TANDEM

An Executive Overview

On-Line Transaction Processing With Tandem NonStop® Systems

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INTRODUCTION

Information is the most important asset of any corporation. From the customer service representative to the president, sound decisions depend on it. The bank teller checks an account balance before processing a withdrawal. The order clerk checks inventory before promising delivery. The manager uses information to control the business today, and the CEO uses it to guide the business through tomorrow and beyond.

While all computers process information, there are major differences in the way they're designed—differences that can have tremendous impact on the future of your business. How long will development take before the system can be put to use? How expensive will it be to upgrade the computer as the business grows? Will the business outgrow the capabilities of the computer? Will information be available when needed?

Tandem Computers has addressed all these concerns, and more. The result is a highly reliable computer system that keeps on working even if a vital component in the system stops. Tandem NonStop® systems give you accurate, reliable information when you need it—without fail.

Designed to grow with the needs of your company, NonStop systems are easily expandable, able to grow to eight times their minimum processing power. And because Tandem systems are expanded rather than replaced, the cost to upgrade and enlarge is substantially lower than that of other computers.

When even more power is needed, up to 14 full-powered Tandem systems can be connected at a single location by a high-speed fiber optic link that is impervious to electrical interference.

In addition, up to 255 locations can be joined in a powerful network, every system able to access and share information as needed—regardless of location. NonStop systems in the network function as a single, large system.

To shorten development time, NonStop systems support a series of sophisticated programming tools that let the computer begin operations smoothly and quickly. At many sites, Tandem NonStop systems have begun processing work just a few months after installation—and this has meant lower programming costs, higher productivity, and a faster return on investment.

Tandem systems provide:

- Fast, reliable information for sound business decisions. NonStop systems keep track of every single transaction between you and the computer, ensuring that information is delivered quickly and accurately every time.
- Continuous availability, even if a component in the system fails. The system can remain up and running even during maintenance and repair. Because Tandem NonStop systems are fault-tolerant, processing continues, business thrives—without interruption.
- Plenty of room for growth. Tandem systems can grow and expand with the needs of your business. You can start with as few as two processors (the part of the computer where actual computing occurs) in a single system, adding more processors as needed to a maximum of 16 per system. And up to 255 systems can be connected together, functioning as a single, large system. No reprogramming is required and your system remains up and running throughout the changes—while business continues.
- The right amount of computing power for every site. Tandem makes systems that satisfy the computing needs at every company location, from the smallest to the largest. All systems are expandable, so you can start with a system that handles a few transactions, and add to it as your needs demand, until it processes many thousands of transactions—with outstanding price/performance the whole time. And Tandem systems are fully compatible, able to run the same programs, able to work together as a single, cohesive system.
- Ease of use. Information contained in Tandem systems is easy to establish, access, change, and maintain. Some computers use a confusing hierarchical method of organizing data. But Tandem uses a much simpler method that organizes information in such a way that a few commands quickly bring you the facts you want. A special query program permits fast, easy access to the information—and Tandem systems deliver only the information requested; you aren't overwhelmed with unnecessary details that have to be sorted and picked through before you can get to your facts.

- Powerful programming tools that reduce application development time and costs.
- A versatile information movement system that electronically transports messages, documents, and application programs to any single person or group of individuals in the company. Delivery can be immediate or delayed at your option—and dependence on overnight delivery services can be reduced or eliminated. Tandem systems provide fast, economical communications throughout the corporation.
- High throughput. Tandem computers process large amounts of information, providing fast response time for maximum employee productivity and customer satisfaction.
- The ability to communicate with a wide variety of devices. This flexibility protects your investment in existing equipment by allowing you to connect that equipment to your Tandem system.
- The power to support literally thousands of terminals, printers, and other devices. This can result in lower communications costs and improved information flow throughout the corporation.

Tandem NonStop systems represent the state-of-the-art in high-volume communications between the people of the corporation and the information they need. These fault-tolerant systems are designed for businesses that want to use automation for maximum efficiency.

For more information about how we've helped corporations grow and what we can do for you, please read on.

WHAT TANDEM SYSTEMS CAN DO FOR YOU

Current Information — When You Need It

Tandem NonStop computers provide fast, reliable interaction between the people of the corporation and the information they need. We call this on-line transaction processing, which simply means that you communicate directly with the computer. Paperwork and other delays are eliminated, so information is fresh, not hours or days old—and work can be processed immediately, rather than set aside to create backlogs.

With this type of immediacy, availability is critical. Because if the computer fails, the business stops. So to keep your business in motion, Tandem NonStop computer systems continue working even if a major component fails.

Won't Let You Down

Tandem NonStop systems virtually eliminate risk of system failure. Every system consists of multiple components, connections, and processors. If one part of the system fails, a counterpart takes over—and your business doesn't grind to a halt as it might with a conventional computer. Your Tandem system continues working even as the faulty part or module is being replaced.

This does not mean you have to pay for extra computers that stand idle, just waiting for a failure. With NonStop systems, all processors handle their own workloads, much like riders on a two-seater bicycle—both riders pedal, contributing to the speed of the vehicle, but one can take over the full load if the other should fail. Only a small portion of each processor is needed to provide fault tolerance, so if your Tandem system has five processors, it is able to process nearly five times the workload of a single processor.

If one processor should fail in a Tandem computer, its workload is distributed among other processors. Because the system oversees a constant exchange of messages between processors at all times, the running processors know exactly where to intercede and take over—with no loss of time or data in the transition.

The Right System for Every Size Job

Tandem has a NonStop system to satisfy your communications needs, no matter how small or how large. All NonStop systems offer continuous availability, easy expandability to accommodate growth, high reliability for dependable information, and outstanding price/performance.

All Tandem computers are designed to work in harmony—and this gives you unprecedented flexibility. For example, your NonStop systems can be switched around between sites if necessary, without extensive reprogramming. You can reallocate your resources as

your business grows, so you get the most efficiency from the computers you have—and only buy more computing power when you really need it.

As the volume of work increases, add processors, terminals, printers, and other devices. Since your Tandem system is evolving with your business needs, you don't have to worry about replacing it with larger equipment; it *becomes* larger equipment.

Sharing Information, Near and Far

Just as multiple processors are joined in a system, multiple NonStop systems at different locations can be joined in a network. They can be connected in a variety of convenient and efficient ways to systems located in another room, across the country, or around the world.

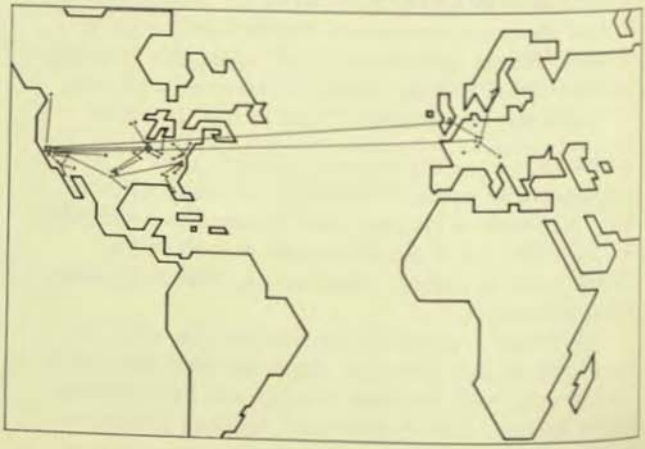
Chances are, some information needs to be shared by these remote locations. For example, offices in both Dallas and Los Angeles may need to review the same customer file, located in New York.

So Tandem developed a "distributed data base," which simply means that you have access to the information you need—regardless of its location. The system keeps track of where the data resides, so you don't have to. You simply request the information, and the system quickly locates and retrieves it for you.

And the speed of this process can be further increased by the NonStop system's ability to store information at the location that uses it most. The information travels a shorter distance, it gets to you faster—and communications costs are reduced.

Fault-tolerant Links between Sites

NonStop systems at different locations can be connected in several ways, including leased telephone lines, satellite link, even fiber optic link. In a typical network of Tandem systems, multiple communication paths exist



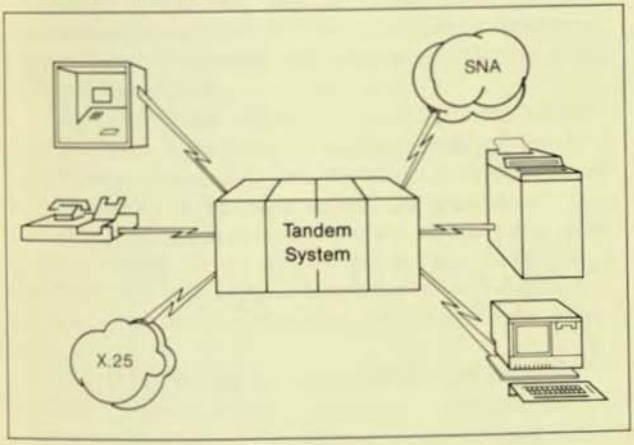
With multiple paths between locations, messages can be automatically rerouted if one path should fail.

between locations. Each NonStop system automatically selects the optimum path, according to predetermined criteria, and routes messages and information along that path. If the selected path fails, the system automatically selects the best alternative path. Information is never lost in transit, nor is it duplicated.

Efficient Corporate Communications

If you already have a sizable amount of data processing equipment, there is no need to sacrifice that investment. NonStop systems can communicate with other manufacturers' systems and devices. All this adds up to more than just a flexible computer system—Tandem systems can support your corporation's entire communications network. Special Tandem products allow you to connect devices of virtually every type, from word processors to facsimile machines to large mainframe-type computers.

We set out to develop the first fault-tolerant computer system, and along the way created a highly reliable, easily expandable, simple-to-operate system versatile enough to support the communications needs of virtually any corporation.



NonStop systems support a wide variety of devices and communications methods, and can link them into a powerful corporate network.

Following are some examples of how large corporations use Tandem systems to manage their information.

WHAT WE'RE DOING FOR OTHERS

BEECHAM COSMETICS
Order Processing/ Distribution

Beecham Cosmetics is the fourth-largest domestic supplier of cosmetics and fragrance products in the world. The company markets 3,000 products to 42,000 customers ranging from small family-owned shops to large department stores, and has annual sales in excess of $150 million.

Founded in 1969, Beecham has grown consistently, and today produces and markets products labeled Jovan Inc., Yardley of London, Vitabath Inc., OMNI Cosmetics Corporation, Lancaster, and Hermark.

The Problem

Beecham's remarkable sales growth, combined with the addition of many new divisions, necessitated greater efficiency and productivity in order processing and shipping. Demand is particularly high during peak seasons. For example, about 60% of Beecham's orders occur during the three months before Christmas.

Volume ranges from 1,000 to 2,500 orders a day, and each order may specify 5 to 20 different items. During the pre-Christmas rush, Beecham ships as many as 35,000 boxes a day.

Most of the order processing/shipping tasks were done manually. A corporate system generated a hard copy of each order which was then sent to a warehouse 20 miles away. All the plant operations were done manually—picking, checking off filled orders on a sheet of paper, writing all the bills of lading, etc. Then the paperwork was sent back to corporate to be keypunched and entered so that the corporate computer could print invoices.

"The sheer volume of orders compelled us to automate," explains Ronald J. Trzaskus, Director of Information Systems. "Although we were running three full shifts at the warehouse, we saw that the constantly increasing volume would be so great that we could not handle it in a 24-hour day."

Why Tandem?

"Actually we never considered any other vendor; I knew that I wanted Tandem. It was the only one that could meet the constraints of our business," comments Trzaskus. "Because of the heavy volume in a very short period of time, not only did we need additional throughput, but a big factor was the need for reliability. We needed a computer that wouldn't let us down during peak workloads.

"Expandability without reprogramming was another key factor. With our incredible growth, it was important to be able to add more hardware to handle new product lines and multiple locations easily and quickly. The Tandem system allowed us to do that."

The Tandem Solution

Beecham installed two three-processor NonStop systems—one at corporate and the other at the warehouse—and linked them together using Tandem's EXPAND™ data communications network. The warehouse system was installed and fully operational ahead of schedule, just eight months from the date of the order. It supported 150 application programs, 10 terminals, and three high-speed printers.

Next, Beecham brought up the corporate order entry system on schedule, within nine months. This system supported 75 to 100 programs with 42 terminals and six printers. Programs were written in COBOL and TAL.

Beecham's data base consists of 1,100 files. Because data integrity is so important (what company can afford to lose orders?), they use mirrored discs.

Current Applications

The corporate system handles all order entry, invoicing, customer file maintenance, and reports. One interesting feature is that data entry clerks don't have to know the account number or how to spell a customer's name. All the clerk needs is the first initial of the name or an approximation of the spelling, and the zip code. The system displays all customer records matching the entry. The clerk simply places a cursor over the correct account, and the system captures all customer information needed to process the order. The order and customer ship-to information is then transmitted to the warehouse system.

"The Tandem system has grown and continues to grow to support new and varied additions to our business," says Trzaskus. "All inventory control is being handled by the Tandem system at the manufacturing facility. And from receipt of components at the receiving dock, to storage and retrieval from component warehouses, to finished product storage and replenishment, all the way through the product picking area, the Tandem system is an integral part of the material flow."

Beecham has instituted a novel approach to storage with a sophisticated high-rise warehouse. Components and finished products are stored in 16,000 pallets stacked eight pallets high in 22 aisles. The warehouse is serviced by six specially equipped lift trucks fitted with remote radio frequency terminals and laser scanners. The Tandem inventory system tracks all orders and tells

trucks which aisle to go to and what parts or components to get. The movement of each truck is monitored by special microprocessors. If a truck is in the wrong place, the driver is automatically notified of the mistake. Potential errors are avoided.

