey results, the engineering function is the primary user and largest generator of standards, but other groups also employ standards. Many companies indicated that each functional department is responsible for its own standards—communications, administration, human resources, and manufacturing. The pervasiveness of standards within corporations indicate the need for a central repository to maintain, organize, and disseminate this important body of information.

Standards enforce a discipline that focuses people toward a common goal.

Coordination of a company's diverse activities is difficult. Although decentralized standards operations are typical, the responding companies claimed more tightly controlled, organized, and efficient standards operations were facilitated by centralized core groups. For example, in response to the question about which business areas the standards cover, a representative from one large aircraft and technology company replied, "You name it, we've probably got it!" The same respondent, when asked who is responsible for standards, replied, "Everyone!" The accuracy of standards (and presumably their credibility) suffers as control becomes decentralized and more people become responsible for their maintenance.

For many years at DIGITAL, SMC—a small, centralized core group—has enforced discipline and order upon the standards operation. Although some groups prefer to develop their own standards, many take advantage of SMC's skills in organizing and writing standards documents. Several groups participate in SMC's document control and distribution functions, and new groups or new standards representa-

Table. Internal standards benchmarking survey: Summary of results

General trends	• A majority use centralized standards operations. • Typically, an engineering group is responsible for standards, although other groups are represented. • Many people are involved in the development of standards. • Standards cover all areas of business.
Impact of standards	• Standards are deemed critical to the business. All respondents said their companies could not function without internal standards. • 90% agreed that standards help to lower the cost of operation.
Standards process	• 67% of respondents have a defined process to develop standards; the other companies are developing processes. • All companies use or modify industry or externally developed standards. • Most companies use standards as part of ISO 9000 processes.
Dissemination of standards	• 75% of respondents indicate standards can be accessed within 20 minutes. • Most companies have or are developing a corporate intranet.

tives frequently ask how to benefit from this long-time service.

Impact of Standards

Some respondents indicated that, as time passes, certain standards fall into disuse and are neglected. At one company, an "underground" standards development effort is reinstituting standards without top management's knowledge. This company (not a computer company) had moved away from internally generated standards during a period when rapid growth demanded full attention to product development and production. However, several manufacturing engineers and production managers witnessed the random activity that undisciplined activity yielded; they wanted to restore order to increase efficiency in the use of resources and personnel. They admitted that top-level management did not see cost savings as a direct result of standards, but the workers—the employees—*felt* the need and understood how standards directly affected their jobs.

Similar to the DIGITAL experience, several companies reported that their standards programs had evolved over time from a central committee that developed and approved standards to a system of decentralized development. In this way, standards are developed directly by those who use them and who know the subject best. As at DIGITAL, it is a challenge to manage duplicate efforts and notify appropriate users, therefore awareness of appropriate, relevant standards varies. Since compliance to standards varies, audits are commonly used to measure compliance. Because ISO 9000 certification is the goal of many companies, coordination and control are essential.

Standards Development Process

Due to decentralization, standards development activity varies among the companies polled. Likewise, the effectiveness of communication on the subject varies. All respondents have or are developing a development process. A single process, monitored for uniformity

Companies Polled

Members of the American Productivity and Quality Center were chosen on the basis of size, industry, and location. (DIGITAL also was surveyed.) Companies polled ranged in size from those with only a few thousand employees to those approaching 200,000 employees.

Less than half of the companies surveyed were in the electronics industry, and the group included insurance, chemical processes, government and military, health care, and services. In this way, we hoped to uncover novel approaches to standards development in many industries. Companies located in five countries were contacted in an attempt to determine the effects of different cultures, economies, and legal systems.

The survey consisted of 20 questions and was designed to be completed in under 10 minutes. Replies came from 15 percent of the companies and included responses from two countries. This response rate is considered quite high, indicating a high level of interest in internal standards. ✳

All survey respondents said their companies could not function without internal standards, and all indicated that standards lower manufacturing costs.

and consistency, is considered desirable to instill discipline and control.

The existence of a core group to maintain standards requires ongoing attention to ensure that the credibility of standards is not compromised. One large company had several thousand standards but only three people to develop and maintain them. This company's respondent said that standards are not critical to success and have only moderate value. (This may be symptomatic of an understaffed standards group unable to keep up with the volume of work needed to harness the productive energy there.)

Similar to most other companies polled, DIGITAL recognizes an expert for each standard in a specific field. This person's work is shared with other leaders knowledgeable about that technology, process, or practice, after which it is tailored to DIGITAL's requirements. This may include modifying externally generated standards to meet internal requirements.

As with most companies, the standard is then distributed to the relevant users known to the developers of the standard. DIGITAL, on the other hand, may be unique in that it allows *and encourages* all employees to participate in a general review of a standard. Recognizing that people's education, training, and experiences differ, DIGITAL seeks synergy. Different opinions play a role in the application and method of standards adoption so the review is open to all. This open participation also encourages acceptance, and confers high credibility on the standards.

Dissemination of Standards

To have value, people must know about the standards. Distribution consists of notifying interested personnel about new or revised standards and delivering useful information. Most of the survey respondents use electronic mail to notify users. Interestingly, some use only electronic mail and others only interoffice mail.

Quick distribution is the norm, with most respondents using corporate intranets; other methods are being used as the technology evolves. Of companies responding, 90 percent have, or will soon have, a corporate intranet. In some companies without corporate-wide intranets, individual departments or divisions may have localized networks supplying locally accessible documents.

Among the companies polled, Web-oriented methods of notification, access, and distribution are highly favored. DIGITAL uses a flexible system of notification and distribution, which includes various forms and formats for memos, announcements, and postings. SMC typically uses electronic mail for notification. In addition, the SMC Web site also includes an announcement page for documents in review, newly released documents, and listings of all DIGITAL standards and other documents under SMC revision control. Documents are available in several formats to accommodate user preference.

Significance of Standards Process

SMC's operations are consistent with the attitudes and practices reported in the survey. Like other companies, DIGITAL is working to improve its methods and procedures. Centralized development, maintenance, and distribution help instill discipline, control, and uniformity to help maximize efficiency and effectiveness.

SMC continues to provide service to DIGITAL by maintaining its position as an industry leader in the system of internal standards. The benchmarking project has provided new tools to advance that lead. ✳

web*sites*

http://www-server.mso.dec.com/smc/home.htm
Refer to the Standards and Methods Control Web site for documents in review, newly released documents, and listings of all DIGITAL standards and other documents under SMC revision control.

http://www.apqc.org/download.htm
Download the American Productivity and Quality Center Benchmarking Code of Ethics and other documents.

DIGITAL Europe's Information Services Year 2000 Team Surges Forward

'2K or not 2K?' Shakespeare aside, the European Information Services Y2K team is taking the sword to any Year 2000 problems lurking behind the curtains of DIGITAL's internal operations.

By Joe Quigley, Information Services Year 2000 Program, Maynard, Massachusetts

joseph.quigley@digital.com

Some members of the Brussels Center of Expertise team gathered recently to declare their stance on the Year 2000 issue.

David S. Walton, a leading Year 2000 consultant in the UK, does not pull any punches when he describes the Year 2000 problem as "the worst crisis this country or the world has faced since the Second World War." His comments refer to the potentially disastrous situation whereby computer systems across the globe make date-processing errors that either cause the computers to crash or to produce erroneous output—incapacitating banks, financial institutions, and many other businesses.

No Laggards on the DIGITAL Europe Team

How bad will it get for businesses and government enterprises that either ignore the problem or wait too long to deal with it?

As far as DIGITAL Europe is concerned, the IS Y2K team has no intention of waiting to find out. The European IS Y2K team has taken an aggressive approach to the Year 2000 dilemma by putting in place verification processes for all internal business applications and third-party software, desktop systems, telecommunication systems, building infrastructure, automated manufacturing systems, and electronic data interchange (EDI) with trading partners.

John Harrison, IS Y2K area manager for Europe, comments, "The European community is typically 6 to 9 months behind the US in implementing new technology or initiatives; but, for obvious reasons, the Year 2000 issue is different. You cannot slip this deadline! I'm afraid many European companies and governments have failed to take the Year 2000 problem seriously, despite widespread warnings. DIGITAL will be ready, though."

Planning for the European IS Year 2000 effort began a year ago as a part of the corporate-wide IS Year 2000 Program, managed by Vice President Richard Scarborough. The European effort has become a model for teamwork, with a "center of expertise" (CoE) located in Brussels and complementary Year 2000 work taking place in manufacturing sites in Ayr, Scotland, and Galway, Ireland. The Brussels CoE was populated specifically for Year 2000 conversion work and currently operates with 56 people representing a total of over 500 years of applications experience. Scarborough elaborates, "Our European operation is top-notch. They are actually ahead of schedule."

A Daunting Task

The European Y2K team may be on target, but the job is anything but easy. As Harrison explains, "We're dealing with the entire spectrum of Year 2000 issues in 30 countries, all with unique lan-

European IS Y2K Program Management Office

Staff members are
John Harrison, Area Program manager

Paul Bennett, Area Operations manager

Terry Schroeyens, Brussels Center of Expertise manager

Abdellack Alouani, Electronic Commerce and Engineering

Cindy Scherrer, PMO administrator

Danny Schmidt, Third Party Suppliers

Dave Skinner, Desktop

Fazal Quadir, Production Systems Group Interface

Joe Donnelly, Small Countries

Tony Kelly, Y2K Program manager Galway plant

Phil Dagleish, Y2K Program manager Ayr and Irvine plant

Tony James, Y2K Program CCS Interface

Frieda Catteeuw, Brussels Center of Expertise assistant

Bill Lubak, Brussels Center of Expertise Project Scheduling

Clive Hill, Brussels Center of Expertise Standards

Claire Folie, Brussels Center of Expertise Tools & Procedures ✻

guages, customs, and government considerations. Also, we're dealing with the impact of the Eurocurrency on our IS systems at the same time; we need to be ready to handle certain transactions by January 1, 1999."

DIGITAL takes full advantage of the synergy between its IS (internal) and external Y2K programs. The Network and Systems Integration Services (NSIS) organization operates a Year 2000 Compliance Center in Dublin that offers analysis and remediation of Year 2000 problems to customers. Both the IS and NSIS groups use the same proven methodologies and tools that produce results. The effective and efficient IS Y2K operation in Brussels can be used as a reference point for customers, as it was recently when NSIS was chosen to perform Year 2000 services for a large European operation.

While a large percentage of European companies may be slow in responding to the Year 2000 issue, the European IS Y2K team is making sure that DIGITAL is ready to do business into the Year 2000 and beyond. ✻

The effective and efficient IS Y2K operation in Brussels can be used as a reference point for customers, as it was recently when DIGITAL Network and Systems Integration Services was chosen to perform Year 2000 services for a large European operation.

web*sites*

http://y2k00001.pko.dec.com/isyear2000/
Global IS Year 2000 Program Web site

http://y2k-geo.geo.dec.com/
European IS Year 2000 Web site

DIGITAL Shatters TPC-C Performance Record

**By Dave Stanley,
DIGITAL Products
Division Performance
Group, Nashua,
New Hampshire**

D. Willett

Members of the world record TPC-C team. From left, John Shakshober, Doug Johnson, Dave Stanley, Maria Lopez, Bill Carr, Sadhana Kyathappala, Ruth Morgenstein, and Joe Donaher. Not present for the photo: Anne Bradley.

In early May, the DIGITAL Products Division Performance Group achieved a TPC-C benchmark of over 100,000 transactions per minute (nearly twice that of the previous record holder, IBM) with a DIGITAL UNIX TruCluster powered by AlphaServer 8400 5/625 systems, Oracle8 Enterprise Edition, Oracle Parallel Server, and DIGITAL StorageWorks.

On the basis of the industry-standard TPC-C benchmark suite, the UNIX-based Alpha/Oracle platform achieved an astonishing 102,541.85 tpmC at US$139.49 per tpmC. Whereas a typical audit takes at least 2 weeks, the DPD/PG audit team completed this Alpha/Oracle audit in a record-breaking 48 hours, enabling Oracle President Larry Ellison to announce the benchmark achievement at DIGITAL's UNIX Executive Summit, held in New York City on May 5.

Undeterred by Oracle admonitions that benchmark figures under 100K would not be announced by Ellison or be publishable, we embarked on a round-the-clock work schedule during the weekend preceding the UNIX summit. We knew that the configuration was capable of 100K performance because a 90-minute run at 99,800 tpmC had already been achieved.

The DPG team impressed the seasoned Transaction Processing Performance Council auditor who said that "this has been one of the cleanest, tightest, and most well run projects that we have seen in a long time."

The performance engineers who "camped out" at Spitbrook and the diligent Oracle engineers and technicians from the Salem, New Hampshire, facility typify the "old DEC" tradition of persevering till the job is done—even if that requires a few stints working 36 consecutive hours! ✳

We wish to acknowledge the contributions of the following people: From Oracle—Karl Haas, Walter Battistella, Jeff Kennedy, Srini Kareenhalli, Saar Maoz, Richard Sarwal, Graham Wood, Jeff Fischer, Tak Wang, and Tirthankar Lahiri. From DIGITAL—Vince Ryan, Brian Stevens, Jim Woodward, Sean Reilly, Peter Yakutis, Wayne Campbell, Joe McFadden, B.J. LaChance, Joe Tomaswick, Jerry Stricker, Greg Tarsa, and Larry Twaits.

Compaq-DIGITAL Computing Timeline

Compiled by Information Research Services, Acton, Massachusetts

Compaq	DIGITAL	Industry Milestones
1982		
Compaq Computer Corporation is founded by Rod Canion, Jim Harris, and Bill Murto—all former senior managers of Texas Instruments. Compaq Computer is first to market with a portable computer, the Compaq Portable PC.	ALL-IN-1, a new concept in integrated office software, is introduced. DIGITAL moves to the forefront in storage technology with the announcement of the RA60 and RA81 disk drives and DIGITAL Storage Architecture.	*Time* magazine departs from its annual tradition of naming a "Man of the Year," choosing instead to name the computer its "Machine of the Year." The use of computer-generated graphics in movies advances with Disney's release of "Tron."
1983		
In its first year, Compaq Computer ships more than 53,000 portable PCs. Compaq Computer makes its first public stock offering, raising US$67 million.	DIGITAL establishes Internet connectivity. Initial email, FTP archive, and USENET news hub are established. DIGITAL launches its first multivendor customer service program, designed to provide customers—from small businesses to Fortune 500 organizations—with a full range of service and support for both DIGITAL and non-DIGITAL products.	Total computers in use in the US exceed 10 million units. The Musical Instrument Digital Interface (MIDI) is introduced at the first North American Music manufacturers show in Los Angeles.
1984		
Compaq Computer introduces the Compaq Deskpro, its first desktop computer. Compaq Computer establishes sales operations in Europe. Construction begins on Compaq Center, a 55-acre site in northwest Houston, Texas.	Announcement of the VAX 8600, the first of a new generation of computers within the VAX family, and, at the time, the highest performance computer system in DIGITAL's history. Introduction of the VAXstation I, DIGITAL's first 32-bit, single-user workstation. DIGITAL delivers its 25,000th VAX system to Citicorp.	The 3 1/2-inch "microfloppy" diskette wins widespread acceptance. In his novel *Neuromancer,* William Gibson coins the term "cyberspace."
1985		
Compaq Computer introduces the Compaq Deskpro 286 and the Portable 286.	DIGITAL is the first computer company to register an Internet domain. DIGITAL introduces the MicroVAX II.	550-MB CD-ROMs evolve from regular CDs on which music is recorded. The C++ programming language emerges as the dominant object-oriented language in the computer industry.

web*site*

weblib.ako.dec.com/clg/cc/compaq-d.htm

Compaq	DIGITAL	Industry Milestones
1986		
Compaq Computer joins the Fortune 500 list faster than any company in history. Compaq Computer ships its 500,000th personal computer. Compaq Computer introduces the Compaq Portable II. Construction at Compaq Center in Houston is completed and Compaq immediately begins a series of expansions and additions to the new facility. Printed circuit board assembly plant opens in Singapore.	DIGITAL creates the first Internet firewall and establishes http://gatekeeper.dec.com as a major FTP site on the Internet. DIGITAL occupies its first built-for-remote services facility in Colorado Springs, Colorado. Introduction of the VAXmate, a networked personal computer combining the resources of the VAX-VMS and MS-DOS operating systems.	The number of computers in the US exceeds 30 million. Daniel Hillis of Thinking Machines Corp. moves artificial intelligence forward by developing the controversial concept of massive parallelism.
1987		
Compaq Computer introduces the 20-MHz Compaq Portable 386 and the Compaq Deskpro 386/20, which features a 20-MHz Intel 80386 and a cache controller. Compaq Computer manufactures its 1-millionth personal computer. Scotland manufacturing plant opens.	Introduction of the VAX 8978 and VAX 8974, DIGITAL's most powerful systems to date, offering up to 50 times the power of the industry-standard VAX-11/780. DIGITAL ships its 100,000th VAX system to the Standard Oil Company's Dallas Technical Data Center. The VAX 8800 is to be used in oil exploration and for production computing.	The number of Internet host computers exceeds 10,000. NASA's newest installed supercomputer system is capable of a sustained rate of 250 million calculations per second.
1988		
First to market with a fully functioning laptop, Compaq Computer introduces the Compaq SLT/286, its first laptop PC with VGA graphics, a 12-MHz 286, 640-KB RAM, 20- to 40-MB hard drive, 3.5-inch disk drive, and built-in 10-inch grayscale LCD VGA screen. Compaq is among the 61 computer companies supporting formation of Extended Industry Standard Architecture (EISA).	DIGITAL introduces the VAX 6000 system platform, based on the CVAX chip. DIGITAL extends its Network Applications Support (NAS) facilities to integrate MS-DOS, OS/2, and UNIX systems into the open DECnet/OSI network environment.	Pixar's "Tin Toy" becomes the first computer-animated film to win an Academy Award. 23-year-old Robert Morris sends a nondestructive worm through the Internet, causing problems for about 6,000 of the 60,000 hosts linked to the network.
1989		
Compaq Computer introduces its first notebook PC, the Compaq LTE. The first full-function notebook computer, including hard and floppy disk, weighs less than 7 lb. (3.2 kg.). Compaq Computer introduces its first server PC, the Compaq Systempro; this is also the first EISA PC. Overtaking Apple and Olivetti, Compaq Computer becomes the #2 supplier of business PCs in Europe. Compaq Computer establishes a service operations facility in Stirling, Scotland.	The Rigel chip set is introduced. The DECstation 3100 is among the broadest set of desktop solutions announced by DIGITAL to date. Introduction of the VAX 6300 systems, DIGITAL's most powerful and expandable VAX systems in a single cabinet.	The number of computers in the US exceeds 50 million units; the worldwide number of computers in use surpasses 100 million units. The concept of "virtual reality" emerges as the hot topic at Siggraph's 1989 convention in Boston.

Compaq	DIGITAL	Industry Milestones
1990		
Compaq Computer opens a Berlin office and sets up an East European sales organization. Compaq Computer announces it will sponsor the Grand Slam Tennis Cup.	DIGITAL opens an operations center in Berlin to prepare for the opportunities created by a unified German marketplace. DIGITAL software engineers begin to participate in USENET newsgroups such as comp.sys.dec to provide informal customer support over the Internet.	The number of Internet host computers surpasses 100,000. The World Wide Web is born when Tim Berners-Lee, a researcher at CERN (the high-energy physics laboratory in Geneva), develops HyperText Markup Language (HTML).
1991		
Compaq Computer reports its first billion-dollar quarter. Compaq Computer eliminates its use of chlorofluorocarbons by changing to a new manufacturing process.	DIGITAL is the first in the industry to offer an Internet tunnel product.	Compaq Computer leads a group of companies in launching the Advanced Computing Environment (ACE) standard for PCs and workstations.
1992		
Compaq Computer enters the Japanese market with aggressively priced PCs—as much as 50% lower than Japanese PC prices. Initiation of on-site warranty coverage for all products and 3-year warranty and 24-hour technical support for all Compaq PCs. Introduction of Compaq Computer's first low-cost PCs: ProLinea and Contura, and the first low-cost server, Compaq ProSignia.	DIGITAL announces Alpha, its program for 21st-century computing. DIGITAL provides computer systems and software to the America3 Foundation racing team for its defense of the Americas Cup. DIGITAL installs the industry's first commercial Internet firewall.	The beginning of nationwide ISDN digital networked telephone service is marked by the "Golden Splice" as local and national carriers are networked for the first time.
1993		
Compaq Computer becomes #1 worldwide in portables market. Compaq Computer introduces Presario, a PC family targeted for the home market and the first all-in-one Compaq PC. Presario quickly becomes Compaq's fastest selling PC family. Compaq Computer delivers its first Pentium-based product. Compaq Computer announces Concerto, the first pen-based Compaq notebook. The first mini-tower Compaq PCs (Presario and ProLinea) are introduced.	DIGITAL becomes the first Fortune 500 company with a corporate Web site on the Internet (www.digital.com). DIGITAL establishes its first departmental intranet. DIGITAL and Microsoft ship the Windows NT operating system for Alpha systems. DIGITAL delivers its first video-on-demand system for an early broadband communications trial.	Compaq Computer, Intel, Microsoft, and Phoenix Technologies define the "plug and play" specification for PCs. The number of Internet host computers passes 1 million units.
1994		
Compaq Computer introduces first sub-notebook, the Compaq Aero. Compaq Computer announces its first rack-mountable server, the Rack-Mountable ProLiant.	DIGITAL describes the 21164, its newest Alpha microprocessor. The Network Systems Laboratory at DIGITAL builds and deploys the State of California Election Server, which delivers the first live election returns over the Internet during a statewide election.	The number of email users in the US surpasses 20 million.