In another specialized application, Beecham provides its sales representatives across the country with hand-held terminals. The salesperson enters order information into the small terminal and it is transmitted directly to the Tandem order entry system at any time, day or night.

As soon as the order passes all edit checks, the Tandem system handles shipping. Previously, all orders were handwritten and then mailed to the corporate office for manual entry into the system. "This new method of handling orders has resulted in a substantial increase in order throughput, since each order is captured, sent, verified, and ready for shipping, all in the same day."

The Tandem system automatically weighs all orders, selects the carrier and routing based on geographic areas, and generates packing slips and manifests. It also automatically handles UPS (United Parcel Service) shipping, including proper zone charges.

"Another benefit of the Tandem system is that it consolidates multiple orders going to a single customer at a given location. Not only is this more efficient, but it reduces freight costs considerably. Prior to the Tandem system, Beecham used only two shipping docks at a time; now as many as six are operational simultaneously, and with improved accuracy."

The Tandem system also helps Beecham optimize manpower. Since the system can generate and route picking lists for a variable number of aisles and shipping docks, Beecham can shut down any of the aisles and docks during slack periods, and reopen them when business demands increase.

After a shipment is confirmed, the warehouse system transmits the data back to corporate for invoicing. If an order was short because of an unforeseen shortage of stock, the system automatically adjusts the invoice and creates a backorder, if the customer so desires. As soon as the stock is replenished, the Tandem system automatically cuts an order to the backordered items.

The Tandem system also generates special reports. For example, the system examines all past due orders and the required ship dates of new orders projected ahead for a user-specified number of days (say, the next 10 days), then checks these against stock levels to see if

there is enough in inventory. Once a week, the system prints a product requirements report to show warehouse demands for *x* number of days ahead, so that Beecham can plan in advance allocating personnel, trucks, materials, overtime, etc.

Most of Beecham's reports are inquiry searches across history files. For example, the customer service department may ask for a report on the volume of a particular item, by sales rep. "With ENFORM™ (Tandem's report-generating software), we can do surveys, shipping analysis reports, whatever a manager wants, within a short turnaround time."

How did Beecham do these reports prior to the NonStop system? "Not very well nor very quickly."

Beecham's order processing/distribution software is available for sale in the form of 12 functional modules, through Decision Consultants, Parkridge, Illinois, a Tandem software house.

Benefits of the Tandem System

"We gained major productivity and throughput benefits when the initial distribution and order entry systems were first installed in 1979 and 1980. Order processing time was cut in half, the number of manual corrections to orders was virtually eliminated, and customer service was improved," reports Trzaskus.

"These are now mature systems, and they continue to provide those same benefits. But today, the expandability of our Tandem systems has become the highlight advantage at Beecham. We've grown from two companies to six since the initial installation, increasing our product base by 200%, and have added major new applications, such as freight bill processing and sales analysis reporting. Our Tandem system has handled this growth by the simple addition of processors and discs."

What about reliability, the critical factor in system selection? In one instance, Beecham's system withstood 14 power outages in 10 days. "The NonStop system has lived up to its name. It has absorbed power spikes with no degradation or loss of data. It has survived numerous brownouts and major blackouts with no loss of continuity to the application in progress at the time of the outage.

"And while single components have occasionally malfunctioned, our system has never effectively gone down. Service to our customers has continued virtually uninterrupted—while we continue to grow."

GTE TELENET Electronic Mail Network

GTE Telenet, a subsidiary of GTE Corporation, is a pioneer in the application of data communications technology. GTE Telenet introduced the first public network designed to lower communications costs by allowing multiple companies to use the same lines. Special packet-switching technology provides customers with efficient, economical communications through full utilization of existing telephone lines.

The Problem

GTE Telenet realized that its public packet-switching network could provide the perfect base for an electronic information delivery service. Such a service could add a new dimension to traditional methods of communication. Information would be transmitted electronically, its delivery virtually instantaneous. Problems like "telephone tag," where correspondents keep missing each other, could be eliminated. And in many cases, charges for expensive overnight delivery services could be avoided.

While the idea of electronic mail had been around for some time, no one had introduced a public information distributing system. One of the biggest problems was the difficulty and cost of establishing a network on which such an application could run.

But GTE Telenet already had such a network and could develop the application—and they could provide the service to subscribers at an affordable price. So GTE Telenet decided to develop the first public electronic mail service. This new service was to be called TELEMAIL™

The first step was to establish goals and objectives for TELEMAIL. These design goals were used as criteria in the selection of a computer system on which to develop the application.

Selection Criteria

System selection was based on the following criteria:

- High reliability and availability. TELEMAIL is a service, so the system must be ready for use whenever the subscriber needs it, and information must be transported accurately every time.
- Transaction processing capability with fast response time, user-friendly operation, and easy programmability.
- Manageability with extensive traffic- and performance-monitoring tools to maintain efficiency.
- Easy expandability through modular expansion.
- System security set by each subscriber to determine who can use the system and for what purpose.
- Accessibility. The system must be able to support the X.25 communications protocol to allow efficient access from any terminal utilizing the GTE Telenet network.

And so the search began for a computer system that could satisfy these requirements. Proposals were received, details discussed, benchmarks performed. In the end, a Tandem NonStop system was selected for the application.

Why Tandem?

Tandem was selected because TELEMAIL requires an operating system that yields high performance from a single, transaction-oriented application—and NonStop systems are specifically designed for high-speed, on-line transaction processing. Other proposed systems were of the time-sharing type, which manage the operation of multiple, concurrently running programs.

Another reason Tandem was selected is its fault-tolerant continuous operation. "Ours is a 24-hour, 7-days-a-week communications service," says C. Thomas Taylor, Vice President, Network Applications and Terminals, GTE Telenet. "Customers expect responsiveness. They expect every single message to be delivered. We can't afford downtime." The NonStop system can even be serviced and maintained while processing continues.

Other factors in the decision to go with Tandem included:

- Modular expandability. NonStop systems can grow with the business without program changes. Easy expandability is crucial in a new marketplace expected to experience rapid growth.
- Flexible, effective data base environment. Tandem's relational data base is simple to use and highly efficient.
- Tandem is certified to support the X.25 interface, a requirement for TELEMAIL.

The Tandem Solution

GTE Telenet purchased a two-processor NonStop system with two mirrored 240MB disc drives in September 1979 to develop TELEMAIL. The development system grew to four processors within the first year, and a second system was purchased in March 1980 for production. It started with three processors, and grew to six processors six months later. Shortly after that, both systems were upgraded to NonStop II® systems.

Today, GTE Telenet has three NonStop II systems in operation: a four-processor system used for development and performance analysis; another four-processor system exclusively for GTE's use (internal TELEMAIL, order entry, other transaction-processing applications); and a 14-processor system, with 12 mirrored pairs of 240MB disc drives, used by TELEMAIL subscribers.

Current Applications

More than 100 of the nation's largest corporations use TELEMAIL to send and receive information within their organizations, anywhere in the world. TELEMAIL systems are also used in the communications networks of the following organizations, providing service to their subscribers:

- Trans Canada Telephone System
- British Telecom
- Manitoba Telephone Systems
- Rabo Bank

Tandem systems used by these organizations will soon be linked to NonStop systems used by TELEMAIL in the United States.

In addition to message delivery, TELEMAIL lets users enter orders from the field, manage sales and distribution channels, even facilitate financial reporting and electronic publishing. More than 15,000 "mailboxes" (representing individual users) are assigned, and the Tandem system handles over 200 interactive sessions per hour during peak periods. Customer usage of TELEMAIL is increasing at a rate of 15% per month. And GTE Telenet has added another service for its customers: it now acts as a software vendor, selling Tandem systems that run TELEMAIL applications.

Some of the basic services of TELEMAIL allow a customer to:

- Compose and send messages.
- Scan and read messages.
- File and retrieve messages.
- Answer, forward, or purge messages.

A series of sophisticated capabilities distinguishes TELEMAIL's services from those of competitors. For instance, the Inform Script feature allows a user to create special formats for specific types of information. It also allows the user to specify what responses are acceptable throughout the format, and what message will display if an unacceptable response is received. For example, if a sales rep enters a customer's name where the amount of the sale should go, the system may display a message that says "ENTER AMOUNT OF SALE."

TELEMAIL also allows the user to specify destinations for a message. A TELEMAIL message can be delivered to an individual or to any size group. The sender can even specify that the message be broadcast to undefined groups via a Bulletin Board option.

Benefits of the Tandem System

"As the world's most advanced computer-based message system," says C. Thomas Taylor, "TELEMAIL service assures our customers that their information will get to the right place—and it will get there on time. The certainty behind that guarantee is our Tandem NonStop II computer system."

GTE Telenet's NonStop II systems provide the high-speed response time, high data integrity, and easy expandability that are key factors to TELEMAIL's success.

"Whether it's providing the TELEMAIL service or supplying an entire TELEMAIL system, we look forward to satisfying more and more of our customers' communication needs. And the contribution of the Tandem NonStop system is essential."

SECURITY PACIFIC NATIONAL BANK
Automated Loan Collection

Security Pacific National Bank is the tenth largest bank in the United States, with $30 billion in assets. Security Pacific maintains over 600 branch offices throughout California, with headquarters in Los Angeles.

The Problem

In 1979, Security Pacific started looking to acquire a computer system for use by its Consumer Leasing Division; loan collection was planned as a secondary application. However, by the end of 1979, the leasing market declined while, at the same time, high escalating interest rates necessitated better control and accounting of loan activity (home improvement, installment loans, and charge cards). Since outstanding money was suddenly worth 20%, loan collections became a high priority.

Debt collections were handled manually at each of Security Pacific's 600 offices and at collection centers. Loan information was scattered in tickler files and on ledger cards. Not only was the paperwork cumbersome, but by the time information was collected and compiled for a summary report, the data was out of date.

The bank decided to centralize all collections to six regional adjustment centers and a charge card center. The six centers would communicate with a central system and data base via a terminal network.

Selection Criteria

The main criteria for system selection were:

- Reasonable cost
- High system reliability
- Backup capability
- Data base management
- Easy expandability
- Efficient system software
- Vendor support
- Data communications capability

Secondary considerations included ease of use, documentation, and the ability to generate management reports.

"We first looked at packaged systems with application software already developed," states Sandy Weinstock, Vice President, Security Pacific National Bank, "but none provided the data base management, system reliability, and modular expandability that we needed. Although the system wouldn't run 24 hours a day, it was imperative that it be operational during working hours. Once business was committed on-line, we could not tolerate interruptions due to downtime.

It's ironic. . . .Customers can understand telephones being down, but not computers. They will tolerate a delay in paperwork, but get annoyed at delays in processing.

"Since we rejected packaged systems, that meant we would be writing our own programs. Software tools to help develop applications then became important."

When a Request for Quote was generated, eight computer companies submitted bids. The project management team chose five semifinalists, including Tandem, for detailed comparative study. Based on this study, Tandem was selected.

Why Tandem?

"It was not the least expensive in terms of hardware, but when we looked at five-year life cycle costs (research and development, investment, and operating cost), Tandem was the lowest. Also, Tandem was the only vendor that had an off-the-shelf fault-tolerant system for the continual availability we needed.

"The deciding factor was Tandem's superior system software for applications development. Since we didn't want to reinvent the wheel, we used all the Tandem software available. Before we started the project, I was told application design/development for the basic collection system would take four or five people at least two years. In reality, with three programmers, we did it within nine months."

The Tandem Solution

Security Pacific has an 11-processor NonStop system with mirrored discs at its Woodland Hills headquarters. The system supports 110 local terminals for charge cards, 170 remote terminals in the regional centers, 10 terminals for credit, 40 for loan recovery, 80 for real estate, and 24 in leasing. The system was installed in its permanent location in December 1980, and was ready by January 1981. Beginning the following month, the regions went on-line one at a time.

The Loan Processing application has over 1.5 million accounts on disc and, at any given time, roughly 80,000 of these are delinquent or "active." Each record is 300 to 500 characters in size. The system handles over 100,000 transactions a day, half of which are data base updates. Each transaction that involves the retrieval of a new account takes an average response time of one second (locally) or five seconds (remote).

The current system consists of 1,200 application programs, all less than 64kB, to take advantage of parallel processing across the Tandem multiprocessor architecture. There are also 200 user screens. (The original 40 screens were developed within 1½ months using the PATHWAY™ transaction processing system.)

Application design and development of the basic collection system were done by three programmers with just one week of NonStop system training; the detailed design took 10 man-months, and programming, 15 man-months. All programs were written in COBOL. "One person who was not a programmer became interested in programming after attending the one-week Tandem training, so we sent her to a COBOL class at UCLA. Before she even finished the course, she was programming on the NonStop system."

Staff members at the regional centers were trained in two days. For the first three days of operation, Security Pacific continued the manual paperwork as a backup, but when it soon became apparent that everything was running smoothly, the manual backup was eliminated.

Current Applications

If a loan payment is five days overdue, the account becomes "active" in the collection system data base. When a payment is 15 days overdue, the Tandem system sends the information to the appropriate collection center where a financial consultant attempts collection. While talking to the customer on the phone, the consultant has the complete account history on the terminal in front of him/her. If a customer responds with "the check is in the mail," the consultant can instruct the system to recall the account again if no entry is posted within the next two or three days.

The Tandem system is also linked to TYMNET® for automatic generation of collection letters.

After loan collections were operational, Security Pacific added general ledger, accounts payable, program development/documentation, and word processing. Later applications were leasing, real estate, loan application processing, and management reporting. The NonStop system will also handle consumer loan recovery and loan charge-offs.

Benefits of the Tandem System

"The first six months on-line at the adjustment centers increased delinquent loan collection efficiency by over 100%," commented Weinstock. The increased productivity resulted mostly from elimination of paperwork and greater labor efficiency. "We reduced financial consultants' paperwork 95%. At the six adjustment centers, the number of effective collection calls placed daily jumped from 7,245 to over 16,500—and with fewer people." In addition, Security Pacific's overall delinquency ratio and loan charge-offs have dropped considerably.

Centralization of debt collection data is a tremendous asset to senior management. Bank executives now obtain information that's current within 24 hours. More importantly, they can spot early trends, such as delinquency in a particular loan class or in a particular region.

What about system availability? Has the NonStop system lived up to expectations? "So far, the system has never gone down by itself, although it seems like we've tried to destroy it a few times. For example, while the system was stored temporarily in a basement, the air conditioning failed one weekend. When we came in on Monday morning, despite the heat, the Tandem system was still running.

"Another time we had a brownout that lasted over an hour. The NonStop system went down for less than 60 seconds, then came right back up with its battery backup power. The other computers in the same facility died, and three days later we still had problems with some of them."

Security Pacific projected and achieved a $4 million savings by the end of the first full year of the collection system's operation due to the more efficient delinquent loan collection operation. The Tandem system paid for itself within eight months.

ROCKWELL INTERNATIONAL CORPORATION
Order Management System

Rockwell International is a world leader in the design and manufacture of aerospace and aviation products. The Avionics Group, part of Rockwell's Commercial Electronics Operations, makes and distributes a broad line of products and systems to airline, business, and aviation industries; and to military and government aircraft industries.

With headquarters in Cedar Rapids, Iowa, and a manufacturing plant in Melbourne, Florida, the Avionics Group has over 7,000 employees.

The Problem

The Avionics Group was receiving orders faster than it could manually process them. Every order, from the smallest to the largest, required several time-consuming steps. Just receiving order information and typing it onto order forms was a major task, since thousands of parts are sometimes included in a single order.

Recognizing that the entire procedure could be vastly improved if computerized, the group began formulating requirements for a new system to fully automate the procedure. User personnel began drawing up requirements for an on-line computer system.

Selection Criteria

The new system would have to be user-oriented, since the operators had no computer background. It would have to be able to handle large numbers of terminals with a fast response time. And it must be able to accommodate many changes in both the orders and the programs that process them.

In addition to these requirements, system selection was based on the following criteria:

- Architectural flexibility (easy expandability)
- Communications capability, including effective networking software
- Reliability and uptime
- Vendor stability and support
- Product compatibility with existing mainframe equipment
- Software development time
- High throughput
- Easy maintainability

Why Tandem?

While the Avionics Group was defining the selection criteria for its new system, an advertisement brought Tandem NonStop systems to its attention. Three of Rockwell's requirements—easy expandability, high data integrity, and constant availability—were stressed in Tandem's ad. So Rockwell invited Tandem to compete for the contract.

The competing systems were studied and compared. Tandem was given the highest marks for reliability and availability, two key criteria. Rockwell's Cedar Rapids system has to be available 24 hours a day, 7 days a week because rush orders and customer emergencies sometimes require extensive overtime. For example, an order may arrive marked AOG, which means that an airplane is stuck on the ground, and parts need to be shipped immediately.

Tandem also rated highest in growth and upgrade capabilities, and in architectural flexibility. The Tandem system is able to expand well beyond expected application growth without the need for reprogramming, and using the same basic hardware.

Add to this Tandem's superiority in networking, maintainability, and throughput, and it's easy to see why Tandem was awarded the contract.

The Tandem Solution

In April 1979, a two-processor NonStop system was delivered to the Cedar Rapids plant. The team of six programmers and developers assigned to the project had no previous experience with Tandem, so all attended Tandem education courses. The designated Order Management System was developed in a modular framework, the first module being released as early as August 1979; the final module was released within 18 months of hardware delivery.

The application programs were written in COBOL. A universally accepted language, COBOL provides easy training for programmers new to the Tandem system. In addition, programmers trained on the Tandem system could be easily moved to work on other applications in the company.

In December 1979, a third processor was installed in the system. This completed the original order. Higher volumes, company growth, and migration of the application to the group's Florida manufacturing plant later justified further system expansion, and in August 1982, a fourth processor was added.

Current Applications

Rockwell's Avionics Group uses the Tandem system in their Order Management System (OMS). Orders are tracked all the way from placement through shipping at the Melbourne and Cedar Rapids plants.

"By virtually eliminating paperwork and the errors that go with it, our Tandem NonStop computer has greatly simplified tracking orders for our avionics products," reports Robert P. Marovich, Vice President and Controller, the Avionics Group. "And that has produced highly visible improvements in the way we're able to respond to our customers' inquiries."

The Tandem system consolidates all data pertaining to the orders, beginning with placement and going right on down the line to shipping. It also transfers relevant information to the appropriate department—to accounting, for example, for the generation of invoices; and to manufacturing, where $175,000 a year in internal freight charges was eliminated by reorganizing ordering/shipping procedures. "The entire operation has helped us reduce order entry errors by 75%," adds Marovich, "while eliminating 140,000 keypunched records and 25,000 reproduced documents every month."

In addition, the Tandem system allows Rockwell to automatically calculate prices, and to control backorders—another factor contributing to vastly improved customer service. "And because the system has virtually eliminated the manual drudgery from employee routines, our people are continually finding new ways to do their jobs better," says Marovich. "The net result is an operation that is helping us achieve some very significant gains in plant productivity."

Benefits of the Tandem System

Rockwell's NonStop systems save time previously spent preparing and handling paperwork, increasing efficiency throughout the ordering procedure. "The system has ended the need for most paperwork, and automatically generates the few documents that remain. Because of this, manual typing of orders, which required a great deal of time, is no longer necessary."

Orders can now be processed the same day received, which reduces inventory carrying charges. When a customer places an order, credit limits are quickly checked, and if necessary, orders are adjusted on the spot. When a customer calls with a question, current account information is readily available; the customer never hears, "We'll have to get back to you."

CHASE MANHATTAN BANK
Account Locator

In 1977, Chase Manhattan Bank's Controller's Office was receiving 1,500 calls a day for account verification and customer account information from other banking departments. Forty-five to fifty clerical personnel manually accessed, updated, and filed 1.5 million 3×5 cards on 750,000 customers to respond to these inquiries.

The Problem

The system was completely manual. The cards were kept in 11 Diebold rotating tubs. Access time was typically 1½ minutes. Updating was cumbersome, time-consuming, and required changes in as many as 18 places in the files. Cards were frequently lost or misplaced. An entire room was needed just to store keypunched cards. Even worse, Diebold, because of the age of the automated tubs ("vintage 1946"), no longer offered field maintenance. When the tubs failed, bank personnel had to hand-crank them to gain access to the index cards. To restore these manual tubs to service, Chase Manhattan retained a blacksmith to rework or fabricate new parts.

The operation was "labor intensive, redundant, and inefficient."

Alternatives Considered

The Controller's Office began evaluating several solutions. The first option considered was an on-line utility approach, using a mainframe computer. However, this would require a special communications interface at a high internal charge for the Controller's Office. Also, it wouldn't provide control over data base security and scheduling system resources. The last objection touched on the issue of data base growth and the requirement for system expansion without costly conversion.

Another possibility, a microfiche application, was rejected because of its rigidity. Expansion to allow for growth of the data base (data elements) was not cost-effective using the microfiche concept.

The third option, implementing their own system, gave the Controller's Office three critical advantages: (1) security of the data base and control of the on-line system, (2) access to the data base via terminals so that other sections of the bank could be "self-sufficient," and (3) modular expansion to handle growth through the 1980s.

Selection Criteria

The Controller's Department and their consultants evaluated several systems and narrowed the choice down to three, including the Tandem NonStop system. They based their evaluation on:

- Cost of development
- System reliability

- Field maintenance record
- Modular growth potential without reprogramming
- Backup capability
- Programming language support
- Financial stability of the vendor

At that time, Tandem had been marketing for only a year, so Chase Manhattan had some reservations. These were dispelled by a demonstration of the application. A Tandem representative presented a prototype of the application "with ease," halting processors and discs to show how the NonStop system remained operational. "This demonstration of NonStop systems convinced us that this thing was for real. We decided to investigate seriously."

A consulting firm was asked to evaluate Tandem according to the preset criteria. The firm was skeptical; they proposed a competitor's system and promised to disprove Tandem's claims. However, after on-site analysis of the company and the product, "the consultants came back and did a 180-degree turnaround. They not only recommended Tandem, but they rebid using a Tandem system."

Why Tandem?

Of the three companies, Tandem's bid was the lowest. However, this cost did not reflect the true "bargain" the Controller's Office saw in purchasing the Tandem system. "We were getting the NonStop system architecture and performance—free. Although we selected the Tandem system principally for ease of expansion, mirrored volume capabilities, and flexible file structure, getting fault tolerance for the same price. . .was truly a bargain."

Tandem's easy modular expansion without reprogramming was an advantage over the competition. "If we made a mistake about sizing," said one member of the development team, "we could always add another CPU to our Tandem system instead of facing a major conversion to a more powerful system."

The competition had no high-availability software for multiprocessor systems. Special software was required. However, all the basic tools required for the application, including operating system, utilities, file management system, screen formatter, compilers, and communication package, were available from Tandem and were considered to be superior.

The Tandem Solution

The Chase Manhattan Account Locator and Account Numbering system included two processors with 384kB of memory each, two tape drives, five 240MB discs, one line printer, and 31 terminals. They have since expanded to three processors, seven discs, and 60 terminals.

The application program was written by Monchik-Weber software consultants and a Chase Manhattan programmer trained at Tandem's education classes. Implementation was very rapid—from mid-February to June, 1978.

Since then, Chase Manhattan has installed three more Tandem systems for other applications.

Current Applications

With the Account Locator system, inquiries can be made by customer name or account number. Partial keys can be used if the name is misspelled or if the information is incomplete. The data base contains 1.3 million accounts, and roughly 2,500 new accounts are added each week.

Up to 60 operators can access the system from terminals located throughout downtown New York. The operators handle 1,500 to 2,000 inquiries a day with an average response time of two seconds. In addition to new accounts, there are over 2,000 changes (data base updates) each week. The system creates a transaction record and a log of inquiries for updating.

Another five-processor Tandem system is used to process customer information that results in the delivery or collection of funds via the Automated Clearing House mechanism. This area is responsible for the collection of 3.5 million repetitive transactions each month, such as insurance premium collections, which are automatically deducted from personal accounts at any U.S. bank or thrift organization.

The Tandem system automatically handles electronic delivery to banks that are ACH members, and produces preauthorized checks for the nonmembers. Other credit entries, including payroll and pensions, will also be distributed via the ACH network. The same system is also used to transfer large dollar-value transactions between corporations.

A third Tandem system at Chase Manhattan uses three processors to manage insurance funds transfer. Insurance premiums are automatically deducted from personal accounts, sorted by insurer, processed through a clearinghouse, then distributed to the various insurance companies' respective banks. Funds are transferred five times a day.

Other Tandem systems are used for communications, directory assistance, and as part of a bond brokerage network at IDC, a division of Chase Manhattan located in Boston.

Benefits of the Tandem System

Major cost savings of the Account Locator system resulted from the reduction in clerical personnel. Fifty percent of the original staff was freed for more productive projects, resulting in a return-on-investment (ROI) of 34% and payback in approximately 18 months. Data base integrity increased dramatically, and access time dropped from 1½ minutes to 2 seconds. In addition, "bank personnel don't have to make five phone calls to get the information—they now go to one source and get the information almost instantly.

"We have much tighter control over the data base. We now have a good grasp on incoming data and know that data can't get lost. The biggest advantage to Chase Manhattan is that the data base is current—before, it was as much as a week old."

The Tandem system can be operated by clerical personnel—with little or no formal training. "When we got praise on the ease of running our Tandem system from a Grade V clerk, we were impressed," reports a Controller's Office vice president. "We were overwhelmingly surprised with Tandem's reliability. They didn't overpromise."

Said one Controller's Office spokesman in summation: "Our system has served us well. We got what we wanted—a reliable, well-designed, well-integrated system—at a cost we could afford."

MOTOROLA INC. Wafer Production Network

Motorola is one of the world's leading manufacturers of electronic equipment and components. With annual sales in excess of $3 billion, it is company number 125 on the Fortune 500 list.

Motorola's Semiconductor Sector, headquartered in Phoenix, manufactures semiconductors, circuits, microprocessors, and a variety of other products for both the military and private industry.

The Problem

The semiconductor business is one of the most intense, competitive, and fast-changing of all high-technology industries. Designs change constantly; there may be as many as 500 to 1,000 specification changes a month, all of which impact manufacturing. The creation of a single wafer can take seven to ten weeks, and may require up to 300 different processes. Every process requires close monitoring, and problems must be quickly identified and corrected. In addition to all this, new product lines are added constantly.

The need for a highly reliable on-line system is critical; when production slows to isolate and correct problems, output (and profit) suffers. And a system failure could be disastrous.

So in late 1979, the Semiconductor Sector started planning an on-line wafer production system to collect data, monitor process variables, and pinpoint trouble spots. This new worldwide distributed processing network would:

- Increase productivity
- Reduce paperwork
- Better utilize production machinery
- Provide timely and reliable data

It was decided that each manufacturing and assembly plant would have its own system to handle local data processing needs. In addition, each of these systems would be connected to a "host" system at headquarters, and would feed cost and other information to the host for corporate analysis.

Selection Criteria

System selection was based on the following criteria:

- Communications capability, including effective networking software and support for IBM devices
- Transaction processing capability with easy programming (e.g., software development tools), fast data base access, user-friendly operation, and screen formatting capability
- Language support for COBOL, FORTRAN, and an assembler-type systems language
- 24-hour availability

- Flexibility to support data base changes
- Ability to support a query/report writer
- Expandability, both for individual systems and for the network, with no need for reprogramming

Why Tandem?