Compaq	DIGITAL	Industry Milestones
1995		
Compaq Computer reaches #1 PC marketshare position worldwide. Compaq Computer introduces the 120-MHz Pentium-based Compaq Deskpro XL and nine new desktop models based on the 133-MHz Pentium processor. Europe's largest PC contract is awarded to Compaq Computer by British Telecom. Compaq Computer's LTE 5000 family is launched. Compaq Computer forms a internetworking products group.	DIGITAL and Microsoft announce a strategic alliance to meet growing customer demand for Microsoft-based solutions and support in enterprise-wide computing. DIGITAL introduces AltaVista, the Internet's first "super spider" software.	Personal computers are in 35 percent of US households. 41 percent of US public schools have computers and CD-ROM players, up 15 percent from 1994.
1996		
Compaq Computer introduces the 180-MHz Pentium Pro–based Prolinea. Compaq Computer enters the workstation market with the announcement of the Professional Workstation line of Pentium Pro–based systems. Compaq Computer ships the PC Companion, a hand-held computer running Windows CE. The Armada family of value-priced, flexible notebooks is announced by Compaq Computer. Compaq Computer announces the LS-120, the industry's first 120-MB floppy drive. Compaq Computer produces its 1-millionth server.	DIGITAL announces a new release of its industry-leading, 64-bit operating system, DIGITAL UNIX Version 4.0. At a worldwide customer event broadcast live via Internet audio and video, DIGITAL announces its strategy to accelerate the growth of the Internet as the environment of choice for cyberworkers. DIGITAL becomes the first computer company to operate an Internet Network Access Point (NAP) when it opens the DIGITAL Internet Exchange in Palo Alto, California.	The computers in use in the US exceed 100 million units. Personal computers are in 44 percent of US households.
1997		
Compaq Computer purchases Tandem Computers for US$3 billion. Compaq Capital, a finance company for customer leasing and other options, is established. Compaq Computer announces an under US$1000 series, the Presario 2000. Compaq Computer introduces the TFT 500 flat-panel monitor.	DIGITAL becomes the world's leading provider of mail and messaging solutions to global accounts. DIGITAL announces MilliCent, the first cybercommerce system. DIGITAL's Mars Landing Web site provides the first live streaming Webcast to over 1 million viewers. DIGITAL sells its semiconductor operations to Intel. DIGITAL and Intel begin a 10-year patent cross-licensing agreement.	Computers and CD-ROM players are in 54 percent of US public schools. 45 million people worldwide use the Internet. Use segments are 54 percent, home; 12 percent, education and government; and 34 percent, business. Backed by the US government and over 100 other organizations, the Internet 2 is targeted to serve universities and research institutions needing a higher-speed, less trafficked, and more capable version of the Internet.
1998		
Compaq Computer announces its intention to merge with Digital Equipment Corporation. The merger would create the second-largest computer company in the world. ✳		

Digital Technical Journal Preview

Volume 9, Number 4

With the industry's most powerful processor in hand, DIGITAL's engineers are working to apply Alpha to effect optimum solutions to computing problems. Samples of that work are presented in this issue and include. . .

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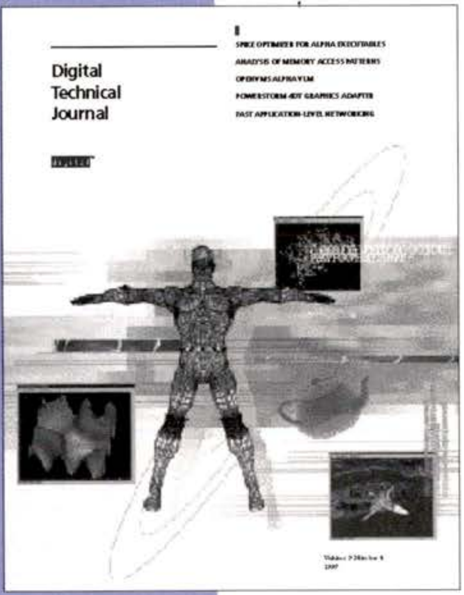

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Journal

SPIKE OPTIMIZER FOR ALPHA EXECUTABLES
ANALYSIS OF MEMORY ACCESS PATTERNS
OPENVMS ALPHA VLM
POWERSTORM 4DT GRAPHICS ADAPTER
FAST APPLICATION-LEVEL NETWORKING

- ✓ Spike, a profile-directed **optimizer for Alpha/NT executables** that "spikes" the performance of NT applications
- ✓ An experimental Atom-based **program analysis tool** that shows developers access pattern behaviors and potential bottlenecks in their technical applications
- ✓ OpenVMS version 7.1 with extended 64-bit **very large memory capabilities** that increase application flexibility
- ✓ A performance and price/performance leader—the PowerStorm series of **graphics adapters** for midrange workstations powered by Alpha
- ✓ DART, a network adapter, connecting gigabit-class networks to gigabit-class I/O buses for **fast application-level networking**

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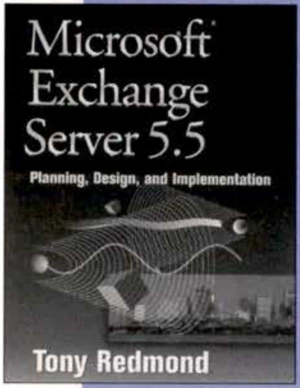
Recent Books from Digital Press

Highlighted below are recent computing titles from Digital Press. Digital Press is the authorized publisher for Digital Equipment Corporation and is an imprint of Butterworth-Heinemann, a major international publisher of professional books.

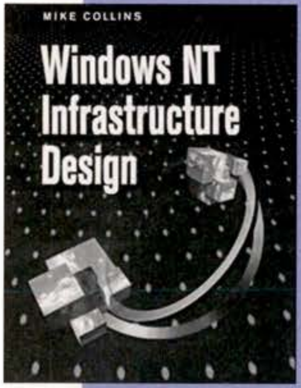
Microsoft Exchange Server 5.5: Planning, Design and Implementation is a new title from Tony Redmond, technical director, Mail and Messaging Practice, Digital Equipment Corporation. The book covers Exchange 5.5 SP1, including advanced security and message journaling, and describes best-practices for planning, design and implementation phases of MS Exchange Server deployment. The foreword is written by Elaine K. Sharp, Worldwide Messaging Server Product manager, Microsoft Corporation.

June 1998, paperback, 800 pages, US$54.95,
ISBN 1-55558-213-3



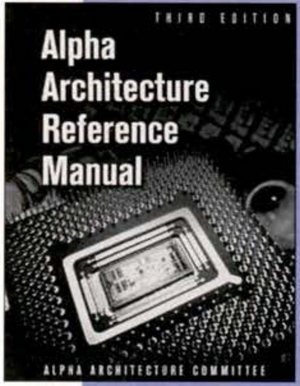
Windows NT Infrastructure Design, by Mike Collins, is a practical guide to planning and designing a Windows NT–based infrastructure in support of a business. The book includes a comprehensive case study and a template project plan that includes phases, activities, and tasks necessary to a successful infrastructure design. Mike Collins is a consultant experienced in building enterprise-wide systems based on the Windows NT operating system.

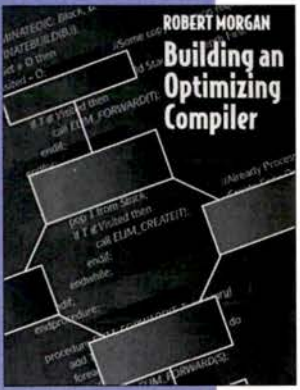
February 1998, paperback, 450 pages, US$39.95,
ISBN 1-55558-170-6



Alpha Architecture Reference Manual, Third Edition, has been updated by the Alpha Architecture Committee and includes a new section about the Windows NT technical port to Alpha and insights into the software aspects of the implementation. This edition also covers new multimedia instructions for increased performance with high-end graphics applications.

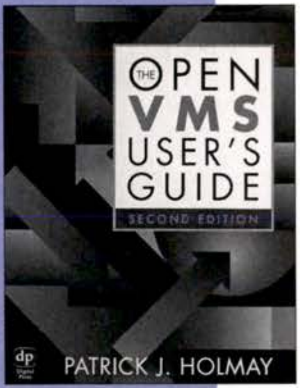
March 1998, paperback, 1000 pages, US$54.95,
ISBN 1-55558-202-8





Building an Optimizing Compiler is a new book by Robert Morgan, Technology Program manager for the Core Technology Group, Digital Equipment Corporation. Taking a practical approach to his subject, the author provides a high-level design, code generator, scheduler, and register allocator for a generic modern RISC processor. The techniques described are applicable to most programming languages for PCs, workstations, or servers.

January 1998, paperback, 300 pages, US$59.95,
ISBN 1-55558-179-X



The OpenVMS User's Guide, Second Edition by Patrick Holmay continues to be the prime resource and invaluable aid for new and nontechnical users on how to use OpenVMS and customize it to their working environment. For more proficient users, the book serves as a quick look-up reference.

July 1998, paperback, 300 pages, US$36.95,
ISBN 1-55558-203-6

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Fall issue: July 1, 1998

Winter issue: October 1, 1998

Spring issue: January 1, 1999

Summer issue: April 1, 1999

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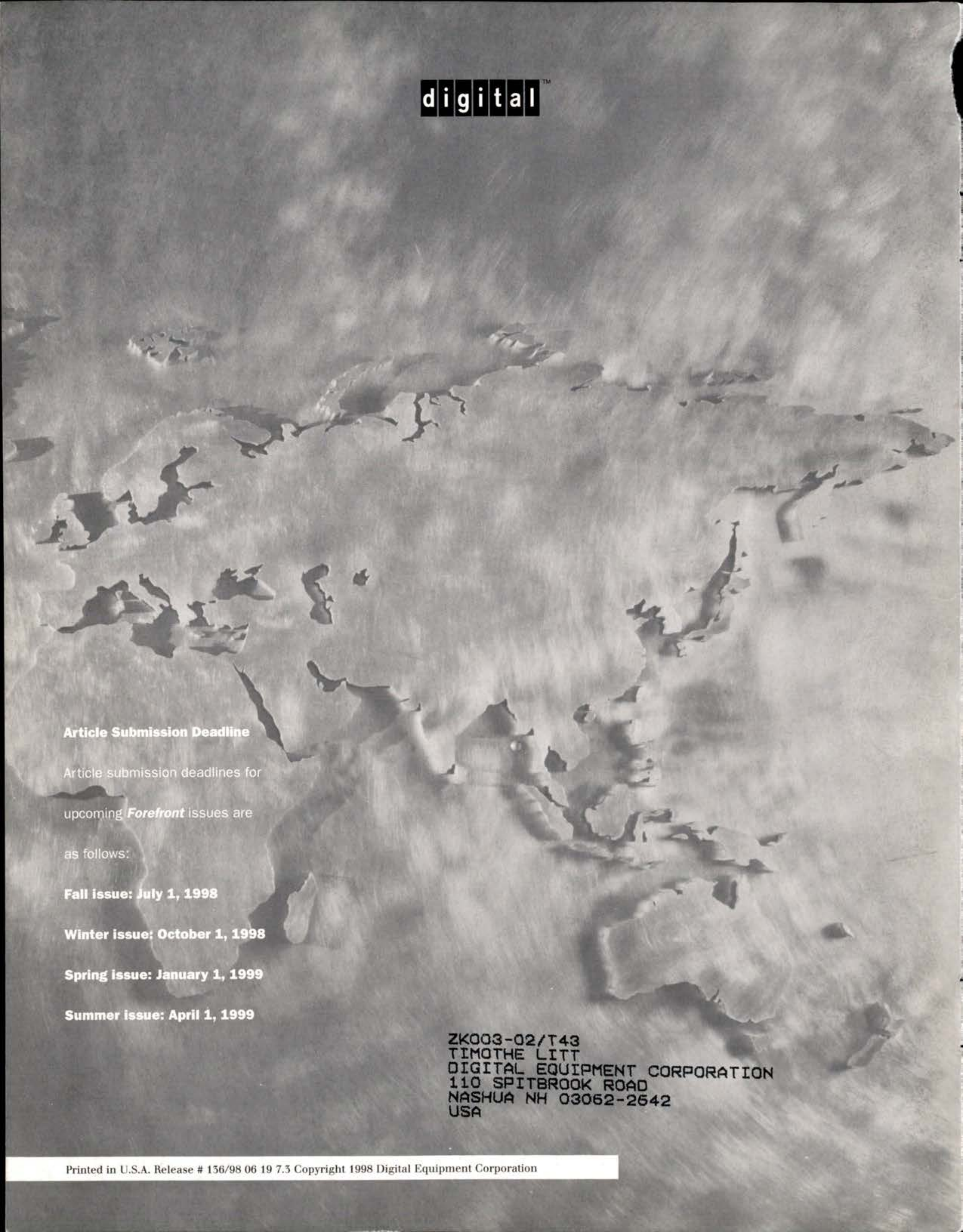

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Forefront

A magazine for the technical community

Fall 1998

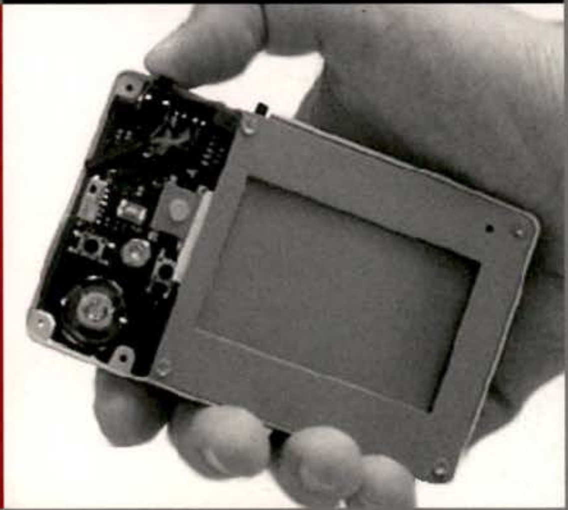
HIGHLIGHTS

- **Internetworked Multimedia: A Major Growth Force**
- **Centers of Expertise: Y2K Remediation and Testing on Target**
- **Integrating Parts Numbers in the New Compaq**

'The Merger: Creating a New Breed of Computer Company'

—John Rose,
senior vice president

Itsy: New Horizons for Pocket Computing



Fall 1998 Issue

Forefront magazine is a forum for the worldwide Compaq technical community to share information, technology and strategic directions, and key accomplishments.

Forefront welcomes contributions of interest to the Compaq technical community. The submission deadline for the Winter 1998–99 edition is October 1, 1998. Contact Managing Editor Dick Willett for information.

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IN THIS ISSUE

On the Cover

In August, Enterprise Computing Group Senior Vice President John Rose spoke in Massachusetts to members of the senior technical community about the "new" Compaq and its approach to integration (see story on p. 2.), which includes a sharpened focus on commercialization of research efforts. Illustrating this tack is a collaborative endeavor of the Western Research Lab and university researchers, called "Itsy" (see story on p. 6).

Compaq internal use only

John Rose Talks about a New Breed of Company

At the Senior Technical Forum in August, John Rose, Vice President and Group General Manager of the Enterprise Computing Group, talked with members of the senior technical community about company cultures, new industry paradigms, engineering strengths, market leadership, and the future of research and development.

The impact of change — to three merged companies, to multiple organizations, and to careers — was on the minds of everyone who attended the Technical Forum in August. John Rose acknowledged this theme in his opening remarks, pointing out the changes in his own career during 8 years at IBM, 16 years at DIGITAL, and now 5 years at Compaq, adding that "having the experience of different cultures is beneficial."

For Compaq, change has meant growth, industry leadership, and success. The future, from John's perspective, is more successes that will be driven by the combined strengths of Compaq, Tandem, and DIGITAL. Following are excerpts from John's discussion at the Forum and from the Q&A session with engineers.

The Compaq Culture

"At the time I joined Compaq in the early '90s to manage the desktop business, the company was completely changing its leaders and its basis of business operation in order to focus on the four Ps: product, pricing, place and promotion. As early as 1992, that reorganization proved to be successful.

"In 1994, when we surpassed IBM to become industry leader in PCs, we knew that we never wanted to lose the lead and that we were always willing to change if the dynamics in the industry caused change. Compaq, then, is a bit of a chameleon with a degree of paranoia. We will either initiate change or be a fast follower. But we will change.

"The new business operation was clearly a success, and by the end of 1995, the company had grown to $14 billion, about the size of DIGITAL, and had done so on what I call "organic" growth.

"In early 1996, we asked ourselves, 'Where can we take this company? We don't want to be just a PC company.' At the executive committee level, the thinking was, 'We really want to be an enterprise leader. So what does it take to be an enterprise leader?' We defined it, we reorganized the company, and we created the Enterprise Computing Group.

"Ultimately, we would say our focus has been and always will be to drive market leadership and be number 1 in every industry segment."

"Culturally at Compaq, we identify changes and paradigm shifts, and we initiate change or quickly follow the change."

Push for Dominant Market Share

In workstations...

"We stormed the market — traditionally a RISC players' environment — with our workstations products. These weren't just PCs on steroids; these workstations perform significant animation visualization. When I visited Disney, it was pretty much all Sun and Silicon Graphics machines. In 12 months, 75% of those systems were Compaq professional workstations."

In service and solutions...

"We also needed to invest in service and to look at it as part of providing the customer with solutions. A good example is the horizontal package solution in the SAP area. In merely 2 years, we had established over 2000 SAP sites with Compaq Proliant servers. It took HP 13 years to reach 2000 sites.

Editors' Note: The editors thank Jeff Schriesheim, Technical Director of UNIX Integration Technologies, and Ed Cotter, Vice President ECG Human Resources, for their help in preparing this article.

"We will continue to drive technologies to become industry standards – letting go of one vine and accelerating forward to grab the next one."

"The SAP model is a good example because it demonstrates alignment of the whole strategy around the solution. We focused on a comprehensive end-to-end model with a partner, we invested in R&D and in competency centers, and we drove the plan down to the field organization. By leveraging channels, partners, and even the competition, we grew the market share to 50%."

In partnering ...

"Partnering is one of the keys to the culture at Compaq. We have business models with our partners – whether it's Oracle, Seibel, or any other partner ... we become the reference platform. We've even leveraged the software side of IBM."

Paradigm Shift, Post Year 2000

"A paradigm shift is coming, I'm convinced, after the year 2000. The shift represents a pent-up demand for new applications.

"The IS leaders of the world have been consumed with helping customers get through Y2K and the switch to the Euro currency. CIOs tell us that the Euro, although it doesn't get much publicity, is two to three times the expense, effort, and complexity of Y2K. But after the year 2000, a pent-up demand for new applications will be released, specifically for object-oriented transaction processing and led by e-commerce from the internet perspective.

"A few of us were then asking, 'How can we maximize on that demand for new applications? What do we need to do to be a major player in the enterprise segment when this paradigm shift occurs?'"

Readiness for the Lead in the Enterprise Market

"In late 1996, we concluded that the paradigm shift toward new applications was going to center around UNIX and NT. We also recognized that this shift involved a major change in technology — technology with horsepower to handle the applications, specifically, 64-bit technology to accelerate toward the shift.

"Although we were making the right investments in a number of dimensions, particularly in the field, we knew that we wouldn't hit the timeframe for this shift through organic growth alone. In reality, we needed a combination of products, technology solutions, service, and people to establish the role of strategic IT advisor to the customer and trusted IT partner.