Of the four vendors considered, only Tandem was able to satisfy all the requirements necessary to achieve Motorola's goals. Continuous operation and easy expandability were Tandem exclusives, and only the NonStop system was specifically designed for on-line transaction processing.

The Tandem Solution

A three-processor NonStop system was delivered to Motorola's Bipolar facility in Mesa, Arizona, in September 1980. Since then, the system has grown to five processors with 768kB of memory, five mirrored discs, 55 terminals, and 12 printers. Motorola uses Tandem products AM3270, TR3270, and EXCHANGE™ to interface with their IBM 3081 mainframe.

In March 1981, the system went into production. Design and development took just over six months. In this time, the Motorola staff wrote over 41,000 lines of code, developing programs in COBOL and Tandem's system programming language.

PATHWAY is credited with the fast development time. According to one Motorola project leader, "It would have taken 40% longer if this application had been implemented on any of the other proposed systems."

Since the initial installation, Motorola has added nodes in Phoenix, Austin, Scotland, France, Malaysia, and Korea. These systems improve plant operations and provide instantaneous information management for fast, accurate corporate decisions. By mid-1984, the company intends to install Tandem systems in all of its wafer fabrication, final test, and assembly facilities around the world.

Current Applications

The major functions of the distributed wafer systems are:

- Specification maintenance
- Inventory tracking
- Production line scheduling
- Furnace management
- Equipment maintenance
- Manpower scheduling
- Resource management
- Performance reporting
- Reject analysis

NonStop systems track wafers from operation to operation, collecting on-line data about process and inventory activity, and measuring cycle times and yields according to standard. Nine manufacturing areas are on-line.

Each system easily handles thousands of transactions daily, providing direct and instant feedback. Motorola uses this information to control the production process, placing resources where they are most needed, and streamlining the entire operation. In addition, trouble spots are identified, isolated, and corrected before they have a chance to cause serious problems.

Benefits of the Tandem System

Motorola has realized increased yields, lower costs, reduced cycle times, lower inventories, and a significant overall increase in productivity. "We now have control of work-in-process in a way that was never before possible."

WELLS FARGO BANK
Distributed Processing Network

Wells Fargo is the twelfth largest bank in the United States and has its headquarters in San Francisco. Its assets exceed $22 billion, and nearly 400 branch offices are located throughout California.

The Problem

In 1980, Wells Fargo began investigating ways to improve profitability in its consumer credit activities. Two major changes were recommended: the first was the establishment of regional loan processing centers, and the other was to market a more diversified range of products. To support the increased volumes created as a result of these changes, automation would be required.

Automated processing would considerably increase efficiency, allowing more effective customer service and an enhanced competitive posture. Employees could process more transactions in less time and with better accuracy.

The bank issued a request for proposal (RFP) for a system to automate consumer loan activities. The new system would handle loan application processing, title maintenance, payment processing, and inquiry handling. The loan processing function at each branch would be consolidated into four regional centers, each with its own system. The four production systems would have to be able to support from 200 to 400 video display terminals, 50 to 100 per location. A fifth system, used for software development and maintenance, would be located at central headquarters in San Francisco.

Selection Criteria

Critical system requirements were defined as follows:

- High availability
- Modular design
- High data integrity
- Good networking capability
- Ease of use
- Competitive overall system cost

Against this evaluation framework, several vendors claiming on-line or distributed data processing capability competed for the contract. Wells Fargo narrowed the competition down to two vendors; in the end, Tandem was awarded the contract.

Why Tandem?

Tandem was selected for overall economy and because it offered the following features:

- Constant availability. Tandem systems are specifically designed for continuous operation, even if a major component should fail. For a bank like Wells Fargo, even a short break in processing can result in very expensive penalties.

- Modular expandability. The systems could grow according to Wells Fargo's needs without expensive software changes and without the need to switch to larger machines. This would result in considerable savings over the long term.
- Extensive terminal connectivity. Tandem systems can support several hundred terminals, each with access to both local and remote data. This is important to Wells Fargo because of the large number of terminals accessing the same data base.
- High data integrity. Reliability is critical in financial transactions, and Tandem's emphasis on data integrity provides undisputed accuracy.

"With automation of our service centers, the productivity of over 600 employees would be dependent on the availability of our on-line systems," says Jack Kopec, Executive Vice President. "Tandem's architecture provided us not only with the availability that we required, but also with the ability to easily modify or expand our systems in response to changing business requirements—and with minimal incremental costs."

The Tandem Solution

A two-processor development system was delivered to Wells Fargo's San Francisco headquarters in April 1981. A team of programmers and analysts attended three weeks of Tandem classes, and the first application went live within ten months of the date the initial development system was delivered. "Tandem software tools, combined with the ease of making changes on the Tandem system, greatly enhanced our ability to meet our implementation schedules," reports Barbara Doherty, Vice President and application development manager.

During the development period, the team formulated an application development method so flexible that it has become a template for all Tandem applications in the Consumer Credit Division.

The first phase went into pilot in March 1982. All four production nodes began operations over a six-month period. This first phase supported customer inquiry, title maintenance, and data base maintenance for customer demographics. A short time later, the second phase began, adding fully automated payment processing for installment loans.

Current Applications

Today, the system processes and monitors all stages of consumer loan and auto lease applications including data entry, fraud detection, automated credit bureau report retrieval, credit scoring, and document preparation.

One centralized technical support group manages the operations staff, which develops all new applications. A Tandem quality assurance group provides assistance as needed. New software is distributed across the network by the technical support staff.

"The time and effort required to support our systems have been substantially reduced by our use of Tandem's EXPAND network," reports Catherine Scuderi, Vice President and Chief Systems Officer. "EXPAND enables us to monitor and control hardware and software problems in all production nodes from our one centralized development site."

The current terminal network supports over 450 terminals at the four California production sites located in Walnut Creek, Sacramento, San Jose, and Santa Ana.

Future phases of the program will include automating revolving credit processing, implementing automobile lease accounting, and installing credit card application processing.

Benefits of the Tandem System

With the automated procedures, Wells Fargo can process more work per employee. Operational head counts have remained steady while productivity has increased. This type of efficiency has helped Wells Fargo position itself to take advantage of the emerging consumer market.

"The Tandem system has enhanced our ability to effectively deal with our customers," says Kathy Burke, Vice President, Consumer Credit Operations. "We can now immediately interact with customers via on-line data as opposed to retrieving information from customer files and/or paper reports. This allows us to deal professionally with our customers and, in general, has resulted in increased customer satisfaction with our services."

REPRESENTATIVE CUSTOMER LIST

Manufacturing

DYSAN INC.
Manufacturing Requirements Planning (MRP)

EXXON
Wiring and Instrumentation Design and Documentation

GENERAL DYNAMICS
Defense Bidding and Control

LOCKHEED MISSILES AND SPACE COMPANY, INC.
Shop Floor Control

MOTOROLA
Production Control

THYSSEN HENRICHSHUTTE AG
Steel Manufacturing Quality Control

Retail Banking

CHEMICAL BANK
Home Banking

GREAT WESTERN SAVINGS
ATM Support

SECURITY PACIFIC BANK
Automated Loan Collection

UNION BANK OF FINLAND
ATM and Teller Terminal Support

WELLS FARGO
Consumer Loan and Automobile Lease Processing

Wholesale Banking

CREDIT AGRICOLE
Domestic/International Money Market

CHASE MANHATTAN BANK
Automated Clearing House

INTERFIRST BANK DALLAS
Electronic Funds Transfer

MERCANTILE BANK
Electronic Funds Transfer

PRIVATBANKEN A/S
Foreign Exchange

International Banking

BARCLAYS BANK
Worldwide Corporate Databank

CHAPS INTERBANK SYSTEM
Funds Transfer Network, U.K. Retail Banks

CROCKER NATIONAL BANK
Worldwide Funds Transfer

FIRST NATIONAL BANK OF CHICAGO
General Banking Functions

Financial	CASA DE BOLSA BANAMEX Brokerage
	CHICAGO BOARD OF TRADE Commodities Exchange
	COMMODITY NEWS SERVICES Commodities Quotes/News
	COX CABLE Home Banking Services
	DAFSA Brokerage
Retail Trade	CONVENIENT TICKET On-Line Multiple-Location Retail Ticketing
	DROGUEROS, S.A. Order Entry/Distribution
	FEGRO On-Line Commodity Control/Checkout (POS) with Inventory Control
	KARSTADT AG Integrated Sales and Information, Furniture Department
	TARGET STORES Distribution Processing
Wholesale Trade	BAUSCH & LOMB Order Entry/Shipping
	BEECHAM COSMETICS Order Entry/Processing/Shipping
	HAMILTON AVNET Order Entry/Inventory Control
	LIEBERMAN ENTERPRISES Retail Distribution
Transportation, Communication, Public Utility	BUCKEYE PIPE LINE Oil Flow Control
	GTE TELENET Electronic Mail
	INDIANA BELL Order Servicing/Billing
	MEMPHIS LIGHT, GAS AND ELECTRIC Customer Service
	VIKING FREIGHT SYSTEM, INC. Fleet Maintenance

Services

DIRECCION GENERAL DE POLICIA
License Plate Control/Arms Distribution/Vehicle Maintenance/Criminal Records

FAST-TAX (COMPUTER LANGUAGE RESEARCH, INC.)
Service Bureau

ON-LINE COMPUTER LIBRARY CORP. (OCLC)
Interlibrary Cataloging

ORANGE COUNTY COMMUNICATIONS
Message-Switching into California Law Enforcement Telecommunications System/Information Exchange between Nuclear Generating Site and Local Government

Hospitals/Universities

COMMUNITY HOSPITAL (OF INDIANAPOLIS)
Patient Care

DISTRICT OF COLUMBIA GENERAL HOSPITAL
Patient Care

HOSPITAL AUGSBURG
Patient Registration/Records

UNIVERSITY OF CALIFORNIA, BERKELEY
Undergraduate Admissions/Registration

UNIVERSITY OF COLORADO
Medical Research

Automotive

FORD MOTOR COMPANY
Engine Assembly and Test Information System

PEUGEOT
Automobile Production Control

PORSCHE
Inventory Control

RENAULT
Automated Manufacturing

HOW WE'RE DIFFERENT, AND WHAT IT MEANS TO YOU

Tandem Systems Are Expanded Rather than Replaced

With most computers, growth is very expensive. As your workload increases, you need extra computing power—and with conventional systems, that means replacing your computer with a larger machine. Expensive reprogramming is often necessary. In order to delay these major expenses, some vendors sell you more computing power than you initially need. But in the end, when your business demands outgrow the system's capabilities, expensive changes are inevitable.

At Tandem, we view growth as the simple addition of processors. You start with what you need, adding more processors as necessary. Since NonStop systems are expanded rather than replaced, you won't need to pay for a costly conversion—and you're free from tying up funds in extra equipment.

Every NonStop system can grow from 2 to 16 processors. If you need still more computing power,

up to 14 systems with 16 processors each can be connected by high-speed fiber optic links for a total capacity of 224 processors at a single site—greater computing power than some of the largest mainframes. And you'll still be using the same system you started with. With Tandem, you don't have to scrap previous investments as your business grows.

You can also connect 255 different NonStop systems—over 4,000 processors strong—and place them at your company's locations throughout the world. Each location has immediate access to its local information base and can also get information from other sites. And from your corporate headquarters' system you have access to information at every site for fast, accurate business decisions and for long-range planning.

When you install Tandem NonStop systems, you get:

- Computers that expand with your business—without expensive hardware or software changes

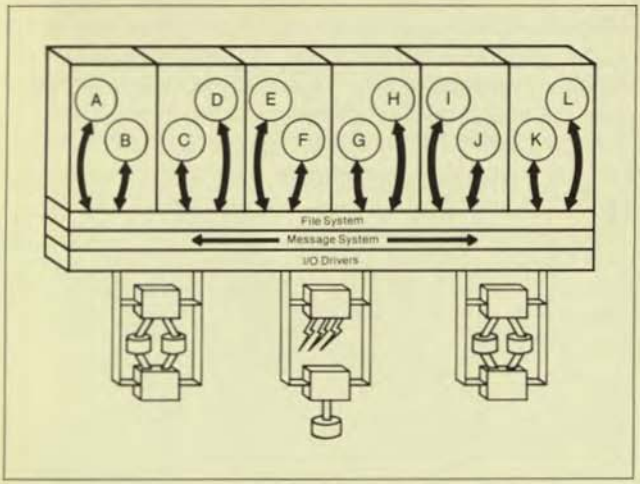
- The right amount of computing power for every corporate location, from the smallest to the largest
- An advanced information movement system that speeds electronic messages throughout the corporation, reducing paperwork and increasing efficiency
- An easy-to-use relational data base that simplifies interaction between you and the computer
- Programs and devices that protect your investment in existing equipment by permitting communication between Tandem and non-Tandem equipment
- A series of programming aids that cut application development time by as much as 50%
- A variety of computer languages familiar to your programmers, to keep programmer productivity high

Tandem Does More So You Can Do More

All Tandem processors communicate with each other as if they were in the same system—no matter how distant they actually are. This means that a Tandem system at one location can get information stored at another location without the operator having to know where the data is stored. For example, you may want to check a customer's records to determine whether he is a good risk for a loan. You simply request information, and the system automatically finds and retrieves it for you, regardless of its location.

All this is possible thanks to Tandem's GUARDIAN™ operating system. GUARDIAN is a series of programs, written by Tandem, that controls the operation and function of every Tandem system. GUARDIAN keeps track of the names and locations of every processor, device, and user in the network. Because you get information directly from Tandem systems at other locations, telephone calls and paperwork between sites are reduced. Your employees respond faster to customers and have more time for other productive activities.