"We had two candidates that would help us get on the path to lead the upcoming paradigm shift: Tandem and DIGITAL. Tandem was a company with about $2 billion in revenue and 8000 people. Like DIGITAL, it had gone from being very proprietary to recognizing that technologies have to be open and industry-standard – technologies such as clustering, ServerNet, and some of the non-stop database technologies. And it had aligned with Microsoft. We decided to engage with Tandem, and within about 30 days from the time we made the call, we actually closed the deal and publicly announced it.

"...So I was sitting there in December thinking, 'The paradigm shift is coming. We've got presence and experience in high-definition solutions.

"In my view, we've put together the best possible team for leading the Enterprise Computing Group."

Tandem runs 95% of all stock transactions throughout the world, and 70% of all secure credit cards in the major banks. We have service that is profitable. We have good technologies and good engineers. Can we still get there in time and be a significant leader?'

"The answer? We needed a leadership UNIX. We needed 64-bit capability. We needed to expand our base of people to be truly the trusted IT adviser to the CIOs. We needed more service capability. It was time to look at DIGITAL.

"We called Bob Palmer, and about 10 days later we drew up the deal. The result, we believe, is a new breed of computer company, with many of the attributes of, but different from, IBM, HP, DIGITAL, and Compaq. I believe it's truly a new enterprise-class company."

The People, Products, Solutions, and Technology to Drive the Paradigm Shift

"As I said earlier, Compaq thinks in terms of volume, of market leadership, of being number 1 in every segment, whether it's a product segment, a geography, a solution, or manufacturing.

"We need to work with Microsoft on NT to get ready for the future demands of enterprises. But right now we have a wealth of technology, for example, in Tandem's Himalaya NSK and DIGITAL's VMS. With these strengths, we can drive NT to enterprise readiness in the near future.

"UNIX is another piece of the solution. We're going to ensure not only that DIGITAL UNIX survives but that it is the leader in UNIX.

"The next underpinning to our leadership infrastructure is Alpha volume. We're working aggressively to get more system players, and we're driving Alpha to volume in our own product portfolio with the Alpha system development team as part of the industry-standard server division. We intend to have Proliant-based Alphas shortly – same thing in the workstation area."

The Research and Development Perspective

"People look at Compaq's balance sheets and say, 'You're not serious about R&D because you don't spend serious money on R&D.' In terms of percentages, that's true. But in reality, our R&D investment is a mosaic of spending. Let me give you some examples. To get the workstation business up and running, I worked with very high R&D investment of 18%. The same is true in our high-end server business. But keep in mind that the goal is always volume sales; when you get the volume, the percentage can go down.

"We've always done advanced development at Compaq, and in DIGITAL we see lines of research that complement our direction. Large-scale networks, large-scale processing, human-machine interface — these are projects that we can move to large-scale commercialization, given Compaq's ability to get to market.

"In my view, we've put together the best possible team for leading the Enterprise Computing Group, which include successful, experienced leaders from DIGITAL, Tandem, and Compaq. The future looks great."✻

QUESTIONS FROM ENGINEERS ATTENDING THE FORUM

Q John, You just held a series of meetings with some of your folks at which they told you about their plans. Could you comment on how it went?

A This quarterly, worldwide Enterprise Computing Group meeting was the first with the new team — including all the division heads and the geography heads. It was a great meeting. The feedback was very positive. We need to do some cleaning up in our messages, but everyone is chomping at the bit and ready to go.

I put together three themes for that meeting.

1. **Customer satisfaction – I believe all three companies need to improve customer satisfaction.**
2. **Market leadership – a hot button of mine.**
3. **And growth – another hot button.**

I believe we need to quickly put the combined companies on a growth trajectory, because growth has a whole series of benefits. It immediately improves shareholder equity; people start to feel good; and we get greater recognition from the financial and industry analysts.

Q One of the challenges to making Alpha an industry standard is that we have a cycle in which the volume is low, therefore there is no software for Alpha, and no one can buy it to do the job they want. How are we going to break that cycle?

A We're breaking that cycle along two dimensions. First, we're empowering the merchant semiconductor market infrastructure. We want people to develop low-cost chip sets, boards, components, etc. We're also encouraging additional people to sign up to develop systems. Then, we get the software. We're clearly already in a good position with UNIX and NT. Next, the drive is quickly into volume in the Compaq products. You know, you can run ads forever, but people are going to look and say, 'Are you walking the talk?' With an announcement of Proliant Alpha, you get people to perk up their ears and say 'Oh wow! They're serious, they're doing it.'

Q What can you say about the Enterprise Group's plans vis-a-vis Dell's foray into the low- and high-end server business?

A We have not lost any marketshare to Dell. Unfortunately, HP and IBM certainly have allowed Dell to increase its share. I like having Dell around because it's a great annoyance, and it focuses us on refining every element of our business model. Our strategy is clearly to be as efficient as Dell. But the Dell model is not going to succeed by itself. In fact, Dell has got to create a hybrid model if it wants to succeed. We believe we've got a hybrid model. We have account managers who are trusted IT advisors. We make effective use of the internet. We sell direct if the customer wants to buy direct. The hybrid model, as long as it's an efficient end-to-end logistics structure, will keep Dell positioned down on the farm as a box supplier.

Q DIGITAL gradually retreated into the high end and lost marketshare. Is Compaq going to end up the same way, retreating to the high-end, high-margin server business because leading Dell brings better gross margin?

A Absolutely not. The name of the game is volume. And I've personally told the field, 'Do not lose to Dell.' We have no intention of retreating to the high end.

Q You talked about the effectiveness of being 'hardware-agnostic' in front of the customer, that is, supporting the customer's choice of equipment rather than strongly recommending our own. What level of agnosticism are we going to encourage with regard to Compaq products?

A Certainly the field has always been somewhat hardware agnostic. The real challenge to Services right now is how to leverage the business to $15 billion. You can't do it on organic growth by adding people; you have to adapt the Compaq model and empower the channels to get the business for us. Also along those lines, we've got to do what the customer wants. But we now have a huge portfolio of leadership products; at the time of the paradigm shift, we'll use the Compaq model to leverage the SI partners, the channel partners, and others to double the business over the course of the next few years.

Q What do you think will be the key differences for the Senior Technical Community in the new company?

A Compaq has always been oriented towards technology. For 16 years, technology has been part of the Compaq culture. It's in DIGITAL's roots, going back 40 years. And it's certainly been part of Tandem's culture during its 25 years. Intellectual property and patents are absolutely important to Compaq. We also focus on technology leadership; and the dual career path is a key element in achieving that leadership. Individuals at Compaq, DIGITAL, and Tandem are making plans now to preserve technology leadership efforts. ✳

Itsy: New Horizons for Pocket Computing

Compaq and university researchers are working together on an open research platform for pocket computing that 'raises the bar' in performance, memory and innovative applications.

By Laurie Schuler, Corporate Research and Advanced Development, Palo Alto, California

laurie.schuler@digital.com

Consulting engineer Bill Hamburgen of Compaq's Western Research Lab (WRL) in Palo Alto, California, has watched his "Itsy" research project reach exciting proportions in just 3 years. His team is now working alongside university researchers to extend the horizons of pocket computing.

The Vision

During the early '90s, Bill and John Fitch, a former DIGITAL researcher, had been developing packaging and test apparatus for the fastest, hottest chips. In March 1995, as these projects began winding down, Bill and John initiated a new research plan aimed at the future of computing. To quote from their proposal:

> *"By the beginning of the next millennium, what we call the computer industry will include a range of networked devices—from personal and mobile information appliances to supercomputers. The 'center-of-gravity' of this world will be commodity PCs running commodity OSs over commodity networks.*
>
> *"In this new world, personal information appliances will proliferate and will not yet have settled into a world of commodity hardware and software."*

The Itsy team. Standing, from left: Carl Waldspurger, Larry Brakmo, Marc Viredaz, Debby Wallach, Marco Annaratone, and Steve Jeske. Seated, from bottom: Annie Warren, Sharon Perl, Keith Farkas, Barton Sano, Bill Hamburgen, and Jeff Dean.

Key to the proliferation of such personal information appliances would be size. They should be small enough to be carried comfortably at all times. Although the exact form of future personal information appliances is not clear—enhanced phones, pagers, PDAs, wristwatches, clothing, or jewelry—it is agreed that they must be tiny and lightweight. As systems shrink to the dimensions of today's silicon chips, packaging will need to change radically.

Advanced packaging could conceivably become an enabling technology for this new class of devices and could prove to be an important means of differentiating products in new and evolving markets.

The Work

For 2 years, Bill labored on his ultra-small personal computer, exploring system components and features to understand the tradeoffs. Introduced in April 1997, DIGITAL Semiconductor's StrongARM SA-1100 looked to Bill like an ideal processor for a pocket computer. With the SA-1100 and many other key components selected, it was time to begin detailed hardware design. Marc Viredaz, who had just completed a scalable computing project, joined Bill to develop the hardware. As Bill had hoped, other researchers soon indicated interest in designing software and applications.

A kickoff meeting was held in April to discuss the required form and feature set for the pocket computer platform. Researchers from WRL and the Systems Research Center (SRC) saw a range of

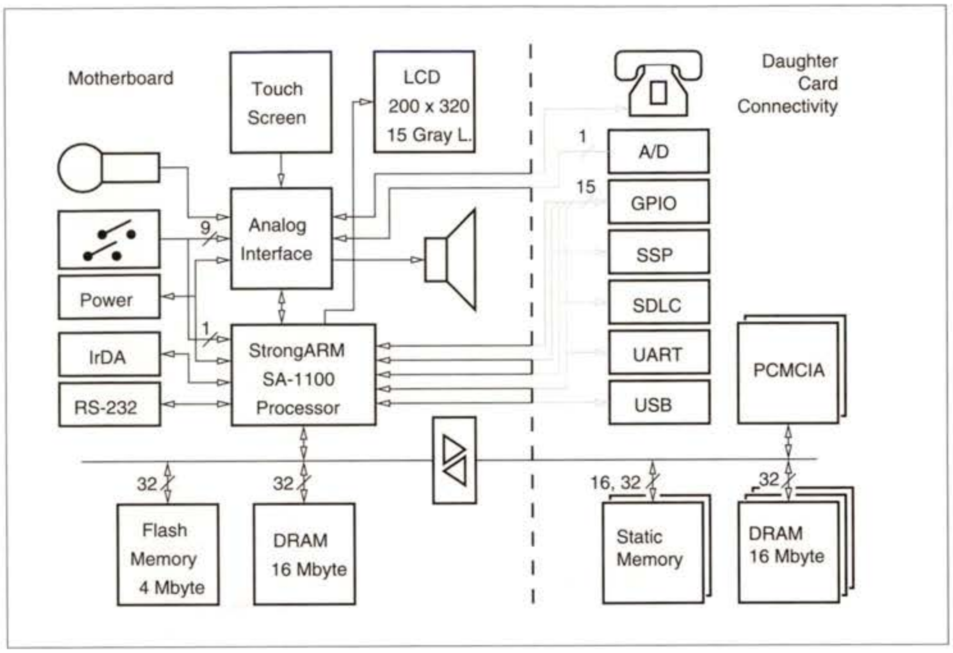

Figure. Itsy architecture

exciting possible applications including speech recognition, assisted text reading, and proximity networking development.

The Result

WRL and SRC researchers began developing these ideas, creating an open platform for pocket computing designed to encourage the development of novel user interfaces, new applications, and compelling, high-volume products. They called the project "Itsy."

Itsy is a self-contained, wallet-sized computer system, which includes a touchscreen graphics display, microphone and speaker, and plenty of memory—the basics needed for developing user interfaces and applications. It is very low-power, using standard, off-the-shelf AAA batteries.

The base system can be used to investigate applications such as character recognition, voice interaction, mobile operating systems, and wireless and proximity networking. What distinguishes Itsy from other pocket computers is its open hardware/software approach which provides a highly flexible interface that can be used to customize daughtercards, enabling a wide range of new ideas and projects (Figure).

Itsy features a 160-pin connector for plug-in daughtercards, with full access to the memory and address bus, as well as most SA-1100 signals. It supports the Linux 2.0.30 operating system, selected for its large user base, relatively small and stable kernel, unrestricted access to kernel sources for research purposes, and wide variety of existing applications. Other operating systems may eventually be ported.

Until now, software development has focused primarily on the base operating system and device drivers. However, the team has already used Apache's Web server and Metricom's radio modem to demonstrate Itsy as a wireless hand-held Web server. Other demos include an

The Itsy Team

Itsy team members work at two Corporate Research labs.

Western Research Lab

- Joel Bartlett, "rock-n-scroll" user interface
- Lawrence Brakmo, pocket companion work, OS, and networking
- Jeff Dean, compressed file system
- Bill Hamburgen, system and hardware design
- Bob Mayo, Factoid and proximity networking
- Bart Sano, GPS applications
- Marc Viredaz, hardware design
- Deborah Wallach, OS and networking
- Annie Warren, program management

Systems Research Center

- David Chaiken, ARM Angel and USB support
- Puneet Kumar, PDA emulator
- Sharon Perl, handwriting recognition
- Carl Waldspurger, OS and networking ✳

Itsy Hardware

The base system characteristics:

- 200-MHz StrongARM SA-1100 microprocessor
- 16-MB DRAM, 4-MB flash memory
- Audio Codec, microphone, and speaker
- LCD and touchscreen
- RS-232, IrDA I/O, and pushbuttons
- Standard AAA batteries

Plug-in daughtercard characteristics:

- 160-pin connector
- Full memory and address bus
- Most other available SA-1100 signals
- Hooks for easy experimentation ✳

Advanced packaging could conceivably become an enabling technology for this new class of devices and could prove to be an important means of differentiating products in new and evolving markets.

Itsy is a self-contained, wallet-sized computer system, which includes a touchscreen graphics display, microphone and speaker, and plenty of memory. It is powered by standard, off-the-shelf AAA batteries.

MPEG video player, a simple voice organizer for recording and playing back .WAV files, a virtual console with touchscreen, a "soft keyboard," and an emulator for a popular commercial PDA.

Collaborative Research

Itsy research was initially shared through presentations to universities such as MIT, Carnegie Mellon University, the University of California at Berkeley, and Stanford University. The Itsy team hoped to secure new ideas and leverage expertise by providing prototype units to university researchers exploring pocket computing. The team has been building and testing Itsy prototypes and is investigating venues for cooperative academic and industrial research.

The Future

The project objective has been to develop "off-the-desk" computing expertise, and establishing Compaq as a technology pioneer in the field of portable/wearable computing and Compaq's Corporate Research labs as a recognized center for research in pocket computing. Forward-looking partnerships with outside research groups will provide access to important new ideas in this field and related applications, thus leading to a continuing stream of useful, innovative volume products.

Send questions or comments about Itsy to Annie Warren, program management: warren@pa.dec.com ✳

web *site*

http://www.research.digital.com/wrl/itsy

Internetworked Multimedia and Networked Entertainment Technology

Multimedia over the Internet and intranets is now a major growth force in our industry. The Networked Entertainment Technology effort advanced the sate of the art in internetworked multimedia and explored its use in existing and emerging entertainment-related markets.

By Andrew Cromarty,
Network Systems Laboratory,
Palo Alto, California

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For the past few years, DIGITAL has been exploring business models and technologies that can lead to new entertainment-related markets and revenue. This work, conducted under the Networked Entertainment Technology (NET) effort, has led to sixteen key technology and market findings and a few important observations about technology and market trends. The project and its findings are briefly summarized here.

Market Forces, the Internet, and Entertainment

Entertainment-related use of computing is surprisingly central to Compaq's business. For several years, most growth in the computing market has been in networked computing, especially the Internet; the Internet's growth, in turn, has been driven by tens of millions of individual consumers choosing to sign up for Internet or "online" service to gain access to the multimedia-based information management features of the World Wide Web, because they perceive it as "cool," fun, or interesting–that is, for their personal edification and enjoyment. In short, for the past few years, consumers have driven the growth of the Internet, and thus of our industry, based on its personal entertainment value.[1]

User interface studies and exploration of new business models were important activities of the NET project. One line of study involved potential new business opportunities for public-use entertainment kiosks. Used extensively in NET work, this lightweight, 6-in-thick prototype kiosk runs Windows NT and has a flat-panel, touch-sensitive display, stereo sound, card swipe reader, trackball, and keyboard.

Substantially all Compaq's new business is derivative of this consumer-driven networked entertainment phenomenon. For example, corporate intranets, now a revenue mainstay of the computing industry, are largely piggybacking on the infrastructure developed for the public World Wide Web; the most widely used web software, both client/browser and server, continues to be based on the tools developed by college students for their own enjoyment of the Internet. In general, server or workstation product and service revenues that can be attributed to enterprise "intranets," the Internet, telecommuting, or ISPs, and certainly most of AltaVista advertising revenues owe their origins to, and still remain largely driven by, this simple powerful phenomenon of millions of individuals surfing the web for personal edification and amusement.

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[1] *The term "entertainment" is not being limited to products and services of existing large commercial entertainment industry corporations. In fact, the entertainment industry is relatively conservative and has moved somewhat slowly to the Internet. This has ledto the creation of several innovative Internet-based cottage industries led by companies that understand the difference between the mature corporate entertainment industry and the consumer's desire to be entertained.*

Content: In Search of an 'Attractive Nuisance'

Content for internetworked multimedia distribution typically was provided by partner companies and was selected based on its ability to be a popular "attractive nuisance" that would stimulate public interest and generate the high level of participation needed to study the technology and market.

The Networking Entertainment Technology (NET) team distributed live and prerecorded audio and video for:

- popular music concerts—U2, Chemical Brothers and The Orb, Lilith Fair, Tibetan Freedom Superconcert
- film festivals—Vancouver, Cannes
- televised awards ceremonies—Tony Awards, Grammy Awards
- sports events—Indianapolis 500 Gasoline Alley, Dallas Cowboys preseason football games

NET maintained a library of partner film clips and gained valuable experience by delivering more than 50,000 video-on-demand viewings to the public via the Internet.

NET also created the DIGITAL Mars Landing Web site, comprising

- a full mirror of the Jet Propulsion Laboratory (JPL) site (requested by JPL)
- exclusive, celebrity-hosted interview videos of the JPL Mars Landing team
- 100%-uptime server for the live worldwide, Internet-based video distribution of NASA Select TV coverage of the event ✳

Computer vendors historically have focused more on achieving excellence in producing the devices and services employed by customers than on understanding the sociology of their underlying reasons for using them.

This shift towards entertainment-based use of computers demands a corresponding shift in our market and technology approaches. Computer vendors historically have focused more on achieving excellence in producing the devices and services employed by customers than on understanding the underlying sociology of their reasons for using them. Historically, this has been a reasonable approach given vendors' technology strengths, the diversity of underlying reasons for customer purchases, and the relative technical maturity of the computing customer base. But the Internet, and particularly the advent of the individual fun-seeking naïve consumer as the industry's principal market force, has changed the rules.

Personal entertainment-related use of computing now is arguably the most significant purchasing force among our consumer's customers and our enterprise customers' customers, and thus is a principal factor motivating purchases from us. In order to succeed in our current and future markets (e.g., enterprise intranets, ISPs, visual computing), we now must understand who our customers and our customers' customers are and the pattern of needs that drives their purchases, in order to develop the technologies, products, and services that can satisfy those needs.

Activities in Networked Entertainment Technology

Understanding the market and technology phenomena of networked entertainment has been the focus of the Networked Entertainment Technology (NET) effort, conducted from 1996 to 1998 within the DIGITAL Network Systems Laboratory (NSL). Networked Entertainment Technology work occurred in three areas:

- assessing the state of internetworked (i.e., IP-based) multimedia distribution/delivery
- mapping out the business models most appropriate for the new market environment
- defining new revenue-bearing candidate product and service solutions

We focused our studies principally on *internetworked multimedia distribution*, the infrastructure-intensive role in entertainment-related emerging market segments that is most suitable for DIGITAL as the premier internetworked solutions provider. Multimedia distribution and delivery is of both technical and market interest:

- Multimedia traffic volume and timeliness constraints generally are many orders of magnitude more demanding than email or text-based webpage traffic. Internetworked multimedia also routinely uses components of the Internet's TCP/IP protocol suite that rudely elbow out of the way more gen-teel web pages, email, remote login, and file-transfer traffic, leading to problems ranging from delay-inducing congestion to potential denial-of-service problems on both the public Internet and corporate intranets.
- Very little is currently understood about how to use multimedia over the Internet *cost-effectively* in support of a revenue-bearing business

Joe Robinson, executive vice president of partner company ActionWorld, demonstrates his company's internetworked Java-based multiplayer games in a joint demonstration space at the Spring 1997 E3 Games trade show in Atlanta. This computing platform is the high-performance, low-cost, multimedia-equipped DNARD network computer prototype developed by Corporate Research.