GUARDIAN helps keep down the cost of processing by letting you put that power where it's needed most. On conventional systems, computing power is often wasted due to changing demands on the system. For example, your business may reach a peak at about 10 a.m. each day, and the program that controls, say, order processing requires extra computing power. An unbalanced workload can result, and on conventional systems, it is extremely difficult to redistribute the system's resources. The purchase of more computing power is often recommended.



GUARDIAN allows you to balance processor loads according to your needs, and keeps your system operating right through a processor failure.

But with Tandem NonStop systems, you can dynamically rebalance the workload whenever necessary, placing computing power wherever it's needed most. And this means you purchase only the power you need, when you need it.

Another benefit of this ability to reallocate the workload comes about when a component in the system fails. In a conventional system, a failure can halt processing. Or worse, it can corrupt the information in your data base. But in a Tandem system, GUARDIAN automatically responds to system failures by reallocating the workload as necessary. Processing continues, and most important, GUARDIAN ensures that your information remains reliable.

Keeping Lines of Communication Open

When the information you need is stored at another location, GUARDIAN automatically brings it to you. In the form of electronic impulses, your data can travel between corporate locations in a variety of ways, including telephone lines, satellites, and fiber optic cables. But whatever method you use, a communications failure between sites can stop the flow of information.

So to protect you from communications failure, Tandem systems support multiple paths with a powerful computer program we call the EXPAND data communications network.

In an EXPAND network, all communications paths are available to speed information from location to location. If one path fails, an alternate path is automatically selected—and the flow of information continues.

Optimum Routing of Information

EXPAND keeps track of all available communications paths, and automatically chooses the optimum route—based on your priorities. Whatever criteria you specify for a particular type of transmission, be it speed or economy, EXPAND selects the appropriate path.

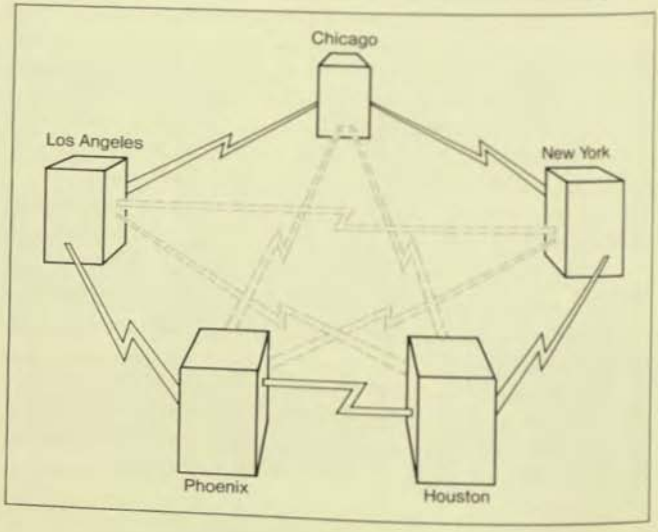
For example, if you need to transfer large amounts of information coast to coast, and you have a satellite link established, you may want to transmit the data over this route. If economy is the major concern, you may choose an economical type of telephone line. EXPAND sees which paths are available, selects the best path per your instructions, and transmission begins.

As new communications paths are added to or removed from your network of Tandem systems, EXPAND automatically updates its "routing tables" at each site to ensure that messages continue to be routed along the best path.

Fewer Lines, Lower Cost

EXPAND also helps keep down the high cost of communication between sites by allowing one location to relay information to another. For example, your offices in New York and California do not have to be directly connected to each other if they are both connected to the Texas site. The Texas site simply passes the information along to its destination.

This "passthrough" capability can result in considerable savings in the cost of communications between company locations. And the more sites you have, the greater the savings. For example, the illustration shows five sites. If each site were directly



Passthrough capability means fewer communications lines, lower communications costs.

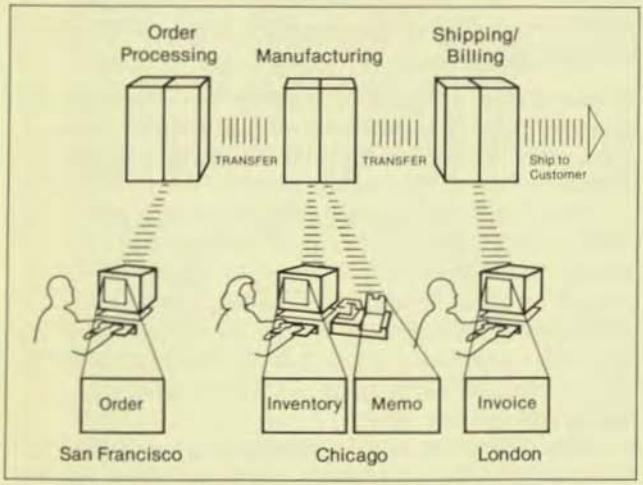
connected to all others, ten communications lines would be required. But through EXPAND, only five lines are required. If one line fails, EXPAND automatically routes your message in the other direction. You save money on communications costs, and fault tolerance is your bonus.

Information from Many Sources

When you need to send information to other locations, powerful Tandem programs help you do it with a minimum of effort. And you can control both the format and delivery of your messages through Tandem's TRANSFER™ information delivery system.

TRANSFER lets you send "information packages" containing data from many different sources, such as data files, word processors, and facsimile machines. You can, for example, send a message consisting of a cover memo; a file containing the current product catalog; and a set of illustrations to be transmitted via a facsimile machine (using Tandem's TRANSFER/FAX software)—all combined in a single package.

With TRANSFER, you can compose and send messages easily, with the speed and reliability of the computer. Forget paying for overnight delivery—your messages are delivered in minutes, whether they're going next door or around the world.



Order information can be taken at one location; passed via TRANSFER to another location, where a memo is attached; then the package can be forwarded to the location that handles shipping. No paperwork is involved, and the entire procedure can be accomplished in minutes.

TRANSFER also lets you determine when a package is to be delivered. You specify the earliest and latest delivery times, and your correspondent can receive the package whenever convenient within those times. You can, for example, send a message on Monday that will be available to the recipient between Wednesday and Friday; and if the message isn't received by Friday, it will disappear, and the system will notify you that delivery was not completed.

TRANSFER also lets you communicate with application programs, and even supports non-Tandem programs. You can send a message scheduled to arrive at a specific date and time that orders a program to begin processing. For example, if an application involves a process in which a very large number of files are to be manipulated, TRANSFER can be instructed to wait until after working hours, or whenever computer resources will be available to handle the load.

TRANSFER is perhaps most frequently used to support Tandem's easy-to-use electronic mail program, TRANSFER/MAIL. TRANSFER/MAIL helps you compose messages that originate from a variety of sources, such as word processors, facsimile machines, or data files. And special screen formats help you organize the message right on your terminal.

When information is sent to you by way of TRANSFER/MAIL, your terminal displays a one-line message informing you of its arrival. After viewing the message, you have several options: you can save it in a file for future use, purge it, respond to it, or add your own memo and forward the package to someone else.

In other words, you can handle the exchange of information just as if it were on paper, the same way you've always done in the past—only faster, easier, and more economically.

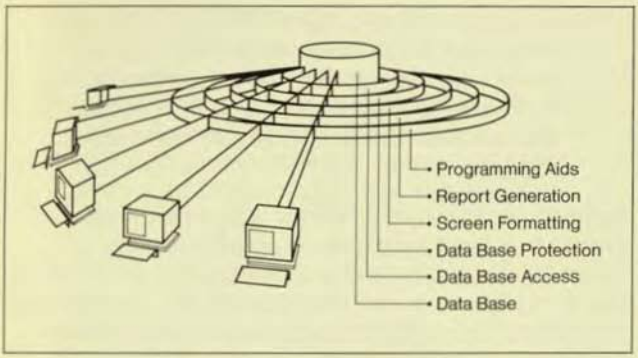
Keeping It Simple

At Tandem, we recognize that many of our users are not computer experts. So we've developed a set of programs specifically designed to simplify use of the NonStop system.

These high-performance programs constitute Tandem's ENCOMPASS™ distributed data base management system, which helps you redistribute processing power to accommodate peak workloads, system expansion, changes to your information base, and application program growth. You can use ENCOMPASS with a single NonStop system or with a worldwide network of Tandem systems.

Complementing the file management capabilities of GUARDIAN, ENCOMPASS provides additional capabilities to access, query, manage, secure, and protect the integrity of your information base. ENCOMPASS consists of the following Tandem software products (programs):

- PATHWAY transaction processing system. PATHWAY consists of a set of programming tools that reduce application development time by as much as 50%. PATHWAY frees your programmers from several repetitious and time-consuming tasks



ENCOMPASS helps you redistribute processing power to accommodate peak workloads, system expansion, changes to the data base, and application program growth.

that are part of the programming process, allowing them to concentrate their efforts on solving the problem at hand. Program development and maintenance expenses are reduced, and as the cost of labor continues to climb, your savings continue to grow.

- ENABLE™ Screen COBOL generator. Another programming tool, ENABLE lets your programmers develop small application programs easily, almost automatically. This contributes to your savings in programming costs.
- ENFORM query language/report generator. ENFORM makes it easy to retrieve information in proper format for those necessary reports. ENFORM responds to a few simple keyword commands and works with GUARDIAN and EXPAND to get information from your information base. Easy-to-use screen layouts help you organize the information right on your terminal screen. You then send the information to the printer, which prints out the completed, formatted report. You eliminate the expense of printed forms and the time required to fill in blanks.

  Even minor formatting functions are simplified by ENFORM. Short keyword commands can be given that center headings, space columns of data, or skip to a new page. Other keywords provide totaling and subtotaling capabilities, and can format numbers with commas, decimal points, or currency signs. Automatic settings used for your standard reports can also be overridden to produce customized reports.
- Transaction Monitoring Facility (TMF). TMF helps maintain the integrity of the data base. TMF backs out all transactions in progress that cannot be

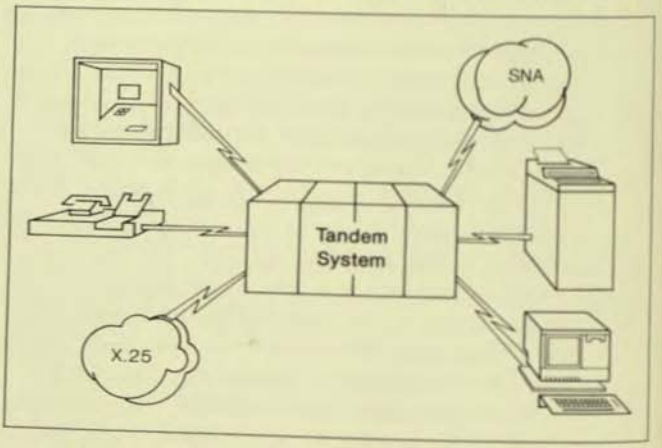
completed due to a failure. When the alternate component or processor takes over, relieving a faulty one, TMF restarts the transaction. Nothing is lost, nothing is duplicated. And it all happens so fast that you may not even know that a failure occurred.

Preserving Your Investments

It would be very convenient for your corporation if all computer manufacturers used the same computer languages and methods of communication. Unfortunately, this is not the case. Yet Tandem makes it seem that way.

Tandem supports the most popular programming languages, as well as virtually every major communications method. This not only helps to preserve your investment in previously purchased equipment, it also means you can use your network of Tandem systems as your primary communications network, to which other computer and communication devices are attached.

NonStop systems support many types of devices, even those made by other manufacturers.



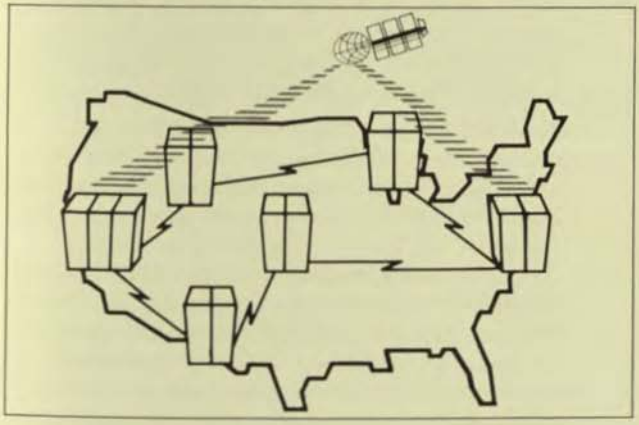
NonStop systems support a wide variety of devices manufactured by other vendors, including word processors and facsimile machines. Tandem systems can be programmed in COBOL, FORTRAN, BASIC, MUMPS, and TAL (Tandem's system programming language). And they support virtually all popular communications interfaces and protocols, including SNA (IBM's Systems Network Architecture) and X.25.

The list of Tandem communications products includes:

- SNAX—Allows your Tandem system to communicate with SNA devices and computers. Using SNAX, you can connect all your SNA devices to a NonStop II or NonStop TXP™ system. Or, if you have a large SNA host, you can use a NonStop II

or NonStop TXP system to reduce the workload on that host, moving your transaction processing applications to the Tandem system.

- INFOSAT™—The first computer network with fully integrated satellite communications, the INFOSAT communications system is a joint product of Tandem Computers and American Satellite Company. Using satellite communications to transfer large amounts of data between distant sites can be considerably less expensive than other methods. And with INFOSAT, your entire computer and satellite network is viewed as one system with continuous availability, high data integrity, and single-source maintenance.