Internetworked multimedia distribution is thus interesting because it pushes both the market and technology envelopes. In practice, focusing on internetworked multimedia distribution meant distributing *webcasts* (also known as "netcasts," these are audio and video, live or on demand, distributed over the Internet to consumers around the world); developing and demonstrating *new origination, distribution, and delivery techniques* (e.g., high-bandwidth wireless multimedia); and studying the *performance of the products* (computers, software, and networks) that provide these services.

Content for distribution typically was provided by partner companies and was selected based on its ability to be the kind of popular "attractive nuisance" that would generate the high public interest and participation needed to study the technology and market. For example, we distributed live and prerecorded audio and video for high-public-interest music concerts (e.g., U2, Chemical Brothers and The Orb, Lilith Fair, Tibetan Freedom superconcert), film festivals (Vancouver, Cannes), televised awards ceremonies (Tonys, Grammys), and sports events (Indianapolis 500 Gasoline Alley, Dallas Cowboys preseason football games). We also maintained and distributed a library of partner film clips as video-on-demand, gaining experience by delivering well over 50,000 video-on-demand viewings to the public via Internet.

NET also created the DIGITAL Mars Landing website, comprising a full mirror of the Jet Propulsion Laboratory (JPL) site (at JPL's request), exclusive celebrity-hosted interview videos of the JPL Mars Landing team, and the 100%-uptime server for the sole worldwide live Internet-based video distribution of the NASA Select TV coverage of the event.

Very little is currently understood about how to use multimedia over the Internet *cost-effectively* in support of a revenue-bearing business.

Working with key partner companies, we explored the use of Java as a tool for changing the model of how to distribute and deliver multimedia, using it both as a vehicle for internetworked live multiplayer action-game delivery and as a way to eliminate the consumer nuisance of browser plug-ins in the delivery of live streaming multimedia.

Our business model studies were important to us as our technology studies. Who will be the players in these emerging markets, and how will they make money? What innovative opportunities does DIGITAL have to earn revenue in these markets? As with the technology, we studied these business models through execution and evaluation. We entered into working relationships with senior management at several dozen key corporations, nonprofit organizations, and governmental institutions involved in these markets, ranging from content owners and producers through distribution infrastructure partners to consumer-delivery companies. We analyzed the markets and the kinds of relationships that will succeed or fail in them. Most of our business model findings are beyond the scope of this article, but a few observations about the markets and how the Internet is restructuring them appear later in this article.

One important part of our methodology was to compare different processors, operating systems, and multimedia products side-by-side in a fair, neutral, resource-rich environment. For example, somewhat surprisingly, this is apparently the first study ever conducted in which DIGITAL UNIX and Windows NT, or Alpha and Intel, were compared side-by-side delivering high volumes of multimedia content over the Internet at our corporate gateway.

In the course of this effort, we succeeded in pushing the envelope hard enough to be first and make Internet history several times. Key milestones include

- *The world's first live wireless netcast,* in October 1996, from the Vancouver International Film Festival
- *The world's first public demonstration of a Java-based, true live multiplayer action game over the Internet*, both wired and wireless, in December 1996 at the DIGITAL booth at the *Internet World* trade show in New York City
- *The world record for live streaming video for a single event,* distributing over 1,000,000 live streams of NASA Select TV video in less than a week to the public from our corporate gateway in Palo Alto via an internationally distributed network of two dozen video reflectors, for the Mars Pathfinder landing in July 1997.
- *The world's first live netcast of an NFL football game,* from the Dallas Cowboys games during summer 1997

A Brief Overview of Our Findings

Our work led to findings in seven areas, summarized briefly below.[2]

- *Servers (hardware and operating systems).* In actual service, Alphas were found to be exceptionally fast, but Windows NT performance in high-volume, low-latency multimedia delivery is disappointing. Specific NT problem areas appear to include TCP/IP performance, kernel resource management, an untuned port that makes Alpha as slow as Pentium, and encouragement of a profligate style of programming. Windows NT is essentially impossible to manage remotely in a secure manner on a hostile network such as the Internet; UNIX was better but still inadequate.
- *Application software.* Webcasting server software is fragile; it frequently is necessary to circumvent the public Internet for server-to-server connectivity, at least for live data. Understanding the behavior of multimedia applications is difficult, principally due to correctable software design flaws. Our Java-based game demos put us ahead of the market. The Java multimedia delivery model works, and provides important flexibility for both content providers and consumers.
- *Internet performance.* The public Internet's performance variations are so severe that the public usually cannot tell whether an entertainment event has succeeded or failed. (They commonly assume the Internet failed them instead.) Publicly acceptable video quality probably will require well in excess of 100 kbps to the home, even with compression improvements. In the near future, the asymmetry of many high-bandwidth, last-mile connectivity models (cable modems, ADSL, etc.) will increasingly fail to meet the needs of the consumer public, who will want to originate their own multimedia content and will expect near-TV quality. Queueing delays, the source of most slowdowns in the public Internet, will not be resolvable through "second generation Internet" designs that merely add bandwidth, and consumer demand will drive development of improved Quality of Service technology.

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- *Webcast challenges.* The hardest kind of webcast is the "itinerant strike team" special-event webcast; the most significant limiting factor is *bandwidth out of the venue.* Wireless or satellite may be one way to circumvent this problem. The next-hardest special-event webcast problems are routing and *software compatibility.*
- *Problems for the public.* The *plug-in/configuration problem* and *firewalls* are consistent impediments to public participation in multimedia Internet events. Low consumer bandwidth means low consumer quality, which means low consumer interest, which means low consumer participation.
- *Scalability.* Full-up high-bandwidth use of third-party webcasting software can cause the software to fail in surprising ways. ISVs may be incapable of fixing their own software. (They lack the resources and, often, the skills required to study scalability). The public Internet is unready for volume multimedia: 100 Mbps is now a tiny amount of bandwidth. IP Multicast scales poorly, is generally unsuitable for most multimedia uses

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[2] *These results are necessarily somewhat qualitative or anecdotal, due in part to deficiencies in the systems themselves that make quantitative analysis difficult and in part to the summary nature of our report here. A separate NSL Technical Report will provide more detail.*

we anticipate, and has pragmatic technical and social problems; it will have limited use for internetworked multimedia delivery.

- *Business models.* Internetworked multimedia does not yet pay for itself. Bandwidth is too expensive, existing revenue models such as banner ads cannot cover costs, and sponsor depth may be thin once internetworked multimedia becomes ubiquitous. New revenue models are needed. Most infrastructure revenue growth will be in services that live "above" the ISPs and between the content makers (consumers, entertainment industry) and deliverers (ISPs).

Observations

Our findings yielded the following long-term conclusions:

- *The death of the website.* The single-website model does not scale. Few companies in the world can afford the cost of an AltaVista-class site; the maximum bandwidth available at any one site is generally a mere few hundred Mbps, and there is a limit to how many AlphaServer 8400's fit in one room. In addition, a single-locus website is a single point of failure, especially for connectivity; and no amount of hardware and wiring in a room will reduce latency to distant points on the globe. Future scaleable designs will be physically distributed to increase performance, reduce latency, and increase robustness.
- *The Web was the Platform.* The Web was, but will not be, the platform. Early in the evolution of the web, interface, distribution, and delivery could be integrated under the abstraction of "website." However, this integration does not scale; therefore, it will split: The web is one presence (one "interface"); the Internet is one distribution medium. There will be additional interfaces and media, and the platform is missing and needs to be built.

When a market commoditizes, consumers buy *appliances* and *service*, not branded "software" or "hardware." This represents a major and irreversible shift of the majority of computing dollars away from (for example) the high-end-product business model historically pursued by DIGITAL and towards a greater emphasis on service and product simplicity.

- *The death of software.* The web provides a uniform abstraction for interacting with remote software-based services, allowing the consumer to neither know nor care what hardware or software is at the other end of the connection. Abstraction leads to commoditization. The web (especially augmented with Java) thus will *commoditize software* – just as software (especially UNIX) commoditized hardware, allowing most users neither to know nor to care which hardware underlies their operating system interface. When a market commoditizes, consumers buy *appliances* and *service*, not branded "software" or "hardware." This represents a major and irreversible shift of the majority of computing dollars away from, for example, the high-end-product business model historically pursued by DIGITAL and towards a greater emphasis on service and product simplicity.

Internetworking Milestones: 1996–98

In the course of the Networked Entertainment Technology effort, we made Internet history several times.

Key milestones included

- October 1996—The world's first live wireless netcast (at the Vancouver International Film Festival)
- December 1996—The world's first public demonstration of a Java-based, true live multiplayer action game over the Internet—both wired and wireless (at the Internet World trade show in New York City)
- July 1997—The world record for live streaming video of a single event (the Mars Pathfinder landing). From our corporate gateway in Palo Alto, we distributed to the public more than 1 million live streams of NASA Select TV video in less than a week via an internationally distributed network of two dozen video reflectors.
- Summer 1997—The world's first live netcast of an American football game (the Dallas Cowboys) ✳

- *Bad is good.* Webcasts, being worse, will displace TV over time as the prin-cipal means of delivering broadcast multimedia to the public worldwide. The reason is simple: Professional TV and film are expensive, mature, high-quality disciplines, whereas webcasting is quick and cheap, though of mediocre quality. However, webcasting is *good enough* for many uses, and can reach millions of viewers globally, independent of space and time constraints. And webcasts will get better far faster than TV and film will get cheaper.

A Brief Example: SportsWeb

The market and technology lessons learned from the Networked Entertainment Technology effort recently were successfully transferred to the field in the form of SportsWeb, a new revenue-bearing business developed jointly with Reuters by the Reuters Account Team, Outsource Management Services, and the Network Systems Laboratory. SportsWeb is a joint partnership venture with Reuters, using Reuters news content and DIGITAL infrastructure expertise to create the premier sports-content website on the World Wide Web. Applying the knowledge obtained from the NET effort, we were able to create a new business based on a distributed-server architecture designed to be scaleable for multimedia that was specified, designed, built, and deployed in about 12 weeks. Its public launch on the web took place in December 1997. SportsWeb was described in a recent Forefront article (see URL list at the end of the article).

Looking Ahead

The initial work in Networked Entertainment Technology is completed. We have turned our attention to transferring technology and market knowledge into operational parts of the company (revenue-producing business units and corporate IT services). We also are exploring new problems in internetworked multimedia delivery and management and its uses in special settings such as the educational environment.

Acknowledgments

Neal Cardwell, Imran Maskatia, Joella Paquette, and Catherine Warner contributed to the success of the NET project as did many other lab members and the gateway and technical operations staff at NSL. Numerous DIGITAL partner companies and other institutions also played an indispensable role in our work, including ActionWorld/ InterWorld, Artsource, Forrester, Icon, ITV.Net, Moonfire, NASA/Jet Propulsion Laboratories, NetGuide, Progressive/ Real Networks, Reuters, SonicNet, States of Art, Vosaic, VXtreme, and Xing. ✳

web*sites*

http://www.entertainment.digital.com/
See the Mars Landing website, the DIGITAL entertainment archive, and other networked entertainment content.

Read analyses of networked entertainment by the author published in Internet Innovators News.

http://intercontent.com/digital/Article.cfm?ArticleID=41
http://intercontent.com/digital/Article.cfm?ArticleID=52
http://intercontent.com/digital/Article.cfm?ArticleID=72

Follow work in this and related areas via

http://www.research.digital.com/nsl/(Internet)
http://nsl-too.pa.dec.com/nsl/(intranet)

To view the results of applying these lessons in a successful revenue-bearing new business:

http://www-corporate.ecom.dec.com/forefront/98summer/sportsweb-summer98.htm
http://www.sportsweb.com/
SportsWeb

SportsWeb: A Joint Venture with Reuters

The market and technology lessons learned from the Networked Entertainment Technology effort were successfully transferred to the field in the form of SportsWeb, a revenue-bearing business developed jointly with Reuters by the Reuters Account Team, Outsource Management Services, and the Network Systems Laboratory. Using Reuters news content and DIGITAL infrastructure expertise, SportsWeb is the premier sports-content website on the World Wide Web.

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web*sites*

http://www.sportsweb.com/
SportsWeb

http://www-corporate.ecom.dec.com/forefront/98summer/sportsweb-summer98.htm
"SportsWeb: Exploring New Business Models at the Internet's Service Frontier" (*Forefront,* Summer 1998, pp. 35–37).

Critical Research Services at Your Fingertips

Rely on speedy access to timely and accurate technical information available by email, telephone, and the corporate intranet.

By Mary Lee Kennedy, Information Research Services, Littleton, Massachusetts

marylee.kennedy@digital.com

D. Willett

Members of Information Research Services. Front row, from left: Richard Coles, Barry Tsirelson, Lynn Seller, Stephen Dougherty, Patti Arsenault, Tracey Storey. Back row, from left: Andy Breeding, Helen Ferrigno, Mary Lee Kennedy, Neela Srinath, Wini Ferguson, and Joan O'Brien.

Several decades of studies on the usefulness, value, and impact of information in organizations show that employee reading results in considerable cost savings and improved productivity, quality, and timeliness of work. Reading also correlates with higher levels of professional achievement.

These same studies provide the following indicators of the value and worth of "managed" information environments in organizations:

- Without centrally managed resources, the cost of acquiring information to an individual user is 1.8 times greater.
- Use of alternative sources of information (i.e., sources outside the company) costs 2.9 times more than use of internal sources.
- Potential "lost benefits" to the current organization are 7.2 to 1, meaning that companies with organized information access benefit seven times more than a company without it.

Restated in a different way, a professional who does not have access to an information service spends, on average, 121 hours annually acquiring information; those using centralized services spend an average of 27 hours annually. That results in an extra 94 hours per year for thinking, experimenting, creating new products and services, or interacting with customers (King Research, "Value of information," May 12, 1998).

Most sources of technical information are not on the Internet, but reside in commercial databases such as those owned by Dialog Corporation. In addition, many technical journals, refereed papers, and texts are not yet available online, and it can be difficult to know where to find such resources. It is important to know about your information sources and how to get the information when you need it.

Following a basic business model, the professional staff of Information Research Services (InfoResearch Services) provides the following services for the corporate community.

Mary Lee Kennedy is the manager of Information Research Services. Contact her at DTN 226-6951 or 978-506-6951.

Archives (the DIGITAL Collection)

The Archives collection includes documentation on:

- major company and departmental projects
- technological advances in DIGITAL engineering
- milestones in manufacturing, marketing, and sales
- changes in the company's financial condition, business operations, and employee demographics

The Archives holds a wide range of text-based materials including executive papers, departmental records, memoranda and project files, business plans, engineering drawings, DIGITAL product and technical manuals, employee periodicals, public relations materials, marketing brochures, and oral histories plus a large selection of videotapes and artifacts ranging from a PDP-1 to a VAX-11/780.

Information Centers

Located in Europe and the United States, these centers provide worldwide access to information professionals specialized in business and computer industry research and provide training on information sources and search techniques. They produce Web-based information packages on the telecommunications, manufacturing, and finance industries, as well as Web-based company profiles and desktop reference tools.

Information Consulting Services

In partnership with business units, Information Consulting carries out in-depth market, industry, technology, and company research. Staff members are experts in Windows NT, Internet commerce, corporate intranets, ISPs, mail and messaging, and services.

Information Programs

Information Programs carries out information needs analyses, provides content recommendations, and implements strategic investments in content for the corporation. Staff members focus on providing the most cost-effective solutions for market research, and securing competitive and technical information. They publish monthly updates on market research services, develop and implement Web-based content resources, and sponsor seminar series on topics critical to the business community.

Interlibrary Loan

If a particular book is not part of the Library Catalog, the InfoResearch Services Interlibrary Loan Service can borrow the book from a library outside Compaq. The "Request for Book Interlibrary Loan/Purchase" form is available on the corporate intranet. (See the URL list at the end of this article.)

Lending Library

The Lending Library loans current books, reports, and audiovisual materials to employees and contractors for the following purposes:

- professional development—books on new technologies and business topics
- work/life issues—Human Resources' "Healthy Balance" collection
- productive use of commuting time—audiotapes
- staff meetings—videos
- everyday business needs

Available materials can be found and items requested online using the Library Catalog. Requested items are shipped directly to you. To request an item or get more information, contact the Lending Library at DTN 297-5040 or via email: CST.Lending.Library@digital.com or CST Lending Library when using MS Exchange.

Online Catalog

Ameritech Horizon Integrated Library System provides desktop/Web access to physical media across the corporation.

Photo Library (the DIGITAL Collection)

The Photo Library serves as a centralized resource of original photography formerly owned by DIGITAL. The library holds nearly 1 million current and historical images on all aspects of company operations including:

- products
- events
- employees

Photo Library staff members assist employees, business partners, resellers, and publishers by conducting research, consulting, duplicating, and distributing top-quality images in a variety of traditional and electronic formats.

Web-Based Content Management Services: The WebLibrary

The WebLibrary provides "one-stop shopping" for external content and content expertise that is focused on the company's strategic areas. It includes market research, and competitive, strategic, and technical information. Instances of primary research exist, including links to other internal sources of primary research. Subsections of the WebLibrary are as follows:

- **Browse WebLibrary** presents a list of all resources managed by the group.

- **Search** provides the ability to search across all indexed content.
- **Customize** allows users to set up a personal or group profile and receive automatic updates to their email or personal Web page.
- **Read News** provides access to real-time news by subject, news source, or in reply to a user's query.
- **Research** presents tailored views, customized to meet specific business needs for the marketing, sales, communications, and product communities.

Resident InfoResearch Services expertise includes:

- Agent-based content profiling and alerting services customized for business groups and individual users
- Content integration services that combine internal and external content for maximum effectiveness
- Information filtering solutions to locate the right material quickly
- Customized information delivery solutions including push/pull, Web/email, and batch/real-time
- Editorial services such as value-added editorial support, as well as Web usability and quality-control services
- Meta-data solutions for organizing the intranet and providing access to knowledge investments

Technical information needs can be met by accessing the WebLibrary at your desktop; refer additional queries or in-depth questions to the network of InfoResearch Services subject experts. ✻

By using the centralized capabilities of InfoResearch Services, each employee gains, on average, an extra 94 hours annually. That's free time for thinking, experimenting, creating new products and services, or interacting with customers.

web *sites*

http://weblib.lkg.dec.com/request.htm
Online request service

http://weblib.lkg.dec.com
WebLibrary

http://weblib.lkg.dec.com/clg/catalog/dlncat.htm
Library Catalog

http://weblib.lkg.dec.com/oclcill.html
Request for book interlibrary loan or purchase form

http://weblib.lkg.dec.com/browse.htm
Browse the WebLibrary

http://weblib.lkg.dec.com/search.html
Search the WebLibrary

http://weblib.lkg.dec.com/customize.html
Customize

http://weblib.lkg.dec.com/readnews.htm
Read News

http://weblib.lkg.dec.com/research.htm
Research

Summarizing the Year and Looking Ahead

High levels of participation by veteran and first-time inventors resulted in an exceptionally good year for the DIGITAL Corporate Patent Program.

By Sharon M.. Lipp, DIGITAL Corporate Patent Program, Corporate Technical and Information Services, Littleton, Massachusetts

sharon.lipp@digital.com

The close of DIGITAL FY 1998 provides a chance to review last year's performance and consider the coming year. Following is a summary of achievements during those past 12 months:

- DIGITAL recorded its largest number of disclosures and applications in the last 5 years.
- Two new incentive awards were initiated—First Patent Application and Defensive Publication. (81 inventors qualified for this award.)
- The *Journal of Record* published its first Internet entry on June 30, 1998.
- DIGITAL inventors were awarded 125 patents in FY98.

At the end of FY98, the DIGITAL patent portfolio included more than 1525 patents, originating from all sectors of the DIGITAL technical community.

As we look at the combined companies, during the same timeframe, Compaq had 207 patents issued, and Tandem had 31 patents issued. The combination of these tree patent portfolios provide Compaq with a world-class portfolio, which will provide the combined company a significant competitive advantage.

Several major technology areas are represented in the portfolio:

- Processor architecture
- Software
- Internet
- Storage controllers
- Computer systems technology

High levels of participation by veteran and first-time inventors resulted in an exceptionally good year for the DIGITAL Corporate Patent Program.

Looking Forward

As integration of the three companies proceeds, patents remain a strategic corporate asset which will ensure the ongoing protection of Compaq intellectual property in the face of increasing competition. Efforts will focus on patents that support the corporate strategy and key product patents, leveraging them to strengthen Compaq's position within industry standards bodies. Generating revenue from licensing opportunities, based on the current patent portfolio, and filing for general patents that may have significant commercial or licensing potential will continue.

During integration of the patent programs of Compaq, Tandem, and DIGITAL, DIGITAL inventors will continue to receive patent awards in accordance with DIGITAL Corporate Patent Award Policy V 5.1. ✳

web*sites*

http://www-server.mso.dec.com/ip/ip.htm.
DIGITAL Corporate Patent Program

http://www.digital.com/journal-record/
DIGITAL Journal of Record

Patent Awards

Thirty-eight patents, issued by the US Patent and Trademark Office, further enhanced the corporate intellectual property portfolio, now totaling more than 1,500 patents assigned to DIGITAL. Twenty-four inventors received cash awards from their supporting business units for these contributions and technical innovations.

Patent Award Recipients from Massachusetts and New Hampshire
Seated, from left: Don Drinkwater; Russ Myers; Vikas Sontakke; Mark Seger; Mahendra Patel, vice president and general manager, Industry Solutions Division; Dale Keck; Trudilyne Leone, and Keith Gutfreund. Back row, from the left: Bob Reed, Patent Award program manager; Bob Ulichney; Roger French; August Reinig; Don Smelser; Matt Benson; and Don Scott, NT and Alpha Design patent engineer. (Photo: D.Willett)

Patent Award Recipients from Colorado
From left: Susan Elkington and Ron McLean. Not present for the photo: Clark Lubbers.

Patent Award Recipients from California
From left: Mike Burrows, Sharon Perl, and Roy Levin

FY98 Recipients of the First Patent Application Award

Beginning in July 1997, the First Patent Application Award was instituted. This award recognizes individuals within DIGITAL who had filed their first patent application and is in addition to the normal patent application award.

In FY98, the following DIGITAL inventors received this award: Jennifer Anderson, Marco Annaratone, Brian L. Avery, Ken Bates, Steven K. Baum, Krishna Bharat, Lawrence S. Brakmo, Robert Burke, Edward Chang, Shiufun Cheung, Andrew D. Christian, John Clouser, Neil Cohen, Jeffrey Dean, Anthony Di Mauro, Timothy P. Dyer, Michael K. Ferris, Bruce Filgate, Paul P. Gehlert, Steven C. Glassman, David W. Goodwin, Edward M. Gould, Michael K. Gowan, Tracy L. Gustafson, Jerry J. Harrow, Rick Hennessy, James E. Hicks, Nickolas J. Howorth, Peter Hurley, Robert A. Iannucci, James D. Isaak, David R. Jefferson, Chris Joerg, Russell Jones, Gregory H. Jordan, Jaroslav Kadlec, Nitin Y. Karkhanis, James R. Kauffman, Mark Kelley, Richard Kessler, Fredrick G. Kleinsorge, Kathleen Knobe, L. Kontothanassis, Tom Kopec, Pattabheraman Krishna, Puneet Kumar, Edward K. Lee, Mark Lillibridge, Ginger Chun-Che Lin, Michael H. Maddix, Mark Matson, Eugene Mcnany, Sven E. Meier, John F. Mertz, Richard E. Mills, Brad Morgan, John Nerl, Rishiyur Nikhil, Andreas G. Nowatzyk, Young S. Oh, George A. Oliva, Davis Pan, Scott Pirdy, Umakishore Ramachandran, Carl Ramey, Robert R. Robuccio, Premanand Sakarda, Matthew Schnee, Madhumitra Sharma, Sarit Shvimmer, William Snaman, Dean Sovie, Glenn Trewitt, Nambiuur S. Vidyashanker, Robert A. Viveney, Dave Wagner, Brian J. Walker, John Wishart, Larry W. Woodman, Mark O. Yeager, and Tina Zou. ✱

Product Stewardship Tools

The Product Stewardship group regularly reviews available integration tools, as well as those under development, and recommends beneficial tools to product development and business people.

By Larry Nielsen, Product Stewardship Group; Environment, Health and Safety; Maynard, Massachusetts

larry.nielsen@digital.com


D. Willett

The Product Stewardship group. From left, Frank Rooney, George Yender, Larry Nielsen, Debra Hanggeli, and David Spengler. Not present for the photo: Lettemieke Mulder (Brussels) and Richard Merlot (Annecy, France).

It is increasingly important that developers address the concerns of customers by integrating product stewardship features into their products (see *Forefront,* Spring 1998, p. 26). To assist product developers with the integration task, there are a variety of tools—ranging from simple reference documents such as checklists and standards to complex schemes to measure the environmental impact of products.

Life Cycle Assessment Tools

In recent years, software tools have been developed which are aimed at engineers and managers who are responsible for integrating environment, health and safety (EH&S) features into products. These tools are based on the premise that EH&S impact must be considered for all phases of a product's life cycle, e.g., through raw materials extraction, manufacturing of components and finished product, packaging, distribution, use, service, reuse, and end-of-life disposition including recycling. As a result, tools based on a process called life cycle assessment (LCA) are of great interest.

As the name suggests, life cycle assessment is a process that compiles and evaluates material and energy inputs and outputs, and the potential environmental impacts of a product system throughout its life cycle. An LCA fundamentally involves three elements:

- life cycle inventory (LCI)
- impact analysis
- improvement analysis

Limitations and application of impact analysis and improvement analysis are still being debated, a major issue being how to equate different types of environmental impact. For example, does a pound of air pollution have the same impact as a pound of water pollution? If not, how does air pollution equate with water pollution? Although it too has limitations, LCI can be a useful tool to compare and evaluate alternative product designs or processes.

A major limitation in using LCI is the effort required to properly apply it. For products as complex as IT equipment, doing a comprehensive LCA would be very costly in bot money and time. Comprehensive LCI may be appropriate for some ultra-high-volume products, although it frequently cannot be justified. Therefore, so-called "abridged" or simplified LCI methodologies have been developed. Some accuracy is sacrificed to simplification, but these methodologies can often be applied successfully to get usable results. A range of software packages is available which vary in level of detail from abridged to highly detailed analyses.

Although LCA software applications continue to improve in usefulness, further refinements are needed before most will be truly cost-effective tools for the IT industry. A major problem is that databases do not yet contain simplified information for components typically found in IT products. Future development will result in LCA versions that will be more useful in evaluating IT products.

Regulations may eventually drive the use of LCA tools. A regulatory requirement that environmental claims be substantiated by LCA has been discussed, both in the US and in the European Union.

Determining When to Disassemble

The Product Stewardship Group currently uses a LCA software tool in the form of Design for the Environment (DfE) from Boothroyd Dewhurst, Inc. (BDI). This software is used within a product assessment process in conjunction with the DIGITAL Resource Recovery Centers. The product assessment process consists of:

- a disassembly analysis which provides an elapsed time to disassemble the product
- a "sorts" analysis which tallies end-of-life expenses and revenues associated with the components and materials in the product
- and recommendations for improvements to the design based on observations during disassembly

In new product development, designers have used this assessment process to identify areas for improvement on the earlier product. It also has been used to document improvements by evaluating the new generation of product. The reports created provide designers with a measurement of performance of their designs with respect to disassembly and recovery costs while suggesting possible areas for further improvement.

The DfE software has become the standard for determining time-to-disassemble within the product assessment process. It provides a fast and cost-effective means to compare different design alternatives. It also has helped reduce the need for product samples that can be destroyed in a disassembly trial, especially with new product prototypes which are typically scarce and expensive during development.

Measuring EH&S Product Content from a Business Perspective

Aside from software tools and the product assessment process, the Product Stewardship Group has developed a scoring system to evaluate EH&S features of a product from a business perspective. Now at a draft stage, we hope to refine it into a useful business tool. It consists of a two-page score sheet with points awarded first for an EH&S feature in a product, e.g., energy efficiency, upgradability, design for disassembly and recovery, and use of recycled materials. Points are also awarded for how well features are communicated to customers through various means such as Web sites, collateral, customer presentations, product advertising, and user guides. To get the maximum score of 100, a product must contain the features, and the features must be communicated to customers.

Using Standards and Checklists

Two other tools now available from the Product Stewardship Group are in the form of reference documents.

- DIGITAL Standard 208 (EL-00208-00), *Product Stewardship Life-Cycle Requirements* (See *Forefront*, Summer 1998, p. 23.)
- a condensed checklist of requirements based on Standard 208 is available on the Product Stewardship web site. Checklist categories include regulatory requirements, voluntary market requirements, and best practices.

Refer questions about the tools discussed above or product stewardship to Frank Rooney at DTN 223-7647. ✻

web*site*

http://www.aeo.dec.com/ehs/ps/
Product Stewardship Web page

Engineering Promotions

Many thanks for the text and photo contributions from the supervisors and colleagues of the engineers whose collaborative and individual achievements earned them these promotions.

Mark Kempf Promoted to Corporate Consulting Engineer

Mark Kempf has been promoted to corporate consulting engineer because of the outstanding contributions he has made during the last 19 years, which are inherent in many successful DIGITAL networking products. Mark clearly exemplifies the best in technical expertise, critical business sense, and leadership skills.

As a member of Systems Engineering, Mark is presently the technical director for the Networks Business Segment where he is valued for his technical expertise and his insight into business issues and their interrelationship with technology. He is a leading proponent and practitioner of "systems engineering" (i.e., designing a system, assuring that the various components perform well together, and delivering a result that is more than the sum of its parts).

Mark's recent work with Acxiom exemplifies his systems engineering contributions. At the request of Servers Engineering, Mark brokered an agreement between UNIX engineering and CustomSystems to test, deliver, and support the early deployment of MUNSA (SCSI multiple access) through Value Added Integration Services (VIS). He continued to enlist the efforts of the Enterprise Systems Lab to preconfigure and tune the Oracle database for the customer's application, while personally leading this effort in the lab. As a result, the multi-terabyte 8400 cluster delivered to Acxiom was installed and running 12 hours after arrival on their dock. Acxiom was so impressed that the story was featured in a recent *Wall Street Journal* article. Such involvement with customers produces feedback in terms of product requirements, which permit product development groups to better adapt our products to customer needs.

Mark's work spans many customer successes, including American Airlines (Sabre), Syncrude Canada, Ltd., and Korea Telecom. His work with the Networks Products group includes contributions to products such as the DECServer 100 and LANBridge 100. He was also the technical leader for the FDDI program.

Mark has been issued seven patents and has applied for five more. In addition, he has published several internal technical publications.

Steve Langdon Promoted to Corporate Consulting Engineer

Steve Langdon's promotion to corporate consulting engineer reflects his outstanding contributions to DIGITAL over the past 6 years as a consultant to major company accounts.

Since joining the company in 1992, Steve has been a key technical resource in creating and leading the Consulting and Architecture group, which consists exclusively of consulting engineers and senior consulting engineers. Through his active leadership, the group has completed a variety of high-profile customer engagements, including noteworthy successes in critical target markets across DIGITAL geographies. He excels in his role as leader of the Consulting and Architecture group because of consistent delivery of quality results.

In the Americas, a key example of a major partnership agreement that was made successful by Steve and his group is the MCI/NASDAQ Enterprise-Wide

Network systems integration program. In this agreement, DIGITAL acted as subcontractor to MCI to build and operate the nationwide network that connects traders from about 2000 sites to NASDAQ's central trading systems. With a follow-on agreement reached last December, this work can potentially bring over $110M to the company. As a result of this engagement, a significant amount of product requirements were forwarded to the product development organization.

British Telecom in the UK and Optus Communications in Australia have been recipients of Steve's technical and insightful consulting efforts over the past few years. Both companies have subsequently awarded DIGITAL significant contracts, including one between Operations Management Services and Optus which is expected to be signed this month.

Steve has consistently been a forceful advocate and practitioner of "systems thinking." He was recently a leader in designing the architecture of the DIGITAL solution set and was a central participant in the Corporate Telecommunications Task Force. Steve has a remarkable ability to earn the respect of senior management and the technical staff.

Before joining DIGITAL, Steve was a well-known and highly respected computer networking expert. At Control Data, he was the architect of a communications system deployed by many of the former AT&T Regional Bell Operating Companies. Later at Amdahl and then as director of architecture for 3COM, Steve played a central role in computer communications consortium and standards activities. He also served as an invited international expert for the United Nations Development Fund in evaluating proposed networking projects in nonindustrialized countries.

Randy Allmon Promoted to Senior Hardware Consulting Engineer

Randy Allmon's promotion acknowledges his work on Alpha microprocessors during the past 8 years and, in particular, his contributions to EV6. In 1994 he became co-implementation leader on EV6 and now is the technical leader for EV6 and EV67. Responsible for the physically, electrically, and timing-verified full chip design, he has contributed to the delivery of next-generation design verification tools and methodology.

Randy joined DIGITAL in 1981 to work on the V-11 project as a logic and circuit designer. In 1985, he joined the Rigel P-chip design team as the E-box leader and later implemented the vector interface on the Rigel VC chip. In 1988, he joined the Mariah MP chip as the overall project leader and, in 1990, became the physical implementation leader of the EV4 FBOX. Randy joined EV5 in 1991 as a co-implementation leader.

A member of the International VLSI Symposium Committee and Alpha's CAD Steering Committee, Randy has been awarded one patent, has co-authored nine papers, and has participated in several panel sessions at international conferences. Randy holds a BSEE from the University of Cincinnati.

Jean Basmaji Promoted to Senior Consulting Engineer

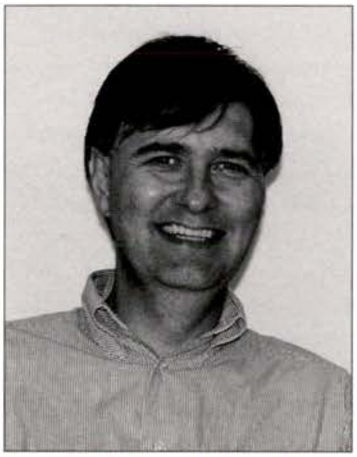
Jean Basmaji has been promoted to senior consulting engineer in recognition of his contributions to the AlphaServer Product Development (ASPD) group and in particular for his leadership in developing the CSALT ASIC technology.

For the past 7 years, Jean has been the technical leader, guiding the development of three generations of CSALT (CMOS standard-cell alternative) technology. CSALT technology provides a timing-driven layout methodology together with a correct-by-construction approach for managing the complex issues associated with state-of-the-art CMOS processes. The timing-driven layout is coupled with an automated standard-cell design approach to bring the complete design process to the logic designer.

The CSALT ASIC technology has been the cornerstone of products such as TurboLaser and Rawhide. It also forms the base technology used in the development of all DIGITAL EV6-based systems because it is the technology used by the GoldRush, Regatta, and WildFire family of servers and Monet, the workstation offering based on EV6.

Jean also has been the technical driver behind the CAD and design verification methodology used within ASPD. He contributed to ASPD design processes and CAD tools during VAX 6000 development when Jean was the CAD and verification project leader and extended through multiple generations of the VAX 6000, VAX 7000 platforms as well as the more recent TurboLaser and Rawhide systems.

Jean joined DIGITAL in 1977 after receiving his BSEE degree from the Lowell Technological Institute.



Frank Fox Promoted to Senior Hardware Consulting Engineer

Frank Fox's promotion to senior hardware consulting engineer acknowledges his accomplishments over the past 8 years in the area of high-performance microprocessor design.

Frank joined DIGITAL in 1984 to work on CVAX. He was the Ebox leader and later became the project leader for the CVAX Shrink. In 1987, he became co-implementation leader for NVAX and also the design driver for CMOS4 technology development. From 1991 through 1993, he was the NVAX+ and NV5 project manager, leader of the first multimedia AD effort, and a member of the leadership team of LCA4s. Since 1994, Frank led EV8, including influencing CMOS process development, promoting CAD development, consulting on design and methodology issues, and setting technical direction and establishing project challenges.

Currently Frank is a member of Alpha's University Advisory Board and the CAD Steering Committee. He has been awarded 2 patents and has co-authored 14 papers, including the one he was invited to submit for the Design Automation Conference in 1994. He has also been a participant in panel discussions at the Symposium on Low Power Electronics and Design, the IEEE Symposium on VLSI Circuits, and the IEEE Solid State Circuits Conference.

Frank holds a BS in electrical engineering from the University College Cork and a PhD in electrical engineering from Trinity College, Dublin.

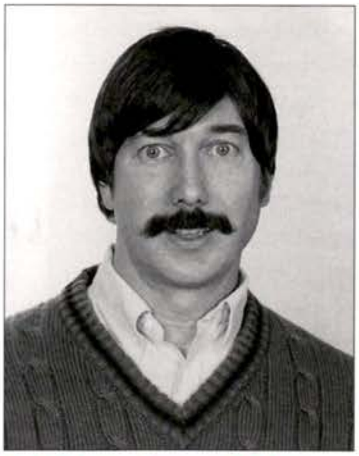
Jim Gettys Promoted to Senior Consulting Engineer

Jim Gettys has been promoted to senior consulting engineer on the basis of his important contributions in developing the HTTP 1.1 protocol. Jim has worked closely with the World Wide Web Consortium (W3C) to ensure that this new version of HTTP has industry-wide consensus.

Jim has spent a significant part of his DIGITAL career working closely with MIT researchers, first on Project Athena and later with the X Consortium, where he (along with Bob Scheifler) was the principal designer and developer of the X Window System. At the Systems Research Center in Palo Alto, Jim directed the DECstation 3100 software testing effort in which DIGITAL successfully shipped a UNIX product on a new architecture in less than 8 months. Moving on to the Cambridge Research Laboratory (CRL), he worked on AF, a network transparent audio server. Jim was responsible for the DIGITAL CRL Internet gateway, the second largest in the corporation. He was also involved in HTML and multimedia systems.

Widely recognized as a significant technical contributor to the ongoing development of the Internet, Jim was cited by *InfoWorld* magazine as Internet Plumber of the Year in its "Best of 1997" awards.

Jim joined DIGITAL as a principle software engineer and MIT visiting scientist in August 1984. He holds a BS in earth and planetary science from MIT.



Fred Glover Promoted to Senior Consulting Engineer

Fred Glover has been promoted to senior consulting engineer on the basis of his outstanding contributions to the company. Over the past 5 years, he has product strategy and provided outstanding technical leadership to the DIGITAL UNIX Cluster Program. Fred worked within the UNIX Engineering Community at Bell Labs and DIGITAL for approximately 18 years. He is well-respected within that community for his work with industry standards bodies and consortia such as the Internet Engineering Task Force, Posix, and the OSF. Fred has made significant contributions to the DIGITAL UNIX and ULTRIX products as a technical contributor, project leader, and project architect. He led projects in physical file systems, remote file systems, and general distributed computing.

Fred's contributions to DIGITAL UNIX clusters were based on his knowledge and expertise in file systems and distributed-computing technology. Since being promoted to consulting engineer in 1989, Fred has had a significant role in defining and evolving the DIGITAL UNIX Cluster Architecture and has been a key contributor in defining a leadership Cluster Program product rollout.

Fred has contributed technical leadership and product visioning to the Cluster Program from the initial A/D project through three generations of Clustering products. Beginning in 1990, Fred was the technical leader of an advanced development project building a highly available NFS file server, which was the basis of DIGITAL's first UNIX clustering product, the DECsafe Available Server.

Fred served as a core member of the engineering team that defined how the available Server product would evolve into a more complete Cluster product offering scalability and single system semantics. Fred co-authored the Wave 3 Architecture, and led a small team of engineers in the design of the distributed raw device service which is used in the TruCluster Production Product. Fred coauthored the Wave 4 Architecture, and led the engineering activities to develop the architectural requirements for the Cluster File System. Fred also coauthored papers describing DIGITAL's UNIX cluster architecture for the *Digital Technical Journal* and the IEEE COMPCON.

In addition to his contributions to products and strategy, Fred has helped to establish a sense of technical community within the UNIX Base Group by hosting a Friday afternoon technical seminar series.

Fred holds an MS degree in computer science from Ohio State University and has completed all of the course work needed for a PhD in computer science.

Joel McCormack Promoted to Senior Consulting Engineer

Joel McCormack's promotion to senior consulting engineer acknowledges 13 years of innovative research and development in fields such as graphics architecture and software. His most recent contributions have been in the design of graphics accelerators. Specifically, Joel was one of the architects of the Smart Frame Buffer, the Smart Frame Buffer Plus, and the Neon chips. He also rewrote and released x11perf, now universally used to measure X11 graphics and windowing performance. The Smart Frame Buffer chip boosted DIGITAL to the top of the workstation pack in 2D X11 performance. The Smart Frame Buffer Plus was designed to drive memory at much higher rates to achieve leadership in its market; in fact, its X11 performance was unsurpassed for several years and also offered an affordable 3D entry system.