- FOX (Fiber Optic Extension)—Allows up to 14 full-powered Tandem systems to be joined at a single site using fiber optics. Fiber optic cabling is not affected by electrical interference and moves information at the speed of light for very fast response times.
- X.25—A commonly used method of connecting computer equipment over distances. Tandem computer systems have the versatility to support virtually every major version in use today.
- AM3270—Allows your 3270-type terminals to operate when connected to a Tandem system.
- TIL (Tandem to IBM Link)—Links one or more NonStop systems with any IBM 370-compatible system.
- THL (Tandem Hyper Link)—Links a Tandem system to local NSC (Network Systems Corporation) HYPERchannel networks, allowing your NonStop system to communicate with a variety of systems made by other vendors. If you

have other large computer systems, THL will allow you to use them in conjunction with your Tandem system, preserving your investments in other equipment.

- EXCHANGE—The EXCHANGE remote batch workstation allows a Tandem system to appear as a 2780 or 3780 terminal to a host computer. It also provides certain remote job capabilities.

Other Tandem software programs make it easy for you and your staff to use the NonStop system. These include:

- Utilities—Tandem provides a series of utilities to simplify the interaction between you and your terminal. A text editor gives your terminal many of the attributes of a word procesor, making it easy to compose text on the screen. Changes are all made before the final copy is printed. No more need for erasers or white-out products.

  Tandem's TGAL utility makes it easy to get printed copies in the format you need. The DEBUG utility saves programming time, and the SORT utility helps you organize data the way you need it.
- XRAY™—A performance monitor, XRAY provides information to help your computer people balance loads on the system and fine-tune applications for optimum performance. XRAY monitors total system performance and spots overloads in work distribution. Bottlenecks in programs, processors, or devices are pinpointed for corrective action.

The Right System for Every Site

Some of your company's locations have greater processing demands than others. So to provide outstanding price/performance, Tandem offers a selection of systems that can be matched to the demands at each site. Every system is easily expandable from two to sixteen processors, and is fully compatible with other Tandem systems, able to share the same information and use the same programs.

The Tandem NonStop computer systems come in three performance ranges:

- The NonStop TXP system is designed for high-volume locations that process enormous amounts of data, support hundreds or thousands of terminals, and still require extremely fast response times. The most powerful computer specifically designed for transaction processing, the NonStop TXP system offers the highest performance for your computing dollar.

- The NonStop II system is ideal for sites with moderate to heavy computing requirements. This full-size computer system supports all of Tandem's products, and has the capability to grow larger and more powerful than many mainframe-type computers.
- The NonStop 1+™ system is designed for use at low-volume sites where less processing power is needed. The NonStop 1+ system provides a low-cost alternative for some of your company's smaller sites, which do not require the communications diversity of our larger systems.

State-of-the-art Peripheral Equipment

Perhaps the most visible part of a computer system is the peripheral equipment (terminals, printers, etc.). And Tandem offers a complete line of reliable, easy-to-use equipment designed for long hours of comfortable use. These state-of-the-art peripherals become an integral, complementary part of your NonStop system. They allow you to fully utilize the performance and convenience features designed into these powerful machines. Tandem's line of peripheral equipment includes:

- A variety of terminals—The 653X family of terminals are designed and built by Tandem to function as an integral part of your NonStop system. They are compatible with Tandem's extensive array of software products, and come in three sizes with 9-inch, 12-inch, and 15-inch monitors. They support 3270 terminal emulation, and voice and bar code input. And all Tandem terminals are ergonomically designed for increased user comfort and maximum productivity.

Tandem terminals support a variety of input methods, including bar code, wand, and voice.

- A series of printers—Full-size Tandem printers range in speed from 600 to 900 lines per minute and use the latest "band type" technology for reliable, trouble-free performance and flexibility. The band can even be changed for different type styles. Tandem also offers a matrix printer that types a fast 340 characters per second, and a letter-quality printer with easily interchangeable print wheels.
- A variety of disc drives—Tandem offers two types of disc drives: some have removable discs for high security, while others have sealed discs for easy maintenance. All drives offer good price/performance. They range from a small 64MB drive to a large-capacity 540MB drive. You choose the size and type of drive according to your needs.
- A series of tape drives—Reel-to-reel tape drives come in different sizes for different purposes and provide high reliability and good price/performance. Tandem's top-of-the-line tape drive operates at a very high speed and packs information onto the tape very densely. The result: information can be moved quickly, less tape is needed, and employees spend less time changing tape reels.
- A fault-tolerant earth station—When you move information via satellite using Tandem's INFOSAT product, you use the first earth station specifically designed to function as an integral part of a fault-tolerant computer network. You get sophisticated performance monitoring and single-vendor maintenance and repair.

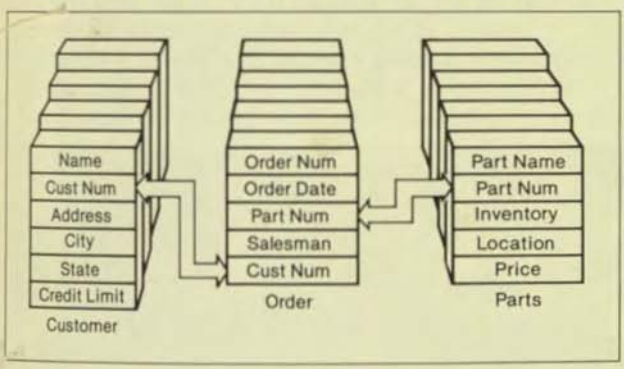
Relational Data Base—Capability without Complexity

A major difference between Tandem and conventional computer systems is the structure of the data base itself. Application programs are ever-changing in response to business requirements. A data base that is structured, unwieldy, or difficult to change poses more problems in the long run than it solves. So Tandem discarded conventional data base designs (e.g., hierarchical, network) and instead perfected a "relational" approach.

A relational data base simply means that information is organized in the form of tables. Since that's the way you look up information every day (e.g., stock market listings, airline schedules, financial statements), Tandem doesn't impose any additional artificial structure just because the data is managed on a computer; no strange computer acronyms, strings of numbers, or pointers.

To obtain information, simply use a key word (such as customer name or inventory item) or value (such as account number, order number, or part number) as your means of reference.

These tables or records can be located anywhere—on a single system, or on several systems, at one or several locations. And you don't have to keep track of where the data is stored; Tandem's GUARDIAN operating system locates and retrieves the information you need.



Tandem's relational data base stores information in a familiar, easy-to-use table format. Data is easy to access, and you needn't know at what location the information is stored.

The chief advantage of a relational data base is its simplicity. Setting up a data base merely involves creating and filling in the tables with pertinent data. To expand the data base, merely add new tables or add more rows of information to existing tables—without rewriting or modifying existing programs. The simplicity of the relational approach saves on program maintenance costs as well as initial development.

Such tremendous versatility is also your best insurance against data base obsolescence. Applications are flexible, so that weeks, months, years after startup, when unforeseen changes arise over and over again, your data base is adaptable and responsive.

Like the NonStop system architecture itself, Tandem designed its data base management system with your growth and expansion in mind. With Tandem, you don't pay a price for success, because we have already planned for the future.

TANDEM EXECUTIVE INSTITUTE

Tandem Executive Institute (TEI) was founded in 1981 to provide an educational forum for senior executives of large companies. Since its inception, over 275 senior managers from companies around the world have attended the Institute.

Issues discussed at the Institute revolve around managing and using information, the most vital of a corporation's assets. Because the emphasis in the conferences is on effective business management rather than the technical details of information systems, little or no knowledge of data processing is assumed.

Corporations are facing increasing pressure due to competition, the regulatory environment, and the economy. Although these pressures vary by industry, topics of interest in most conferences include changes in the industry, economic trends, strategic planning, the evolution of technology, information systems planning, and the use of technology to gain competitive edge.

Most conferences are industry-specific. Programs for the financial services, banking, manufacturing, and telecommunications industries are offered, in addition to a program for software houses. These conferences take place in Cupertino, California; Reston, Virginia; and London, England. Enrollment is limited to 25 participants so that the sessions are interactive.

Conferences include presentations, team case study workshops, demonstrations, and hands-on labs. Presentations are made by prominent academicians, industry executives, and Tandem executives.

In addition to the industry-specific programs, the Institute holds conferences for the senior executives of a single company. These programs are arranged on a custom basis for companies exhibiting a high level of interest throughout the executive organization.

CUSTOMER ENGINEERING

According to *Datamation* surveys, Tandem consistently rates highest in customer satisfaction above all other computer vendors (source: Cowen and Company/ *Datamation* 1980, 1981, 1982 and 1983 computer surveys).

Contributing to this high level of customer loyalty is Tandem's Customer Engineering group. This team of professionals is available to respond to your service needs 24 hours a day, 365 days a year.

And the service starts long before your system is installed. Customer Engineering helps you determine basic system configuration, aids you in site planning and preparation, and coordinates the installation of your NonStop systems. This comprehensive predelivery service helps ensure that installation proceeds smoothly and on schedule.

In addition, Customer Engineering offers complete training for your staff. Subjects range from basic user information to operator diagnostic instruction.

From over 100 sales and service offices throughout the world, Tandem offers a variety of flexible, yet comprehensive support programs that let you choose the level of service you need. Whether you require continuous service from on-site personnel, or simple per-call service, Tandem's Customer Engineering team of professionals has a plan to fit your needs.

SOFTWARE EDUCATION

The goal of Tandem's Software Education program is to educate you and your staff in the operation and use of NonStop systems. Classes are taught at Software Education Centers worldwide.

Each class covers subjects relevant to its participants, from the highly technical programmer to the nontechnical user. Some of the subjects discussed include system operation, application program design and development, data communications, Tandem technical support, and performance management.

The classes are divided into six categories. Some are considered required courses, some are recommended, and the rest are optional, depending on your specific needs. In addition, they are designed to cover different levels of technical depth to accommodate the technical expertise of the participants. All courses emphasize hands-on experience and include numerous laboratory sessions. Students are encouraged to make use of Tandem documentation, including technical manuals.

The six categories are as follows:

- Operations—These classes are designed for the nontechnical user who is unfamiliar with the computer, and unconcerned with the more technical aspects of its use.
- Application Design—This set of courses covers the analysis and design of an application program. Typical job titles related to application design might be programmer, analyst, project manager, systems analyst, data base designer, and data base administrator.
- Application Development—These classes include the writing and implementation of application programs. Titles related to these courses include application programmer, programmer/analyst, lead programmer, and systems analyst.
- Data Communications—These courses meet the needs of developers responsible for the design and implementation of data communications interfaces and networks. Associated job titles include network designer, data communications specialist, and systems analyst.
- Performance Management—Performance Management courses cover system load balancing and other subjects related to performance evaluation

and management. Job titles associated with these courses include systems programmer, system manager, and performance specialist.

- Technical Support—System-level software, system generation, and overall management of the system are covered in these courses. Attendees include systems programmers and system managers.

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COMPANY HISTORY

Tandem Computers Incorporated was founded in 1974 by four computer and business professionals who recognized the need for a computer that could continue processing without fail. Eighteen months later, the first Tandem NonStop system was shipped. A multiple-processor computer, the NonStop system keeps on running even if one of its vital components fails.

Tandem NonStop systems satisfy a full range of computing requirements at the largest of corporations. The NonStop TXP system is the world's most powerful computer for on-line transaction processing, able to handle enormous volumes of information, while providing very fast terminal response time; the NonStop II system is ideal for sites with moderate to heavy computing requirements; and the NonStop 1+ system is designed for use at lower-volume sites with small to moderate processing needs. All NonStop systems are compatible, able to use the same programs and share the same information.

Tandem became profitable in its third year and went public in 1977. Revenues have increased from $7.7 million that year to over $418 million in 1983. Operating income has grown from $400,000 to $49.8 million, while net income rose from $325,000 in 1977 to over $30 million in 1983.

Today, Tandem is among the Fortune 500 largest U.S. industrial corporations. Over 750 organizations use 6,800 Tandem processors worldwide (as of March 1984) in over 25 industries including manufacturing, banking and other financial services, wholesale and retail distribution, medical, communications, computer services, transportation, printing and publishing, legal, and utilities.

Tandem's success is due in part to our ability to meet the needs of our users. The Tandem system's fault-tolerant architecture, integrated GUARDIAN operating system, and easy-to-use programming tools enable users to implement critical on-line applications such as credit verification, electronic funds transfer, medical life support systems, message-switching, reservation systems, and distribution. Continuous system availability, modular expandability without reprogramming, and data base integrity are designed into all Tandem NonStop systems.

At Tandem, we have focused our marketing strategy on selling to corporations that are implementing major on-line applications. As a result, the majority of our business is done through direct sales to end users. The ratio of repeat business is high; many of our customers

expand their systems within 12 to 24 months of the initial purchase. This customer loyalty and satisfaction is due also to our responsive support with a worldwide staff of systems analysts, customer engineers, and software education instructors.

Tandem operates manufacturing facilities at Cupertino (headquarters), Santa Clara, and Watsonville, California; Reston, Virginia; Austin, Texas; Bensenville, Illinois; and Neufahrn, West Germany. Tandem has over 65 sales and service offices in the United States, and maintains offices in Australia, Belgium, Canada, Denmark, England, France, Hong Kong, Italy, Japan, the Netherlands, New Zealand, Norway, Singapore, Sweden, Switzerland, and West Germany.

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Which one of the following most closely describes your position?

- ☐ President
- ☐ Vice President
- ☐ General Manager
- ☐ Division Manager
- ☐ Department Manager (specify) _____
- ☐ Staff (specify) _____
- ☐ Other (specify) _____

What is your company's annual sales?

- ☐ Under $100 million
- ☐ $100 - $500 million
- ☐ $500 million - $1 billion
- ☐ Over $1 billion

TANDEM

NonStop® Computer Systems

Which one of the following most closely describes your business classification by end product or service?