Joel's most recent accomplishment is Neon, a single-chip graphics accelerator aimed at very-high-performance 3D processing. Neon is a very aggressive ASIC design, using 6.8 million transistors on a 300-square-millimeter die with 624 signal pins, and a target clock period of 10 nanoseconds. The chip has been taped out, and testing is taking place. Neon has the potential to deliver price/performance leadership across a wide range of workstation price points. This project involved people in the workstation graphics product group, the Systems Research Center, and the Western Research Laboratory, where Joel has worked for the past 10 years.

Joel holds three patents and has filed eight patent applications. During the past 8 years, he has coauthored five technical papers.

Joel holds BS and MS degrees in computer science from the University of California at San Diego.

Sharad Shah Promoted to Senior Consulting Engineer

Sharad Shah has been promoted to senior consulting engineer for his demonstrated expertise, innovation, and leadership in the area of semiconductor cooling and packaging. During the past 10 years, this work has resulted in the implementation of cooling designs for every chip designed by DIGITAL Semiconductor.

Specifically, this promotion is in recognition of his leadership role in defining power and packaging specifications for StrongARM chips and the successful selection and introduction of the miniBGA package style for later StrongARM devices.

StrongArm is a technology that DIGITAL Semiconductor developed. It combines the benefit of Alpha high-performance design methodology and merges this with low-power RISC architecture which DIGITAL licensed from Advanced RISC Machines (ARM). StrongARM is differentiated in the market by its exceptional performance at very low power.

Critical to the success of the StrongARM product strategy is Sharad's work on the battery technology, defining the maximum power specifications for StrongARM (SA110 and SA1100) products. The miniBGA package style was defined and introduced by Sharad to significantly reduce the package size by more than 50 percent from the original Thin Quad Flat Pack (TQFP) package format to meet customer size requirements. This new package style attracted other customers to StrongArm.

Sharad is also being recognized for his outstanding efforts in developing conventional cooling solutions for Alpha chips—most recently EV6 at 100+ watts and developing heat-sink attach methods for surface mount packages. Sharad is the expert and key person in developing and implementing cooling technology for all microprocessors (Rigel, Mariah, NVAX, and all Alpha chips from EV3 to EV6) in computer systems ranging from desktop PCs to high-end servers. He developed and implemented the separable heat-sink approach for the EV4 chip, which is still extensively being used for Alpha CPU cooling. The approach was developed for EV4, dissipating 25 watts, and Sharad has successfully extended it to EV5 at 60 watts and to EV6 at 100 watts. The industry today employs air-based cooling solutions at much lower power levels; extending air-cooling technology to this level has required careful interaction between Sharad and the design team. Sharad developed an innovative technique to predict and detect "hot spots" on the device. He was successful in conjunction with chip designers to distribute clock power to minimize hot spots, which made it possible to cool EV6 by conventional air-cooling technology.

Sharad joined DIGITAL in 1987 after working at both Honeywell and Sperry/Unisys on the development of cooling systems for military avionics and commercial computers.

Sharad received his BS in mechanical engineering in 1978 at Gujarat University in India and his MS in mechanical engineering in 1980 from the University of Minnesota, where he specialized in heat transfer and fluid mechanics.

Scott Baucom Promoted to Consulting Mechanical Engineer

Scott Baucom's promotion to consulting mechanical engineer was based on his packaging and thermal work on the DIGITAL HiNote Ultra PC lines, including the HiNote Ultra 2000, the first portable PC with a 14-inch screen and the thinnest portable PC of its generation. This product used the latest advances in thin-wall carbon-fiber enclosures, low-profile keyboards, and high-density connectors, and resulted in more than two dozen patent applications. In addition to his own contributions on the projects, Scott was responsible for directing the CAD, prototyping, and evaluation efforts of satellite design teams at Japanese and Korean development partners.

Prior to his work in the NT Systems Business Unit, Scott was a key contributor and team leader in the Electro-Mechanical Design Engineering Group, working on such varied projects as the AlphaServer 2100, AlphaServer 4000, Personal VAXstation 3100, VR315/316 15 inch chassis-less plastic monitors, and a line of award-winning office-ready minicomputer enclosures.

Scott holds a BSME from Rensselaer Polytechnic and has worked at DIGITAL since 1982.

Blaise Corcoran Promoted to Consulting Writer

Blaise Corcoran has been promoted to consulting writer in recognition of his significant achievements in networking documentation during his 12-year career with DIGITAL.

Blaise has been responsible for the technical content and strategic direction of the DIGITAL UNIX networking documentation for several years. This work included the development of the award-winning network administration manual, a book designed for experienced system and network administrators. He also created two new books—one covering the asynchronous transfer mode (ATM) subsystem and one supporting Internet Protocol Version 6.0 (IPv6). The ATM book is for experienced UNIX kernel programmers responsible for writing device drivers and kernel modules. IPv6 is a new network layer protocol and a major revision of the Internet architecture. Blaise's efforts on IPv6 helped DIGITAL deliver an early-adopter's kit and gain ground on competitors.

Blaise is a member of the DIGITAL UNIX Publications Architecture Committee, which meets regularly to address immediate documentation issues and to explore strategic future directions. Blaise's experience, expertise, and creativity serve him well in his role as a leader on this team.

Blaise joined DIGITAL in 1986 and worked in Nac Publications before joining DIGITAL UNIX in 1990. His books have received numerous awards from the Society of Technical Communications.

Mike Daniele Promoted to Software Consulting Engineer

Mike Daniele has been promoted to software consulting engineer on the basis of his outstanding contributions in the area of SNMP agent technology for DIGITAL UNIX and OpenVMS and for writing or contributing to several Internet Engineering Task Force (IETF) Requests for Comment (RFCs).

Mike led the effort to design and develop a new extensible SNMP subsystem (eSNMP) for DIGITAL UNIX. This included an MIB compiler, code generator, and runtime API library for MIB developers. The SNMP agent then became distributed and dynamically extensible, with the bulk of work done in the operating system's "master" agent, accessing MIB instrumentation in other processes. The master agent is a bilingual implementation of SNMPv1 and SNMPv2 (RFCs 1155, 1157, 1901-1908, 2089).

This subsystem was compatible with other de facto SNMP standards in the market, but met the unique requirements of DIGITAL UNIX and allowed a graceful migration for customers who had written to prior SNMP APIs. OpenVMS adopted eSNMP and shipped this as their standard SNMP solution, thus enabling DIGITAL UNIX and OpenVMS customers to share the same APIs and leverage SNMP development across both platforms.

Mike has also been a leader in the IETF SNMP working groups. He was technical leader and primary author of RFC 2257, which defines an architecture for extensible SNMP agents and a protocol for communication between their components. This provides true binary compatibility between multiple, independently developed agent components on a managed node. He is the author of two other RFCs, which define the MIBs for TCP and UDP over IPv6, and has contributed to several other SNMP-related RFCs.

Mike also made has contributed significantly to consulting with customers such as Oracle, Informix, British Telecom, and Barclays on SNMP integration and MIB design/implementation.

In addition, Mike is responsible for the Internet and host-related standard MIB instrumentation on DIGITAL UNIX, implementing RFCs 1231 (Tokenring), 1285 (FDDI), 2011 (IP), 2012 (TCP), 2013 (UDP), and 1514 (Host Resources).

Mike has worked at DIGITAL in network software development for 12 years. He's also worked on OVMS DECnet, the TCP/IP Access Module for DECmcc, and PBX management.

Mike holds a BS from the University of Massachusetts and an MS from the Illinois Institute of Technology.

Dipankar Deshmukh Promoted to Software Consulting Engineer

Dipankar (Dipu) Deshmukh's promotion to software consulting engineer acknowledges his contributions to the industry-leading Reliable Transaction Router (RTR) product. Dipu has been a member of the RTR engineering team for the past 10 years.

Dipu led the architectural design and implementation of key components of the RTR product, including configuration of virtual networks, self-repairing virtual circuits, distributed load balancing, router failover/recovery, quorum consensus algorithms, distributed lock management, and support for external transaction managers DECdtm, XA, and DTC.

The quorum-consensus and distributed lock-manager components, in particular, are crucial to correct functioning of RTR's unique shadow-server feature, in which transactions are replicated on multiple sites. It is essential that only one of the sites be permitted to autonomously proceed for any kind of network partition. The distributed quorum-consensus/lock-manager software ensures this in the event of any arbitrary sequence of network link failures and reconnections. This and the architectural design for interoperation with external transaction managers required high-level analytical skills, as well as a deep understanding of transaction processing and database fundamentals.

Dipu was also responsible for system architecture consulting on several highly successful RTR–based customer projects. These projects include the Indian Railways Passenger Reservation System, Citibank Global Consumer Banking Infrastructure, the Swedish Options Market "Click Trade" application which runs in multiple exchanges, and the Swiss Stock Exchange, which is probably the most advanced integrated trading/clearing system in operation worldwide.

Before joining DIGITAL in 1988, Dipu worked for 11 years in system software development at Brown Boveri in Switzerland, Kajaani Electronikka in Finland, and Televa Oy in Finland.

Dipu earned a BS in mathematics from Presidency College and an MS in applied mathematics from the University of Calcutta. He also studied computer science at the University of Helsinki.

John Dion Promoted to Consulting Engineer

John Dion has been promoted to consulting engineer for his outstanding contributions to DIGITAL's semiconductor packaging technology over the past 12 years. John is a visionary whose innovative, yet technically sound, ideas been incorporated into many of DIGITAL's shipped products.

John recently succeeded in completing more than three years of development of the assembly technology to attach a wire-bond attached capacitor chip (WACC) directly to an EV6 Alpha microprocessor chip. WACC improved EV6 noise-related performance immunity by providing microfarad-level decoupling to the microprocessor chip with extremely low series inductance. This was achieved, not only because the WACC's intrinsic inductance is itself very low, but also because John developed an assembly technology to attach the WACC directly on top of the EV6 microprocessor chip and to connect to it by hundreds of short wire bonds. No such technology for assembling chip-to-chip had previously existed in the industry. John applied his innovative concepts and persisted diligently to explore and optimize alternative technologies and materials sets.

John was a major contributor to packaging for the "Rigel" program, having developed an effective barrier metal scheme for gold bumps on aluminum metal pads which allowed tape automated bonding (TAB). John also contributed greatly to the high-performance tape package (HPTP) for "Pele," and he resolved die-attach issues on both Alpha EV45 and EV5.

John received an BS in chemical engineering from the University of Massachusetts in 1983, an MS in chemical engineering from Northeastern University in 1985, a degree in mechanical engineering from Northeastern in 1989, and a PhD in materials science (polymer physics) from Cornell in 1994. John is the recipient of four patents and has one patent pending. He is the author of four technical publications.

Brian Eberman Promoted to Consulting Engineer

Brian Eberman's promotion to consulting engineer acknowledges his contributions to multimedia indexing and, in particular, his leadership in the creation of AltaVista Media Search, a complete system for digitizing, indexing, searching, and delivering video and audio content over the World Wide Web. Brian is also being recognized for his contributions in the fields of robust speech recognition, digital signal processing, robotics, and virtual reality.

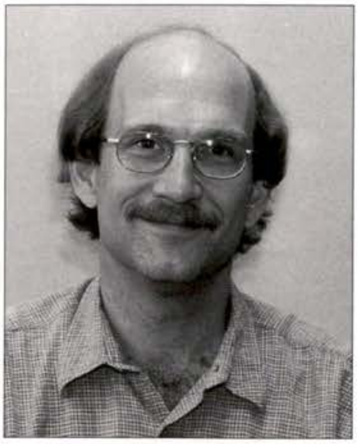
Brian led the AltaVista Media Search team that created the system and developed the overall system architecture. He was also a key contributor to the launch of a concurrent activity to develop and deliver AltaVista Media Search as a product from the UNIX organization. (An internal field test of AltaVista MediaSearch is currently available at http://mvista.crl.dec.com. The site delivers indexed access to various audio and video archives and broadcasts, including selections from National Public Radio, C-SPAN, WGBH, the DIGITAL archives, and the *Rapidly Changing Face of Computing* newsletter.)

Before joining the Cambridge Research Laboratory in 1995, Brian was technical leader at EXOS, Inc., where he developed force-feedback input technology for virtual reality systems. Brian was also a post-doctoral associate at MIT's Artificial Intelligence Laboratory, where he did research in robotics, pattern recognition, and virtual reality–based training applications. Brian has published 16 technical papers and has filed 10 patents on speech, robotics, and virtual-reality technology. He holds SB, SM, and PhD degrees from MIT.

Kevin Farlee Promoted to Consulting Software Engineer

Kevin Farlee has been promoted to consulting software engineer on the basis of contributions to Networker, in particular, a suite of backup/restore products. (DIGITAL sells Networker in partnership with Legato Systems, adding value to support DIGITAL UNIX and tape library devices.) Two years ago, Kevin identified a serious performance problem in Networker and implemented a solution that dramatically improved its performance and competitive stature. More recently, Kevin helped design and implement DIGITAL UNIX TruCluster support in Networker.

Kevin joined DIGITAL in 1986, working in Software Services supporting a number of customer accounts, including Boeing. In 1993, he transferred to the Storage group at the DECwest facility in Bellevue, Washington, where he has led the design and development of the Networker suite.



John Henning Promoted to Software Consulting Engineer

John Henning of the DPD Performance Group in Nashua, New Hampshire, has been promoted to software consulting engineer for his major contributions in leading the Alpha Performance SWAT team and his successful drive for SPEC CPU95 Alpha leadership.

Through SWAT, John pushed for the adoption of DIGITAL's McCalpin Streams benchmark as a standard measure of memory bandwidth. This contributed to the designers' doubling of memory bandwidth on Rawhide and further doubling for EV6.

A typical result of John's work is that in December 1997 DIGITAL held 9 of the top 10 SPECint95 results, 6 of the top 10 single-CPU SPECfp95 results, and all 10 multiple-CPU SPECfp95 results. (SPEC CPU95 is a worldwide standard for measuring and comparing computer performance across different hardware platforms.)

John came to DIGITAL in 1978 and has held engineering and management positions of increasing responsibility, working in Office Automation, DECwindows application performance, and Commercial Languages. He currently works in the Performance Core Technology Development team of the DPD Performance Group, where he is leading the effort to ensure top performance for EV6 Alpha systems in the upcoming SPEC CPU98 suite.

John holds a BA from the University of New Hampshire and has studied philosophy, including advanced logic, computability theory, and probability at the University of Colorado.

Chris Houghton Promoted to Consulting Engineer

Chris Houghton's promotion to hardware consulting engineer recognizes his contributions in high-performance electrical and physical design, most recently for delivering the EV6 packaging solution and wire-bond attached chip capacitor (WACC). The delivery of "The World's Best PGA" and the successful product application of WACC technology are key to maintaining Alpha's position as the industry's fastest microprocessor.

Chris also has consulted on several StrongARM projects on power supply and signal integrity, package modeling/simulation, pad-ring design, and advanced packaging options for future StrongARM chips. He consulted on the PCA5x family of microprocessors on phase-locked loop (PLL) supply noise simulations and supply filter design, and has served as chief technical interface to external vendors in selecting possible technologies for next-generation Alpha packaging, including evaluation of associated substrate and "near-chip" capacitor technologies. Chris consulted on all Bridge chip designs, including the DrawBridge and FootBridge products and their numerous signal integrity and package design issues.

Chris holds two patents in CMOS output driver design, with two patents pending in the area of power supply integrity and on-chip decoupling devices. He has coauthored four papers and recently served as a panelist at the 1998 Design Automation Conference to discuss "Taming noise in deep submicron digital ICs."

In 1985, Chris earned a BSEE from the University of Vermont and came to DIGITAL soon after.

Jim Jackson Promoted to Consulting Engineer

Jim Jackson's promotion to consulting engineer acknowledges his role as technical lead for the value-added (VA) portion of the Array Controller Software team for all StorageWorks controller projects. He has led or participated in technical discussions on many facets of the controller firmware, often extending beyond the VA portion of the code. He has implemented or enhanced software in many areas, an indication of his ability to understand and handle complex projects. He constantly strives to be a "big-picture" person, often finding and fixing problems in areas outside of his immediate responsibility.

Jim joined the Array Controllers Software team in 1988, first working on VAIL, a proprietary high-end storage subsystem. In 1991, Jim and a handful of other engineers developed a quick prototype called Ski Cooper, which demonstrated the viability of the concept of the HSJ controllers. This work contributed significantly to the funding and definition of FIB, the array controller program. HSJ30 and HSJ40 were delivered in June 1993; HSD30, HSD40, and HSZ40 in October 1994; HSZ20 in May 1995; HSJ50, HSD50, and HSZ50 in June 1996; HSZ70 in June 1997; HSG80 in December 1997; and HSZ80 in March 1998.

Jim earned a BSEE from MIT in 1980.

Mitch Lichtenberg Promoted to Software Consulting Engineer

Mitch Lichtenberg has been promoted to software consulting engineer on the basis of his leadership in developing PATHWORKS network transports and, more recently, in porting DCPI to Windows NT. Developed originally under Ultrix, DCPI produces kernel- and user-level instruction-level performance information with very little run-time overhead using interrupt-driven program counter sampling techniques. Among other contributions, Mitch solved the problem of mapping of process identifiers to program images, which is not a documented function in NT.

PATHWORKS is a suite of products that enables seamless integration of personal computers into the DIGITAL network architecture. From 1990 to 1996, Mitch was the network transport technical leader and Intel technology expert in the PATHWORKS group. He made several significant contributions to PATHWORKS, particularly the design and delivery of the "next generation transport" common codebase for the 32-bit Windows architectures, which enabled PATHWORKS for Windows 95 to ship on the first day that Microsoft shipped Windows 95.

A 12-year DIGITAL veteran, Mitch holds a BS in computer science from Worcester Polytechnic Institute. He cowrote a paper published in the *Digital Technical Journal* (winter 1992) and has applied for one US patent.

Shashi Mangalat Promoted to Software Consulting Engineer

Shashi Mangalat's promotion to software consulting engineer acknowledges his outstanding contributions over the past 6 years on behalf of the DIGITAL UNIX Engineering Group. His main contributions to the DIGITAL UNIX product have been in the area of virtual memory (VM) management where he is coarchitect.

In this role Shashi has conceived and implemented numerous enhancements to the DIGITAL UNIX VM subsystem. He was instrumental in delivering initial SMP support for DIGITAL UNIX and continues to deliver performance and functional enhancements that increase the scalability of the product. This work has contributed to DIGITAL UNIX's success in the VLM/VLDB and enterprise server markets. Shashi is currently the project leader for NUMA enhancements to the VM subsystem.

Shashi has applied for one patent and also has published several papers in the proceedings of various technical conferences. Prior to joining DIGITAL, Shashi worked in Encore Computer Corporation's Mach research and development group.

Shashi holds a BS in physics from Calicut University as well as a BS in computer science from the University of Oklahoma.

Jack McCann Promoted to Software Consulting Engineer

Jack McCann has been promoted to software consulting engineer on the basis of his outstanding contributions to the DIGITAL UNIX IPv6 early adopters kit (EAK), and to the Internet Engineering Task Force (IETF), where he co-authored the Path MTU for IPv6 standard.

Jack participated heavily in the IPv6 A/D activities at DIGITAL before taking on the IPv6 EAK project leader role. As part of the A/D activity, Jack was co-author of a *Digital Technical Journal* article titled "Internet Protocol version 6 and the DIGITAL UNIX implementation experience."

Leading a team of engineers, Jack converted the IPv6 A/D work into an EAK for DIGITAL UNIX, which has been installed by more than 100 DIGITAL UNIX customers. This EAK provides a vehicle for customers to begin using the IPv6 API and to run the IPv6 protocol while still supporting the IPv4 protocol in their environments. In addition to his project leader role, Jack developed several significant pieces of functionality. These included modifications to the kernel routing tables to support multiple routing table entries for the same address/net mask pair, implementation of the RIPng routing protocol for IPv6, and support for multiple network interfaces. Jack has led the effort to test the EAK at multiple IPv6 interoperability events at UNH, Interop, and Connectathon. The EAK source code is also the basis for the OpenVMS IPv6 product development.

Jack has also contributed significantly to the IETF, serving as lead author of the Path maximum transfer unit (Path MTU) for IPv6 RFC, which defines a mechanism by which nodes can discover the optimal packet size for a given destination.