- ☐ Banking
- ☐ Other Financial
- ☐ Manufacturing
- ☐ Wholesale Trade
- ☐ Retail Trade
- ☐ Transportation
- ☐ Communications
- ☐ Medical/Hospital
- ☐ Printing/Publishing
- ☐ Energy
- ☐ Service Bureau
- ☐ Federal Government
- ☐ Other _____

☐ Please have a sales representative contact me.

Name _____

Title _____ Phone _____

Company _____

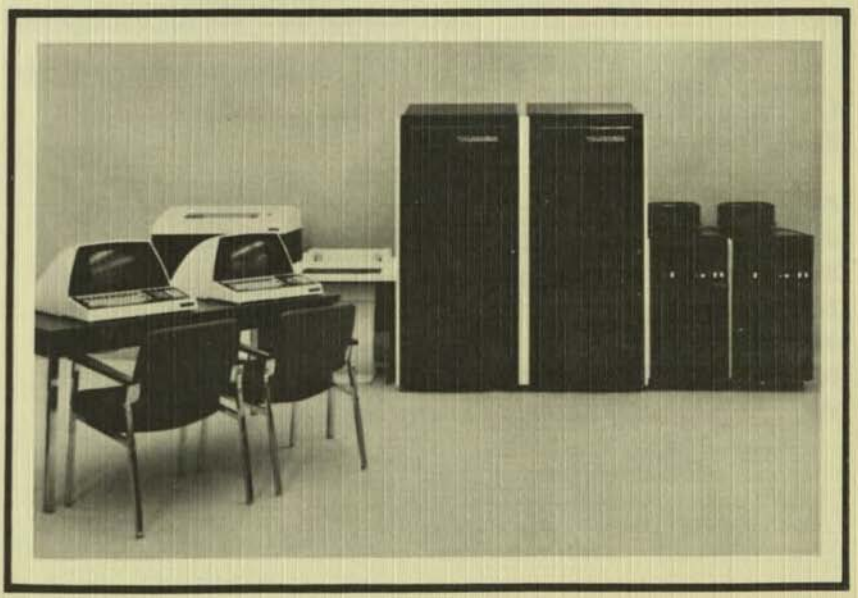
Address _____

City _____ State _____ Zip _____

TANDEM
COMPUTERS

On-Line Processing with NonStop™ *Systems*

an
executive
overview



A TANDEM NonStop™ System

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LIST OF ILLUSTRATIONS

EXECUTIVE PRODUCT SUMMARY

This summarizes the PRODUCT DESCRIPTION, page 43.

The **TANDEM** NonStop™ system is tailored specifically to the end-user whose applications require high volume on-line, interactive, transaction-oriented data processing. To implement these applications, the on-line, end-user needs:

- Protection from down-time — *high system availability.*
- Protection from corruption or loss of the data base because of system or disc drive failure — *data base integrity.*
- The capability to expand the system according to growth needs without reprogramming — *modular expansion that is transparent* (no conversion or reprogramming).

The on-line end-user's computer system must be capable of:

- Handling a high volume of transactions.
- Providing rapid access to small and large data bases.
- Flexibility in structuring, accessing, and securing data bases.
- Flexibility to meet growth requirements.
- Supporting a large number of screen-oriented terminals.
- Operating within a distributed data processing environment.

TANDEM recognized the trend away from the "batch" concept of data processing. Through extensive market surveys, **TANDEM** identified an emerging pattern — end-user demand for a standardized, off-the-shelf, affordable, on-line computer system that could operate in a fault-tolerant mode in a transaction-oriented communications environment.

TANDEM set the following goals:

- Automatic recovery from any single component failure — continuous operation.
- Data base integrity.
- Modular expandability without conversion or reprogramming.
- Ease of application development.
- Distributed data processing.

TANDEM designed its system architecture — hardware and software — in an integrated, top-down fashion to meet these specific end-user requirements.

TANDEM sees continuous operation, modular expandability, ease of application development, data base integrity, and distributed data processing as the "building blocks" of the NonStop system.

Features of TANDEM NonStop Systems:

- No single component failure will stop the system.
- Maintenance and replacement of failed components can be done on-line without bringing the system down.
- The GUARDIAN operating system responds dynamically to component failure, instantaneously reallocating resources according to end-user priorities.

For an illustration of **TANDEM's** *unique NonStop System Architecture, see page* **44.**

The **TANDEM** system is based on multiple, independent processors. All system configurations employ multiple (at least two) processors, multiple data paths between system modules, and multiple power supplies. When a component fails, the GUARDIAN operating system automatically reallocates the workload to other system resources and the program continues uninterrupted throughout the failure and repairs.

TANDEM's high-speed dual bus structure — the DYNABUS — connects the processors, handles interprocessor transfers at the rate of 13 megabytes per second per bus, and insures that there are always two communications paths among all processors.

For maximum efficiency, the **TANDEM** system employs all its processing modules and data paths for processing workloads. There are no idle back-up components utilized only during failures. System productivity is the aggregate power of all its components.

Modular Expansion — Growth Without Reprogramming

- The ability to size the system precisely to end-user requirements.
- A minimum configuration of two processors, capable of expanding to sixteen processors without reprogramming or conversion.
- Expansion in small or large increments:

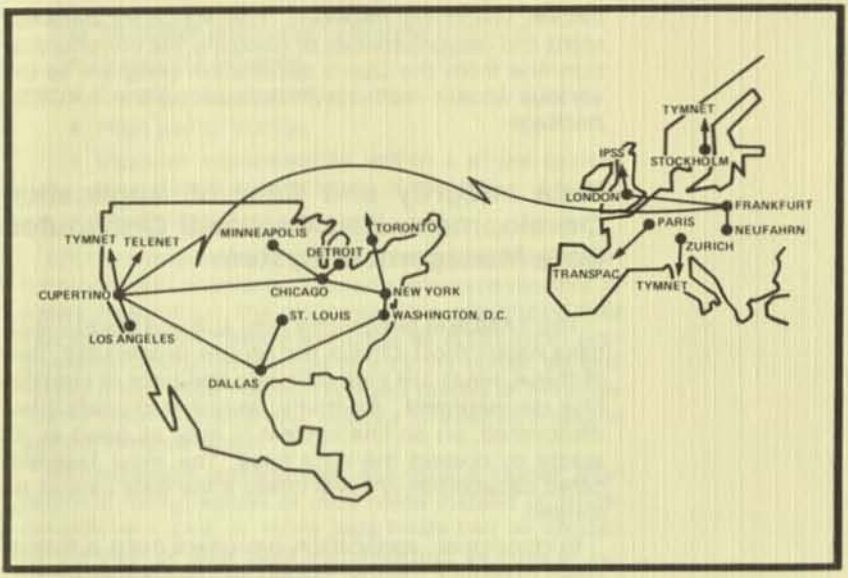
CPU Memory Sizing	I/O Controllers
Disc Drives	Terminals

With GUARDIAN/EXPAND:

- Up to 255 nodes in a network.
- Up to 4,080 processors in a network.

DISTRIBUTED DATA PROCESSING:

- Message and packet switching capabilities.
- Communication with IBM or other mainframes using standard industry protocols.
- X.25 compatibility.



GUARDIAN/EXPAND NonStop Network

Every **TANDEM** system is already a network — a network of processors, managed by an operating system that sees all programs and data transfers as files distributed over a network of processors. Programs can access any device anywhere in the system, even devices that are not physically connected to processors running the program. Only the message-routing part of the GUARDIAN operating system knows the geographic location of resources, enabling dynamic data transfer and reallocation of resources.

Distributed data processing or networking on the **TANDEM** system is simply a logical extension of system design. Expansion becomes a relatively simple matter of adding resources.

The user has several options for system growth. He can expand from a dual processor configuration to sixteen processors within a system without reprogramming or conversion. The GUARDIAN/EXPAND software permits up to 255 geographically dispersed **TANDEM** systems to be linked in a distributed network with a maximum of 16 processors in each system.

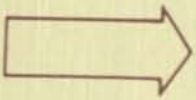
AXCESS software provides **TANDEM** systems with file system level access to multipoint communication devices such as IBM 3270/3271 terminals and the Tandem 6520 and to either remote asynchronous devices or host computers attached to an X.25 public

packet switching network. The AXCESS package shifts the responsibilities of handling the communication line from the user's application program to the various access methods that make up the AXCESS package.

Data Integrity and Ease of Application Development: ENCOMPASS Distributed Data Management System

The **TANDEM** philosophy is to address the key data base needs most critical for on-line processing. Two of these needs are data integrity and ease of application development. As many on-line end-users have discovered, an on-line system is only as good as its ability to protect the data base. The most sophisticated capabilities are worthless if the data cannot be trusted.

Furthermore, application designers need a framework to reduce their workload so that their programs become as easy to write as batch.



The ENCOMPASS software package supplies all the procedures, programs and application structures necessary to allow users to write on-line transaction processing application programs with a modular approach. Specifically, ENCOMPASS was developed to meet the following requirements for the transaction-oriented environment:

- High data integrity and availability.
- High performance.
- Application simplicity for design, implementation and operation of on-line transaction processing applications.
- Unique on-line transaction auditing and backout capabilities — even in distributed data base environments.
- Automatic adjustment to varying transaction loads.
- Expansion capability.
- Flexible and efficient access methods.
- Flexible relational data base structure.
- All the benefits of NonStop hardware and software.

TANDEM chose the relational model to implement its data base management system because it offers the end-users a simple, flexible approach for creating structures to implement applications. In relational models, every file is self-contained. No information is dependent on actual physical address or other physical devices, such as hard address pointers. Thus, changes can be made in a data base without necessitating a change to application programs.

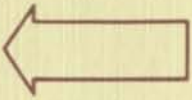
The **TANDEM** relational data base provides:

- High data integrity.
- Constant availability.
- High performance.
- Modular expandability within a single system or a distributed network of systems.
- Flexibility.

Efficient data base access is provided through careful placement of data on a disc to minimize number of seeks. In addition, the most recently referenced data blocks are kept readily available to application programmers through the use of a cache buffer. By buffering these most frequently used pieces of information in main memory, disc activity is reduced and data access is more rapid.

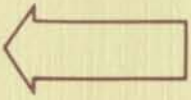
Relationships among files are logical rather than physical, using values of data fields instead of physical pointers. One or more data fields can be chosen by the user or data base administrator as keys or access paths to retrieve data rapidly.

The NonStop system combines the flexibility of the relational model with the capabilities of ENCOMPASS software to simplify the complexities of application programming. Both front end and back end problems of on-line, NonStop processing are solved by ENCOMPASS which allows the end-user to concentrate on the application.



Front end problems associated with terminal management and transaction definition/application control are handled by a transaction processing system (this segment is designated PATHWAY transaction processing system) which provides programs, procedures and application structures necessary to produce user-written applications in less time.

Back end problems are solved by a data base manager (designated ENSCRIBE) which distributes data across multiple processors and discs and provides multiple points of control and a natural growth path in a distributed data processing environment. A transaction monitoring facility provides transaction backout to ensure a consistent data base in both a centralized and distributed on-line environment. Data definition and a powerful ENFORM query/report writer are also supplied.



The ENFORM query/report writer provides the user with a powerful, easy-to-use nonprocedural language for querying or developing reports on relational data bases. ENFORM benefits include:

- Decreased time spent on report generation.
- Elimination of maintenance of report programs.
- Easy customization of query/report applications.
- Transparent and efficient data base access.

For more on **TANDEM**'s *Software Support, see page 55.*

Although the ENCOMPASS distributed data management system is an integrated software system, its components can be used as individual software packages.

For a more detailed description of NonStop systems, see PRODUCT DESCRIPTION, pp. **43-48.**

APPLICATION STORIES

CHASE MANHATTAN BANK

Account Locator

In 1977, *Chase Manhattan Bank's* Controller's Office was receiving 1500 calls a day for account verification and customer account relationship information from other banking departments. Forty-five to fifty clerical personnel were employed to manually access, update, and file 1½ million 3 × 5 cards on three-quarter million customers to respond to these enquiries.

The Problem:

The system was completely manual. The 3 × 5 cards were located in eleven Diebold rotating tubs. Access time was typically one and one-half minutes; updating was cumbersome, time-consuming and required changes in as many as 18 places in the files. Cards were frequently misplaced or lost. An entire room was needed just for storage of keypunched cards. Even worse, Diebold, because of the age of the automated tubs, ("vintage 1946"), no longer offered field maintenance. When these tubs failed, bank personnel had to handcrank the tubs to gain access to the index cards. To restore these manual tubs to service required that *Chase Manhattan* retain a blacksmith in Yonkers to rework or fabricate new parts.

The operation was "labor intensive, redundant, and inefficient." *Chase Manhattan* decided to look for a method of automating the old system. *Chase Manhattan* needed a new system — one that would improve labor productivity, accommodate a growing demand to access customer information, provide tighter security and control over access to this customer file, and improve service to other departments.

Alternatives Considered:

The Controller's Office began evaluating alternative solutions for their Account Locator and Account Numbering applications in 1977. The first option considered was an on-line utility approach, using an IBM 370 mainframe. To implement this option required a special communications interface at a high internal charge for the Controller's Office. The second problem with this option was that it provided no control over scheduling of systems resources and the security of the data base. The last objection to this equipment touched on the issue of data base growth and the requirement for a modular path for system expansion without costly conversion.

The second option, a microfiche application, was rejected because of its rigidity. Expansion to allow for growth of the data base (data elements) was not cost-effective using the microfiche concept. In addition, users that could justify an "on-line" terminal to access the data base were locked out by the microfiche solution.

The third option gave the Controller's Office three critical features: (1) security of the data base and control of the on-line system, (2) access to the data base via terminals so that other sections of the bank could be "self-sufficient" and, (3) modular expansion options to handle growth through the 1980's without reprogrammming any of the applications.