Jack consulted on the design of Cluster Alias, for both IPv4 and IPv6, and has made significant contributions to BIND (the Internet name server) and TCP/IP performance.

A 10-year veteran of DIGITAL, he held various positions in DECnet/OSI for OpenVMS before joining the DIGITAL UNIX group. Jack holds a BS in computer science from the University of Lowell and an MS in computer science from Boston University.

Steve Neuner Promoted to Software Consulting Engineer

Steve Neuner has been promoted to software consulting engineer in recognition of his contributions as project and technical leader for the Logical Storage Manager (LSM) product, the on-line storage management facility in DIGITAL UNIX.

Steve's promotion acknowledges his contributions to the LSM and Prestoserve products for the V3.0, V3.2, V3.2C, and V4.0 releases as well as for his joint collaboration with VERITAS in producing VxVM V2.3. For the V3.* stream, the focus was robustness; for the V4.* stream, the focus was on increasing limits and improving scalability; for the VxVM 2.3 project, the focus was on improving portability. For each of these releases and projects, Steve was responsible for defining the LSM/Prestoserve release contents and for shaping the overall strategy. He also led the development with his own technical contributions and provided guidance and consulting on the designs and implementations of others.

Steve joined DIGITAL in 1994, coming from Sequent Systems where he had led the effort to define and deliver Sequent's first UNIX cluster product set for high-availability and Oracle parallel server environments. His responsibilities included fast recovery file system and volume manager products.

He holds a BS in computer science from California State Polytechnic University.

Marie Piantedosi Promoted to Consulting Information Designer

Marie Piantedosi's promotion to the position of consulting information designer is based on her contributions to the Worldwide On-Site Workbench (WOW) training program. As its lead instructional designer and developer, Marie designed and implemented a curriculum that successfully retrained more than 5,000 field engineers and resource controllers worldwide on new technology and its accompanying work process changes. Marie's training solution was a major force in ensuring the success and acceptance of the WOW rollout.

Recently, the American Society for Training and Development (ASTD) recognized the WOW training program with its Excellence in Practice Award as a "Best Proven Practice" in learning technology, learning organization, and change management. ASTD is the world's premier professional association in the field of workplace learning and performance.

Marie's areas of expertise include instructional and information design, electronic performance support systems, software design and development, course development, teaching, and electronic publishing.

Marie holds a master's degree in educational technology from Boston College and is a member of the Society for Women Engineers.

Ewaryst (Zigi) Polch Promoted to Hardware Consulting Engineer

Zigi Polch's promotion to hardware consulting engineer recognizes his many significant technical contributions to DIGITAL Storage products in the areas of mechanical engineering and applied mechanics. He has led Storage business technology development in the use of analytical methods and software tools for the design and analysis of hydrodynamic bearings, electromechanical devices, product enclosures, and tape and disk drive products. His analytical efforts have broadly covered several disciplines—shock and vibration, structural and solid mechanics, air-cooling fluid mechanics, acoustics, and numerical analysis. As a complement to his analytical consulting and development efforts, Zigi has been instrumental in developing test capabilities within the Storage business for shock and vibration, and acoustics. Zigi recently led the effort to design and build a large anechoic chamber in the Reliability Engineering Lab in Colorado Springs, Colorado. This chamber can test Storage products of any size and was completed for approximately 20 percent of the cost of a comparable commercial anechoic chamber.

Before the divestiture of DIGITAL's disk drive business to Quantum, Zigi had made significant technical contributions in solving "whirling mode" and other vibration problems in Storage's disk drives. He initiated the use of formal mathematical design optimization techniques. His work led to analytical methods that resolve design issues in hours or days instead of weeks or months. His hydrodynamic bearing analytical methods were some of the key technologies identified by Quantum in the divestiture.

More recently, Zigi has developed and provides consulting support for a wide range of test and design analysis capabilities for the StorageWorks product set. These capabilities have enabled most analytical and test work to be done on site with attendant savings in development time and expense.

Except for a year with Quantum, Zigi has worked at DIGITAL since 1987. He came to DIGITAL from the Southwest Research Institute in San Antonio, Texas, where he was a senior research analyst. Prior to that, he was a group leader at the TEKOMA research and development center in Warsaw, Poland.

Zigi has coauthored 5 patents (2 assigned and 3 pending). He has 23 technical publications, 5 of which are in peer-reviewed journals, and has served as reviewer for the ASME *Applied Mechanics Reviews* since 1984. Zigi holds an MS in applied mathematics and a PhD in engineering from the Warsaw Polytechnic Institute.

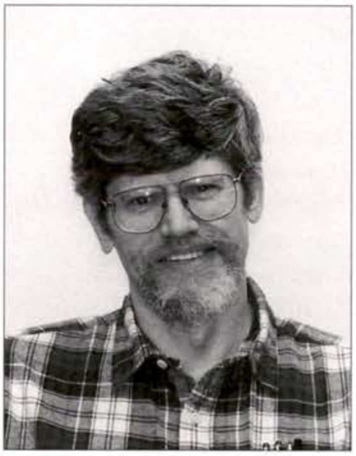
Yanick Pouffary Promoted to Consulting Engineer

Yanick Pouffary has been promoted to consulting engineer for her contributions in the areas of networking software and architecture including both the DECnet and TCP/IP services for OpenVMS products.

As transport technical leader in the area of DECnet for OpenVMS, Yanick led the design and implementation of DECnet and OSI transport protocol engines. She helped to identify the trend in the market away from OSI and the need for DECnet applications to continue to be supported in a network which supports only TCP/IP. She developed the architecture that allows the operation of DECnet applications over TCP/IP networks on all DIGITAL platforms: OpenVMS, DIGITAL UNIX and Windows 95 or Windows NT. To promote this architecture in the industry, she published a number of Internet drafts and standards on this subject. These include RFC1859 (an extension to the Internet Standard RFC1006 which describes the operation of DECnet over TCP/IP) and RFC2126 (which describes how to operate DECnet and OSI over TCP/IPv4 and IPv6), providing a complete migration path to TCP/IP.

In the area of TCP/IP for OpenVMS, Yanick led the investigation and design of the new IPv4 and IPv6 kernel. This work included the definition of a complete architectural specification describing the method by which the DIGITAL UNIX IPv4 and IPv6 kernel could be integrated into OpenVMS. She then led the work to port and adapt the DIGITAL UNIX IPv4 and IPv6 protocol stack for use in the TCP/IP services for OpenVMS product, and developed a process to allow IPv6 kernel code developed on OpenVMS to be returned to a common DIGITAL UNIX source pool.

After working for Codex and IBM for several years, Yanick joined DIGITAL in 1985. She is a graduate of the University of Nice, France, and holds an MS in computer science from the State University of New York, where she wrote her thesis on neural networks.



Del Ramey Promoted to Hardware Consulting Engineer

Del Ramey has been promoted to hardware consulting engineer in recognition of his outstanding contributions in CMOS/VLSI analog design technology.

As the corporation's resident analog design expert, Del is a recognized leader in state-of-the-art phase lock loop (PLL) and clock synthesis technology development; he has made many unique and valuable contributions to DIGITAL products. Attesting to Del's expertise is his delivery of "right-the-first-time" PLL clock synthesis systems and widely used on-chip power regulation schemes for four product families (cost-focused microprocessors, graphics chips, network chips and high-performance microprocessors) in different CMOS processes. Del's specific technical acumen, as well as his behind-the-scene contributions across the organization in CAD tool development, CMOS device modeling, and circuit simulation, were cited by several members of the DIGITAL consulting engineer community.

Del is a highly regarded mentor and serves as a key member of the Intellectual Property Committee. Del has filed two patents in the area of CPU PLL clock synthesis and analog design, authored one paper, and served as a regular reviewer of papers for several IEEE publications.

Del earned a BSEE in1971 and an MSEE in1972 from the University of Louisville and a PhD in electrical engineering with a concentration on integrated optics in 1980 from the University of Cincinnati. He joined Digital Equipment Corporation in 1980.

Gerry Reilly Promoted to Software Consulting Engineer

Gerry Reilly has been promoted to software consulting engineer in recognition of his contribution to the porting of IBM's CICS to the DIGITAL Alpha platform. He brings consultancy skills, commercial experience, breadth of technical knowledge, and the ability to deal with complex software problems to his current role as the technical director of the Software Partner Engineering group in Reading, UK. This group provides consultancy to the strategic ISVs being developed for DIGITAL platforms and collaborates in development projects with partners to incorporate new technology such as clusters integration and Web support. As technical director, Gerry has been responsible for driving DIGITAL's technical relationship with some of its main European software partners and ISVs, such as Dassault, Matra, IBM, ICL, GPT, ABB, and Smallworld.

Gerry was technical director of UNIX Production Systems Engineering in Reading during the migration of CICS to DIGITAL UNIX. He was part of the negotiation team, team leader and technical mentor, system architect, and the engineer responsible for all aspects of performance. After completion of the project, he resolved difficult customer satisfaction issues.

The migration provided several major technical challenges. The UNIX CICS products previously had been run on low-end, non-SMP, user-mode threaded, 32-bit systems. The CICS product is extremely complex, making heavy use of threads, DCE, SNA, and the XA database interface. All of these areas introduced platform dependencies, and two of the key areas that Gerry addressed were

- migration of the inherently 32-bit CICS environment to 64-bit DIGITAL UNIX, and

- creation of a new architecture for the threading and locking support in CICS in order to guarantee both correct and high-performance operation in a kernel-threaded SMP environment

Gerry is an active member of the British Computer Society, ACM, and the IEEE Computer Society. Before joining DIGITAL, he worked as an R&D engineer with Sony Broadcast & Communications and with Stewart Hughes, Ltd., as a software engineer. He joined DIGITAL in 1989 and, before joining UNIX Production Systems Engineering, worked for groups supporting ISVs who were porting their products to DIGITAL platforms.

Gerry received his BSc in physics and electronics from the University of London and his MSc in computer sciences from Brunel University.

Premanand Sakarda Promoted to Software Consulting Engineer

Premanand Sakarda has been promoted to software consulting engineer for his key role in developing new features in Windows NT 4.0 for portable computers. His leadership and work has been vital to DIGITAL's overall strategy for Windows NT.

Premanand came to DIGITAL in 1994 as senior firmware engineer. In this capacity, he designed and developed device drivers and firmware for DIGITAL Mobile Media for DIGITAL HiNote Ultra and Ultra II portable products. DIGITAL Mobile Media consisted of a CD-ROM device and an audio device connected through a PCMCIA controller. These dynamically loadable device drivers supported hot-docking and Plug-and-Play under all operating systems including Windows NT 4.0. Additionally, he developed drivers for different types of port replicators to support hot-docking, as well as simultaneous printing and network access. He worked with a DECwest team and Microsoft to develop Advanced Power Management and PCMCIA solutions under Windows NT 4.0.

Premanand has been instrumental in providing new features and functionality for the DIGITAL HiNote Ultra 2000 family of products. These features include dynamic hot-bay swap for all bay devices, dynamic recognition of PCMCIA/CARDBUS controller, and integrated Ethernet and modem devices behind a PCI/ISA bridge under Windows 95 and Windows NT 4.0. He led a cross-functional team to deliver the most comprehensive solutions in PCMCIA/CARDBUS, Advanced Power Management and Plug-and-Play–like features under Windows NT 4.0. Currently his team is designing and developing advanced features in the area of hot docking, Plug-and-Play, Bay Swap for CD-ROM, LS 120, IDE HDD, and DVD drive, and ACPI under Windows 98 and Windows NT 5.0 for portable computer systems.

Premanand holds an MS in engineering from the University of Maryland where he specialized in computer-controlled systems. He has coauthored several research papers and has two patents pending.

Margie Sherlock Promoted to Consulting Technical Writer

Margie Sherlock's promotion to consulting technical writer recognizes her outstanding contributions to OpenVMS projects, especially her leadership on the OpenVMS 64-bit addressing and OpenVMS Alpha device driver projects. On these projects, she has been instrumental in providing the information that internal groups, ISVs, and customers need to adopt OpenVMS Alpha technology. Margie developed innovative methods to provide early technical information about the OpenVMS 64-bit solution that enabled layered products and applications to migrate quickly to a 64-bit architecture. She helped develop a cohesive engineering design specification from which presentations and papers could be derived quickly, and she began delivering documents to layered-product groups and selected customers well before internal field test began. Her book *OpenVMS Alpha Guide to Upgrading Privileged-Code Applications* provides information and suggestions that are unusually helpful in easing the migration of privileged-code applications.

Margie also provided a series of documents for OpenVMS device driver programmers, culminating in a book published by Digital Press, *Writing OpenVMS Alpha Device Drivers in C.* The information in this book helps device driver programmers connect both DIGITAL and non-DIGITAL devices to an Alpha processor, thus broadening the customer base. Her unusually informative and helpful communications with customers and support organizations has helped win new OpenVMS sales.

Margie has spent the last 12 of her 18-year career in technical publications at DIGITAL, and she has documented many components of the OpenVMS VAX and Alpha operating systems. Most recently she made major contributions to the development of the OpenVMS Galaxy Software Architecture and to the communication of this strategy to customers. She is also the author of an earlier book published by Digital Press, *Using DECwindows Motif for OpenVMS,* and has won several awards from the Society for Technical Communications. She holds a BA in English from Marywood University.

Karla Sorenson Promoted to Consulting Technical Writer

Karla Sorenson, a principal technical writer in the UNIX Systems Group (USG) Publications, has been promoted to consulting technical writer. This promotion acknowledges her outstanding work on the award-winning manual *Guide to the DECsafe Available Server* and her excellent leadership in the planning, design, and writing of the system configuration and tuning documentation.

Karla came to DIGITAL 12 years ago and started writing documentation for the RSX-11M products. She had been the project leader and the sole writer for the DECsafe Available Server product. DECsafe Available Server is a hardware/software product that provides high availability and failover services on DIGITAL UNIX systems. She worked closely with the engineers and field personnel in setting up Available Server Environment (ASE) systems, gaining firsthand knowledge of problems customers might encounter when setting up hardware and software.

Well into the development of the ASE product, packaging plans changed, and DECsafe was to become part of USG's first complementary products CD. As a result, Karla produced an online installation guide and release notes, something USG Publications had not done previously. She did this following the release engineering requirements for the CD, without impacting her original milestones and schedule. As Karla moved onto other products, she mentored other ASE writers. She continues to serve today as a primary reviewer of ASE documentation.

Karla is currently working on a new manual, *System Configuration and Tuning*. This new manual was conceived as a way to provide DIGITAL UNIX configuration and tuning information to a wide audience under a single cover. DIGITAL sales personnel, service organizations, engineers, and both novice and experienced customers (especially system administrators and programmers) expressed the need for this information. Because DIGITAL UNIX V5.0 (Steel) would not be ready for delivery for some time, and based on the urgency of customers' requirements for tuning information, Karla decided to make the manual available sooner with a minor release of DIGITAL UNIX. To both lead the project and write this manual required that Karla gather information from a wide variety of sources and different organizations, examine benchmarks, and review various specs and sales documents. Despite these technical and logistical challenges, she completed the manual ahead of schedule.

Subsequently, Karla was selected to accompany a consulting engineer, on a visit to T-Mobil in Germany, an important DIGITAL customer in the telecommunications industry. T-Mobil was experiencing problems with system tuning. Karla's presentation and her documentation enabled T-Mobil to solve many of the company's problems.

Karla holds a Bachelor of Arts in English from the University of Lowell and a Master of Liberal Arts in English and American Literature and Language from Harvard University.

Rebecca Stamm Promoted to Consulting Hardware Engineer

Rebecca Stamm has been promoted to consulting hardware engineer for her work as an architect and logic designer during 15 years with DIGITAL as well as for her key work on the design of five generations of DIGITAL microprocessors. These include the DIGITAL Dataflow project; Rigel, a VAX design in 1.5-micron CMOS; MicroPRISM, a RISC processor that was a precursor Alpha; and NVAX, a macro-pipelined VAX microprocessor EV6, as an Mbox architect.

Currently, Rebecca is developing simultaneous multithreading as a general technique for increasing system performance, and designing the architecture for its implementation in EV8.

Rebecca holds a degree in history from Swarthmore College and a degree in electrical engineering from MIT. She holds 10 patents in computer design and has written several papers including some recent pioneering ones on SMT.

Graham Swift Promoted to Manufacturing Consulting Engineer

Graham Swift's promotion to manufacturing consulting engineer acknowledges his long history of contributions in areas of process development and the application of statistical methods in manufacturing. Graham has developed both the Unified Data Collection methodology and the Module Manufacturing Process Control and Certification programs for manufacturing. These methods have enabled Module Manufacturing to achieve worldwide benchmark quality levels and world-class cost competitiveness.

Graham's most noteworthy accomplishments over the past few years were in the development and implementation of performance enhancement principles and methodologies in volume manufacturing. He created DIGITAL's manufacturing standard for defect recognition and identification, including measurement, categorization, and calculation of performance which is documented as the UDC manual or ELMF-804 series. Graham directed a large number of quality and process engineers worldwide to develop this architecture and drive the implementation of these methods. Graham's more recent accomplishment was the creation and implementation of the Module Manufacturing process control and certification program. This work included the identification and specification of critical equipment variables that control the process performance proactively. It also included the design and development of software to manage the certification methodology, which includes the procedure, and statistical calculations to measure the Capability of the SMT process in Cp and Cpk.

Graham has been at DIGITAL for 18 years. He earned a BS in electrical engineering from the Portsmouth University in the UK and continues to advise the University of Tennessee in its enhancements of Statistical Process Control Management development programs.

Michael Tsuk Promoted to Hardware Consulting Engineer

Michael Tsuk has been promoted to hardware consulting engineer. Michael's promotion was based on his outstanding contributions to the company over the past 8 years and in particular for Michael's recent achievements on the TurboLaser, Rawhide, and Alpha microprocessor programs. Major accomplishments included putting Signal Integrity Modeling Parameter Estimation Tool (SIMPEST) at the forefront of signal integrity tool technology and his contributions to the Server Product Development program, enabling these products to become top performers in the industry.

Michael developed the SIMPEST into an industry leading CAD tool, which can solve increasingly complex problems. In addition to providing software used in product design, he has consulted with TurboLaser, Rawhide and Wildfire teams on the use of SIMPEST as well as on general signal integrity issues.

Michael is a recognized expert in the areas of signal integrity and electromagnetics. He has published more than 20 technical papers.

Michael holds BSEE, MSEE and PhD degrees in electrical engineering and computer science from MIT.

Alan Zavalick has been promoted to Software Consulting Engineer

Alan Zavalick's promotion to software consulting engineer acknowledges his outstanding contributions to the company over the past 13 years, and, in particular, his leadership of the development team that is designing the architecture and delivering the Worldwide On-site Workbench (WOW). WOW is a highly complex mobile-computing solution which encompasses a variety of technologies, resulting in a platform that is a true service differentiator and has had a tremendous beneficial impact on business. Its deployment is key to improving efficiencies of on-site service delivery within Multivendor Customer Services (MCS). At this time, approximately 3,000 field engineers and 125 resource controllers in 15 countries are using WOW as an integral part of the MCS on-site service delivery operations.

Prior to the WOW project, Alan contributed greatly to a variety of projects or products such as System Health Check/PATHWORKS, several systems and network configuration tools, and DECmcc TCP/IP Fault Diagnosis Assistant Performance Analyzer.

Alan earned a BA from the University of Massachusetts in 1978. ✳

Integrating Part Numbers in the New Compaq Environment

Part identification across disparate systems presents challenges for the integration process.

By June Davenport, Chief Engineer's Office/DIGITAL Part Identification Domain, Littleton, Massachusetts

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A position statement jointly issued by Compaq and DIGITAL through the DIGITAL Reader's Choice service on July 9 outlined some issues related to integration. Part number integration will likely occur in three phases:

- **Phase 1.** All processes and disciplines relevant to part numbering will remain intact in the short term to ensure that dependent processes are not compromised.
- **Phase 2.** Certain applications will be identified and enhanced in order to support both DIGITAL and Compaq part numbers without loss of integrity. A cross-reference will be maintained to ensure synergy with other necessary systems and requirements.
- **Phase 3.** A new part numbering structure will be created to support the fully integrated Compaq environment.

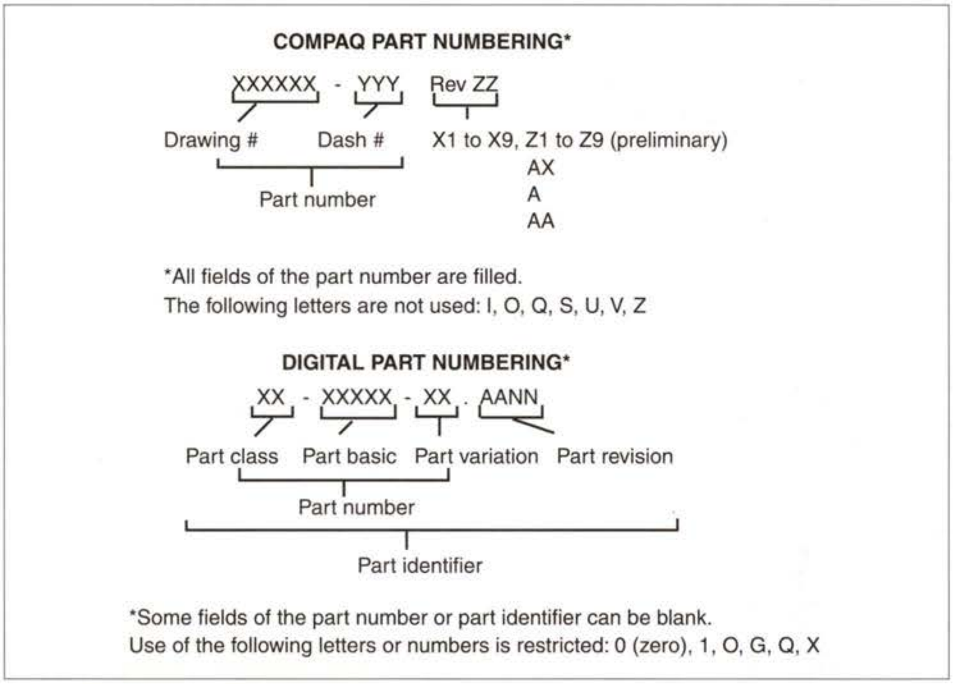

Figure. Compaq and DIGITAL part-number identification structures

Purpose of Part Numbers

Part numbers underlie the engineering discipline and the basic engineering processes of documentation and bills of materials (BOM). Part numbers are the transport mechanism for most part- and product-related information. They support design, purchasing, planning, manufacturing, ordering, sales fulfillment, invoicing, and servicing. Regulatory and worldwide trade requirements, duty and duty drawback, and revenue recognition also rely on part numbers.

The structure of part numbers is not arbitrary. It has evolved on the basis of specific engineering and process requirements. Thus, changes in the part numbering structure have a significant ripple effect throughout the functions and disciplines that depend on part numbers.

In mid-June, representatives of the DIGITAL Part Identification Domain met with their Compaq counterparts to begin the integration work. Areas requiring analysis and consideration are outlined below along with an overview of the Compaq and DIGITAL part-identification models. As part-numbering integration proceeds, comments, suggestions, and—most importantly—descriptions of your detailed requirements are welcomed.

Comparing Part Numbering Models

Compaq part numbering uses a 6-3 format (see Figure). The six digits represent a drawing and the three digits, called a dash number, represent varia-

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June Davenport is Part Identification Domain manager. DTN 226-6485.

tions of drawings. The six-character portion may be alphanumeric, but is generally numeric.

The revision indicator is a separate two-character field which denotes design status. If the revision portion begins with X or Z, it is under Engineering control and is unreleased. An alpha character, such as +X, means that the number is at the pre-release stage, and the drawing is under ECN (Engineering Change) control (i.e., it still requires signatures, etc.). Nothing can ship in the pre-release state. When one character appears in a two-character field, it is right-justified and space-filled.

The revision designation of the part is inherited from the drawing number; the revision of the part is actually the drawing revision. Thus, in the SAP system, all base numbers are assigned the same revision number. Only printed-circuit boards are built to revision. Compaq sells repaired boards only as spare parts; the board is marked with the revision. When a drawing is revised, the part also is revised. Compaq does not inventory by revision.

Compaq buys and sells under the same part number; vendor part numbers are not used. All parts must use Compaq part numbers. Although the part number model is based on drawing numbers, drawings often do not actually exist. Instead "virtual" drawing numbers are assigned.

DIGITAL uses a 2-5-2 part number. The first two characters are the part class, which is used both as a commodity code and to create broad product classification types and to build relationships between parts. The part class is used to manage distributed part number assignment authorizations. The DIGITAL drawing number format differs from the part numbering format; the former contains codes that convey additional information specific to drawings and documentation, such as media/drawing size or the type of documentation. The revision indicator is placed in a separate field from the drawing number.

Integration Issues

Some of the issues that will have to be addressed during integration work.

1. Differences in part-number identification models (Figure).
2. The impact of the Engineering Change Order process on drawing identifiers, part numbers and part identifiers, the revision of part numbers, and the effect on higher-level assemblies. DIGITAL drawings can be revised independently from parts.
3. Use of part numbers in purchasing. Compaq purchases and sells using the same part number; DIGITAL generally purchases under one part number and sells under a different part number. When a single part number is used, the saleable part number is used for both purchasing and selling. Neither Compaq nor DIGITAL use vendor part numbers.
4. Resolving differences in the part-numbering systems used by DIGITAL, Compaq, and Tandem. Part numbers in each model represent different things.
5. Accommodation of requirements for short manufacturing cycles, such as those characteristic of Compaq's commodity PC business, as well as those of high-end environments characteristic of some DIGITAL (and Tandem) products. A server BOM, for example, is much more complex, has a large number of documents, etc.
6. Handling of regulatory submissions.
7. Requirements for part-numbering revision management in the Manufacturing and Services operations. DIGITAL's part revision structure was driven by Manufacturing and Services requirements based on the complexity of the products and the interdependence of product revisions in enterprise installations.
8. Translation of differing part-identification models into material within the SAP environment.
9. Handling of DIGITAL software revisions. The use of numeric revision (.0001, .0002, etc.) with an eight-character version number as a separate field in the SAP environment has been proposed.
10. Impact of current part-identification models and proposed changes on productivity tools within each entity.
11. Impact on and accommodation to application utilities and requirements outside the SAP environment.
12. Adequate support of the "configure-to-order" (CTO) environment.
13. Ability to leverage common parts for high-volume purchasing.
14. Inclusion of Tandem part numbers in the evaluation.

As integration proceeds, we encourage your comments and participation in this challenging work. ✱

Standards: Reliability and Validity

Standards in the manufacture of computer products are, in fact, the differentiating factors that ensure the validity of a customer's selection of our products.

By Eric Falkof, Standards and Methods Control, Littleton, Massachusetts

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D. Willett

Members of Standards and Methods Control. From left, Dennis Nyhagen, Margaret March, Seth Anderson, Sylvia Lundberg, Gloria Chao, Eric Falkof, Donna Fougere, Chip McConney, Eleanor Jacobi, Jim Boice, Jan Litchfield, and Maureen Bishop-Elfring. Not present for the photo: Eric Williams, Charles Abernethy, and Georgia Ireland.

How do you know when you can compare similar items and trust the results of your study? This is a question statisticians have grappled with especially in the 1920s and 1930s when standardized testing became the vogue.

To prepare for a possible war, the Department of Defense commissioned the US Labor Department to develop a test to identify individuals and the jobs for which they were most well-suited. The General Aptitude Test Battery (GATB) was developed and thousands of men were subjected to the test, which consisted of paper-and-pencil tests to show intellectual ability and wooden-block manipulation tests to demonstrate manual dexterity skill. The final results of the test battery produced a profile of the person. These profiles were matched to similar profiles of persons already performing well in existing jobs, and the person (that is, Army inductee) was placed in the military job that had a matching profile. The reasoning was that a person whose GATB profile matched the profile of successful performers would also perform successfully on the job. Thousands of young men were placed in jobs quickly and efficiently, based on the results of the test. No one questioned the method or the results because of the immediate need and the trust in the scientific method used to develop and administer the test.

Shortly after World War II, many young US veterans and high school graduates applied for college admission. The Educational Testing Service and the College Entrance Examination Board developed a test to assess the intellectual ability of students with a paper-and-pencil test called the Standardized Aptitude Test (SAT). Although it was supposed to measure aptitude, the ability to predict the level of eventual attainment, more recent research has shown that it was merely a test of current accomplishment. Detractors claimed the test was not an intelligence test, but an ability test that measured only what had already been learned. Some people claimed the results were biased on the basis of sex, race, and other factors. However, there was no question that the results were reproducible for each person; that is, the same person produced similar results consistently.

The GATB was validated by testing thousands of persons on the job and the results were used to place people in jobs. The test was still widely used into the 1970s for classification of jobs and people in each of the states' labor departments. Although the results were reproducible and performers in the jobs also produced similar profiles, the test was considered to be reliable: it was reliably producing the same results for what it tested. Singularly, the SAT (not the current SAT I and SAT II tests) also produced reliable results and was used for college admissions and placement for years. But were these tests valid; that is, were they true measures of what they purported to measure?

Reliability and Validity Are Not the Same

Reliability and validity are important considerations in standardized testing, and these concepts are equally important for manufacturing in the computer industry.

Reliability of a manufacturing process requires that the conditions surrounding manufacture must be reliable. Substitute the word "repeatability" for "reliability" and you can see that both refer to consistency of results. A baker, for example, cannot bake bread consistently if the dough is made with different grades of flour or kneaded to a different texture. Computers cannot be built with consistency if the electrical components are of varying quality. Nor can they be built if different methods are used on different assembly lines.

Validity is verified in the testing industry by determining the valid constructs that identify or typify a concept, and the proof that it is actually a factor being assessed. Intelligence is assessed *indirectly* with validity by observing performance of a task that requires a demonstration of the ability being assessed. For example, mathematic ability is assessed with validity by successful computation of equations. The degree of validity becomes obscured, however, as the degree of difficulty of the equations changes.

With standards, reliability is ensured—that is, the results are repeatable—and the users of such products can be assured that the product meets a specified level of performance.

For computers, validity is measured by the ability of the manufactured product to perform the tasks required. Although you can reliably drive a nail into a block of wood with a computer keyboard, it is not a valid use of the device. The keyboard's valid use is to enter data into a computer!

Ensuring Reliability in the Computer Industry

Reliability in the computer industry (as in any other) is ensured when the factors surrounding the manufacturing steps are kept constant. This means that the input materials and the process are consistently the same. In this way, the end result should be predictable. When requirements for raw materials are defined according to criteria that a supplier must satisfy, the input factors have met the requirements for reliability. When requirements for the manufacturing process are defined according to criteria that the plant personnel and equipment must satisfy, the process also can be considered reliable. The requirements for each, if defined as an operational requirement, must be available as standards for performance.

Still Valid Today?

The Cooperative Test Service in 1947 published the Cooperative General Culture Test to assess the degree of acculturation and "citizenship" of a person. Using questions such as the following, the results were repeatable for each individual and therefore the reliability of the test was assured!

"Question 3. In which of the following is censorship most strict? Books, magazines, newspapers, plays, or radio."

"Question 68. In the United States, which of the following occupational groups contains the largest number of gainfully employed persons? Domestic service workers, farmers and farm laborers, craftsmen, clerical workers, professional and semi-professional workers."

Were these questions valid 51 years ago? And are they valid today?

Fortunately, computer products built according to standards are not subject to question and their performance can be measured against standards over time. ✳

All affected parties (for example, suppliers, purchasing agents, incoming inspectors, machine operators, assembly operators, and quality assurance personnel) are subject to standards of performance below which that performance is considered unacceptable and the part or assembly subject to rejection. With standards, reliability is ensured—that is, the results are repeatable—and the users of such products can be assured that the product meets a specified level of performance.

Ensuring Validity in the Computer Industry

Validity for computers is more difficult to assess. Validity would seem to involve whether the computer is the correct tool to use; but in fact, the more relevant question is whether the computer at hand is the correct computer to use. The computer system that meets the test of validity is the one that meets the customer's needs at that moment for the task to be performed.

Again, standards that define performance in terms of CPU cycles or color rendition or bus speed are measures of validity, since they define the ability to satisfy the task at hand. If, for example, the requirement is data throughput, the computer system that meets the requirement for speed is a valid choice. If the standard for that performance is stated prior to manufacture, the computer can be designed to satisfy the requirement. If the standard is known to the customer, the customer can select knowing that the choice is valid. Preexisting standards also define validity in the computer industry by defining the results of the design and manufacturing process.

Standards to Ensure Reliability and Validity

Standards are the essential elements for both reliability and validity. When standards exist, processes are controlled from initial design through delivery to the customer. Some might also add that standards are required even before the initial design, since regulatory agencies debate the merits of new standards for future products. Standards in ability and intelligence measurements can be assessed for reliability; standards in the computer industry also ensure reliability. However, as the debate over the validity of the testing industry continues to be waged, standards in the manufacture of computer products are differentiating factors that ensure the validity of the customers' selection of our products. ✳

Some might also add that standards are required even before the initial design as regulatory agencies debate the merits of new standards for future products.

CCS Team Works Magic for Year 2000 Internal Readiness Program

The Americas Computing and Connectivity Services Y2K team has devised the system configurations necessary to ensure that the corporate Internal Readiness Program meets its Y2K goals.

By Joe Quigley, Information Services Year 2000 Program, Maynard, Massachusetts

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D. Willett

Members of the Year 2000 Test Lab team. From left: Brian Clendenin, John Donahue, Lou Baccari, Gerry Reidy, and Bob Naismith. Not present for the photo: Chris Morning and Jack Craunakis.

In July, US President Bill Clinton held a special news conference to address the Year 2000 problem. His message was clear: Wake up! The Year 2000 issue is *real*! While much of the world may be lagging behind in dealing with this problem, the Y2K Internal Readiness team is on target ensuring that no disruptions will occur in Compaq's business operations because of Year 2000 date issues.

A major reason for the corporation's success is the state-of-the art remediation and testing environment created by the Americas Computing and Connectivity Services (CCS) team in support of the Y2K program.

The Information Services Y2K Program relies heavily on sites known as Centers of Expertise (CoE), which specialize in assessment and conversion work. The Americas CoE is located in Maynard, Massachusetts, where the CCS team has outfitted a lab with the systems to handle any possible scenario.

To appreciate the complexity of the CCS lab setup, let's consider the DIGITAL Order Administration System, which consists of over 40 applications. Order Administration enables the company to receive and process equipment orders from customers. If a Year 2000 problem were to cause the system to fail, business and the company's revenue stream would be seriously disrupted. To prevent Y2K problems, the code for the entire Order Administration System was submitted to the Y2K program, where it is being assessed, fixed, and tested.

The CCS Lab

The Y2K CCS team constructed a lab consisting of two sets of computer systems: one set for remediation and the other for testing. When an application enters the Y2K program, it is first placed on a development system so a team of Y2K experts can check for and fix any date problems, then do unit testing. When this stage is complete, the application moves to the testing environment where the CCS team faces its biggest challenge.

The testing environment consists of eight computer systems, each capable of mirroring a real-life production setup. In the case of Order Administration, CCS had to create a scenario that allowed more than 40 applications to be accurately tested. As for any group of applications, this is a complex task and can take up to 6 weeks. To achieve the desired turnaround time requires meticulous planning; building of the test environments must start long before the actual testing begins.

The CCS testing environment consists of eight computer systems, each capable of mirroring a real-life production setup.

Bob Naismith, Y2K geography manager for the Americas and Latin America, has high praise for the CCS team: "They have done a great job building an environment that allows us to operate at full speed on a 7×24 basis. Our Y2K team in India must be able to access these resources during these extended hours."

Additional complexities arise before testing of an application begins. The CCS team must decide whether to build the applications on an existing machine or to clone the entire production environment. To accurately replicate an environment, each test system must be named the same as the actual production system and must exist separately behind a firewall as an entity separate from the corporate network

The success of the Y2K Internal Readiness Program continues to depend on sophisticated and timely system and network solutions like those described. The Y2K Americas CCS team is doing its part by creating the seamless infrastructure necessary for this worldwide effort. ✳

web *site*

http://y2k00001.pko.dec.com/isyear2000/
Global Information Services Year 2000 Program Web site

Compaq and DIGITAL: Internal Readiness Programs Integrated

The Compaq and DIGITAL Y2K Internal Readiness programs have been integrated under the leadership of Dick Scarborough, vice president, Information Services Year 2000 Program. Besides examining and correcting (when necessary) over 100 million lines of code worldwide, the Y2K program is executing verification processes for:

- third-party software
- desktop systems
- telecommunication systems
- building infrastructure
- automated manufacturing systems
- electronic data interchange (EDI) with trading partners

"Integrating the two Y2K programs took some planning, but we have not slowed down our conversion efforts one bit," Scarborough stated. "We continue to aggressively seek out and solve any Y2K issues that could pose a problem for the company." ✳

Compaq Sponsors INET '98

Sponsorship of INET '98

Compaq's prominence at the Internet Networking '98 conference was intended to

- Convey a clear sense of Compaq's continued commitment to the Internet and influential standards bodies such as the Internet Engineering Task Force, the World Wide Web Consortium, and the Internet Society
- Promote Compaq's innovative, Internet technologies
- Leverage future business by building relationships with contacts from developing countries which are planning and deploying their Internet-based infrastructures
- Strengthen Compaq's credibility within the global Internet community ✳

By Jonathan Baer, ISP Business Group, Marlborough, Massachusetts

Compaq affirmed its commitment to the promotion and development of the Internet at the Internet Networking '98 (INET '98) conference, the annual conference of the Internet Society, held in Geneva, July 20–23. Compaq, a principal sponsor of INET '98, is a founding member of the Internet Society, an international policy and governing board dedicated to promoting global cooperation and coordination for the Internet.

The event attracted approximately 2,500 of the Internet's most influential technology, policy, and academic leaders. As a principal sponsor, Compaq hosted more than 200 members of the international press corps and supplied the PCs for the pressroom.

The Compaq booth was the hit of the show. At times, visitors stood 20 deep waiting to speak with the booth staff. Extra collateral had to be shipped to the booth from the UK office to accommodate the close to 1,000 people who stopped by the booth. The booth highlighted the new "Q" campaign and its related messages. The booth included the following demonstrations:

- AltaVista Search (highlighting its language translation capabilities) and AltaVista Search Intranet
- a rack-mounted AlphaServer showcasing the High Availability Clustered Solution which runs on Digital UNIX and provides maximum uptime for mission-critical Internet applications
- the High Availability Internet Security Solution which runs on Digital UNIX or Windows NT and includes the AltaVista Firewall and Tunnel software

Previously unknown ISPs hailing from Croatia, Mongolia, Cameroon, Ghana, and Switzerland stopped by the booth to introduce themselves to Compaq staffers. ✳

The COMPAQ booth at INET '98. From left, Mark Conway, Wai Lee, Ethel Kaiden (Corporate ISP press/analyst relations), Thomas Dieuleveut and Jan-Michel Guiral (CS Annecy, France), John Hurd, and Jon Baer (Corporate ISP Team).

Digital Technical Journal Preview

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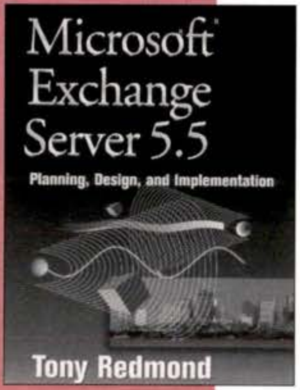
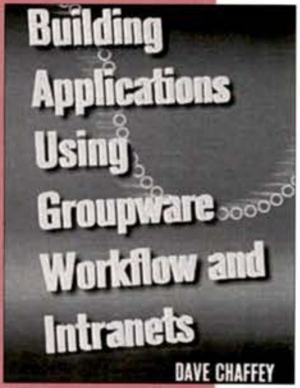


Microsoft Exchange Server 5.5: Planning, Design and Implementation by Tony Redmond describes the best practices used during the planning, design, and implementation phases of projects to deploy Microsoft Exchange Server. It incorporates the author's general expertise gained from 16 years working with corporate messaging systems around the world. The lessons learned from over 350 corporate-level engagements involving more than 3 million Exchange seats are documented and explained.

July 1998, paperback, 780 pages, US$54.95,
ISBN 1-55558-213-3



Building Applications Using Groupware Workflow and Intranets by Dave Chaffey is a comprehensive guide for managers, consultants, and system developers. It concentrates on how intranets, groupware, and workflow technologies can be used to improve the efficiency of their organizations. The focus is on how to use these tools to support organization transformation through business process reengineering, continuous improvement, or TQM programs. It gives practical guidelines for evaluating where these tools can best be used, selecting the right tool, and managing the stages of process analysis, design, and implementation.

July 1998, paperback, 265 pages, US$34.95,
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