The Controller's Office staff had not decided at this point that their application needed to be up all-the-time. However, one advantage of microcomputers was that a back-up system for a mini would be cheaper to develop than for a mainframe system such as the IBM 370, if they wanted to explore this option.

Using a matrix format, the Controller's Department and their consultants evaluated a number of systems. Entrex and the IBM System 3 were eliminated first. Remaining on the short list were the Data General Eclipse, DEC PDP 11/70's with special software, and the **TANDEM** system. The criteria for evaluation were: (1) cost of development, (2) system reliability, (3) field maintenance record, (4) modular growth potential without reprogramming, (5) programming language options supported, (6) back-up system for "full-availability" and, (7) financial stability of the vendor.

TANDEM was first recommended by a software consultant. At the time, **TANDEM** had only been marketing for a year. The product looked good and the cost was attractive, but the Controller's Office still had doubts. "Being of an accounting background," said one department spokesperson, "although the product seemed superior, and the numbers were attractive, two points bothered me. The first thing I worried about was **TANDEM's** being a little shop in somebody's garage. The second point was if IBM was going to come along and drive this young company out of business."

The first turning point in the selection process, according to the Manager of Special Projects, was a demonstration of the application by **TANDEM**. A **TANDEM** representative presented a prototype of the *Chase Manhattan* application "with ease," halting processors and discs to demonstrate how the **TANDEM** system remained operational. "This demonstration of NonStop systems convinced us that this thing was for real. We decided to investigate seriously."

A consulting firm was asked to evaluate **TANDEM** according to the preset criteria. The firm took a skeptical attitude towards **TANDEM**. In fact, they proposed a system using Data General and promised to disprove **TANDEM's** claims.

After on-site analysis of the company and product, "the consultants came back and did a 180-degree turnaround. They not only recommended **TANDEM**, but they rebid using a **TANDEM** system." *Chase Manhattan* representatives visited **TANDEM** headquarters in California. They were especially impressed by **TANDEM's** production facilities and quality control. They also received input from users who had been operational for a year or more, without their **TANDEM** systems being down. These facts convinced the Controller's Office that the **TANDEM** system was designed for their application.

Why TANDEM?

Of the three companies, (DEC, Data General, and **TANDEM**), **TANDEM's** bid was the lowest. However, this cost did not reflect the true "bargain" the Controller's Office saw in purchasing the **TANDEM** system. "We were getting the NonStop system architecture and performance — free. Although we selected the **TANDEM** system principally for ease of expansion, mirrored volume capabilities, and flexible file structure, getting fault tolerance for the same price ... was truly a bargain."

Although continuous availability was not vital to the application, it gave **TANDEM** a significant advantage over Data General and DEC in terms of system reliability.

TANDEM at the time did not have a track record on maintenance, but the NonStop system's architecture meant that component failures would not be as critical. Troubleshooting and repair were also significantly easier on the **TANDEM** system because of its on-line maintenance capabilities.

TANDEM end-users interviewed by the consulting firm verified that **TANDEM** was significantly easier to operate than either DEC or Data General. Comparing other systems to **TANDEM** for ease of operation was "like night unto day," according to one user.

In comparing ease of adding components, memory, processors and peripherals, **TANDEM's** easy modular expansion without reprogramming was another advantage over DEC and Data General. "If we made a mistake about sizing," said one member of the development team, "we could always add another CPU to our **TANDEM** system instead of facing a major conversion to a more powerful system."

For more on MODULAR EXPANSION, see page 2.

All three vendors quoted 90-day delivery, bu **TANDEM** promised part of the system within 6–8 weeks from contract.

Data General had no high-availability software for multiprocessor systems. Special software was required to put the application on DEC. However, all the basic tools, including operating system, utilities, file management system, screen formatter, compilers and communication package required for the application were available from **TANDEM** and were considered to be superior.

See COMPANY HISTORY, page 65.

TANDEM scored lowest on market share because of its newness but demonstrated good management and financial backing. "The company seemed to be well-managed, well-organized, and controlling their growth. The **TANDEM** system was obviously a superior product, and the price was right."

The TANDEM Solution:

The *Chase Manhattan* Account Locator and Account Numbering system includes two processors with 384 KB memory each, two 45 ips tape drives, five 240 MB discs, one 600 lpm printer, and 31 page-mode terminals. Software packages include the ENSCRIBE data base manager, the ENTRY screen formatter, TANDEM/COBOL, and the SPOOLER utility.

Creation of the data base was a major conversion task. It required temporary clerical personnel to process 10,000–12,000 cards a day for six months. The application program was written entirely in TAL (**TANDEM's** Transaction Application Language) by Monchik-Weber software consultants, and a *Chase Manhattan* programmer trained in TAL at **TANDEM's** Education classes. Implementation was very rapid — from mid-February to June, 1978.

*For more on **TANDEM's** Education Network "TENET", see page 63.*

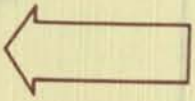
Current Applications:

The current system combines the Account Locator and Account Numbering functions. Inquiry can be made by customer name or account number; partial keys can be used if the name is misspelled or if the information is incomplete. Up to 30 operators can access the system from terminals located throughout the bank; forecasts show this number increasing to 100 operators in the near future. The operators make 1,500–2,000 inquiries a day, and perform 600 – 700 updates. Updating is done "on-line." Access time is in the range of three to four seconds per transaction. The system also creates a transaction record and a log of inquiries for updating. The application is split between the two **TANDEM** processors. *Chase Manhattan* has recently brought up a second

application on this **TANDEM** system — running Corporate Payroll, feeding the output directly into their Funds Transfer system.

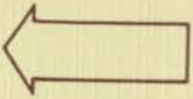
Benefits of TANDEM System:

Major cost savings of the system are reduction in clerical personnel. Fifty percent of the original staff required for the labor-intensive automated tub operation has been freed for more productive projects, resulting in an ROI of 34% and payback in approximately 18 months. Data base integrity has been increased dramatically and access time reduced from one and one-half minutes to three or four seconds. In addition, "bank personnel don't have to make five phone calls to get the information — they now can go to one source and get the information almost instantly."



A second benefit is high system availability. "We have no down time, no dissatisfied terminal users, and much tighter control over the data base. We now have a good grasp on incoming data and know that data can't get lost. The biggest advantage to *Chase Manhattan* is that the data base is current — before, it was as much as a week old."

The **TANDEM** system can be operated by clerical personnel . . . with little or no formal training. "When we get praise on the ease of running our **TANDEM** system from a Grade V clerk, we're impressed," says one Controller's Office vice-president.



Doubts about "the little shop in someone's garage" have been laid to rest. "We're overwhelmingly surprised with **TANDEM's** reliability. Support has been good. They don't overpromise; we've had no down time since Febuary 1978, the date of installation."

Said one department spokesperson in summation: "The **TANDEM** system raises expectations other systems can't match. Our system has served us well. We got what we wanted — a reliable, well-designed, well-integrated system — at a cost we could afford."

CASE HISTORY HIGHLIGHTS

User	• *Chase Manhattan Bank* New York City, New York
Industry	• Banking
Application(s)	• On-line Account Locator and Account Numbering for customer verification
Problem	• Labor intensive, inefficient manual system using antiquated equipment • Poor security
Competition	• Data General, DEC
Why **TANDEM**?	• Price • Ease of expansion • Mirrored volume capabilities • Flexible file system • General system reliability
Date of installation	• January 1978

— PITNEY BOWES —
Remote Meter Resetting System

Pitney Bowes of Stamford, Connecticut manufactures approximately ninety-five percent of the postage meters used in the United States. Eighty-five percent of the revenue of the $711,000,000/year company derives from its Business Systems Division, principally from the domestic and international sales, rental, and service of its internationally-known mailing equipment, which includes postage meters, parcel registers, and mailing machines. At the end of 1978, *Pitney Bowes* reported an installed inventory of 876,980 postage meter systems in Canada, Great Britain, and the United States.

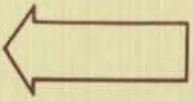
In 1976 *Pitney Bowes* began the development of "the most dramatic breakthrough in postage meter technology" since *Pitney Bowes* pioneered the metered mail system in 1920 — the Remote Meter Resetting System (RMRS). According to company representatives, RMRS represents "the first successful attempt to link the postage meter with computer technology." The application is designed to reduce the time required for meter resetting from an hour to a 90-second phone call to the RMRS computer center in Stamford.

This will be accomplished by eliminating the necessity to transport the postage meter to a post office where it is manually reset by U.S. Postal Service employees. Instead, customers that use RMRS communicate directly with the **TANDEM** computer and the "on-line data base." The RMRS system gives the customer the combination to unlock the meter and reset it.

The RMRS system also handles advance deposits, payment to the Postal Service, and customer billing. Customer remittances are sent to a lock-box bank, where they are processed and forwarded to a trustee bank. The funds are later transferred to the Postal Service when meters are reset. *Pitney Bowes* does not receive the customer deposits directly, but is responsible for customer billing, funds movement, and service.

The Problem:

To implement this innovative application, the company needed an on-line computer system they could rely on — a system that was truly fault-tolerant, maintainable, and available. Delays in customer service could not be tolerated. Of equal importance was protection of the data base required to implement meter resetting and the financial transactions among



the customers, lock-box and trustee banks, Postal Service, and *Pitney Bowes* Accounting Departments.

Conceptual design of RMRS involved market research; human factors field tests at pilot customer sites; and an exhaustive search for the most reliable computer to support the application.

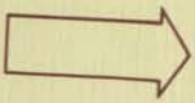
Pitney Bowes' highest criterion was up-time, followed by throughput, ease of use, maintainability, and system flexibility for growth. Price, within reasonable limits, was the least important of the criteria.

Alternatives Considered:

The search team narrowed the list to IBM, Univac, DEC, Honeywell, Data General, Burroughs, and **TANDEM**. Although price was not a major consideration, **TANDEM's** quote was the lowest.

Pitney Bowes did benchmarks on Burroughs, DEC, and **TANDEM**. Evaluating the three systems with a weighted matrix analysis, the company found that throughput, field engineering and available software were equally competitive at that point in time. This meant the final choice had to be based on fault-tolerance and maintainability. Here, the difference in systems architecture and design approach was dramatic.

Why TANDEM?



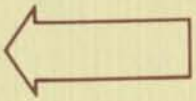
"The other systems were all hybrids," stated a member of the search team. "They were all unique, one-of-a-kind solutions to our problem — only **TANDEM** offered an off-the-shelf fault-tolerant product."

The differences in approach to fault-tolerance and systems integrity were equally dramatic. "The other approaches we considered were 'cold start' approaches — one back-up computer had to be switched over manually if the primary CPU failed, leaving us with an exposure time of fifteen minutes to one and one-half hours. . . . This was certainly more exposure than we could tolerate. The other systems were equally unconvincing in regards to data base integrity during periods of down time."

TANDEM rated #1 on systems availability. However, there was still an obstacle to making the final choice. "The biggest hurdle to **TANDEM** was the relative newness of the company," a company representative stated. "*Pitney Bowes* is cautious, low-key, and methodical." The product looked excellent; but *Pitney Bowes* wanted to be doubly sure that they could depend on it.

Company policy for the RMRS project was "to do it ourselves," rather than depend on OEM's, turnkey operations, or outside assistance. *Pitney Bowes* representatives decided to interview **TANDEM** customers

to gather their own evidence about the system in action. "Visiting **TANDEM** headquarters in California, and interviewing **TANDEM** users such as Wells Fargo Bank and the Tandy Corporation convinced us of the **TANDEM** system's reliability and supportability. After the visits to users, we were sold on **TANDEM**."



The TANDEM Solution:

In October 1978 *Pitney Bowes* installed their **TANDEM** dual processor system in a highly specialized computer data center, custom-designed and constructed to support the RMRS system and provide for fail-safe, uninterrupted processing of incoming customer calls. The data center is constructed to operate in a self-sufficient environment, including a separate fire protection system, a stand-alone air conditioning system and a separate, uninterruptible power supply.

The RMRS system in its entirety includes the computation and control of reset combinations; telephone line and computer facilities for direct customer-computer contact; handling applications of funds forwarded by the lock-box bank; customer invoicing and service charge billing; and the interface of the computer system with operations and support staff.

At the heart of the application are two **TANDEM** processors, 288 KB memory each; mirrored data bases; two subsystems of dual ported controllers and 160 MB disc drives; two mag tapes; eleven terminals; one 600 lpm printer; one 900 lpm printer; and two interfaces with the Votrax Audio Response Unit (ARU).

The ARU's are moderately intelligent communications devices directed by the **TANDEM** computer. To complement the **TANDEM** system's fault-tolerant operation, one ARU is in active mode and a back-up can be switched into the system in case of failure. Dual paths and modems are also employed.

Current Applications:

The **TANDEM** system directs customer transactions, posts remittances, and manages disbursement of funds. The **TANDEM** system interacts directly with the Votrax Audio Response Unit; an IBM 370; tape-to-tape transporting mode with 1122-88 Univac mainframes; and DEC PDP 11/34 tape swapping.

In-bound WATS network lines terminate at the ARU. The ARU decodes the analog telephone signals transmitted by the customer's touch-tone telephone or acoustic touch-pad and transmits the message in digitized signals to the **TANDEM** computer via asynchronous controllers.

The **TANDEM** computer prompts the ARU to request the customer to enter his customer account number, meter serial number, and current ascending

and descending register readings. The **TANDEM** system then validates and verifies the information; decides if the customer has sufficient funds on account to receive a reset; and inputs variables to the combination algorithm. The combination algorithm computes the next combination that will unlock the customer's meter for reset.

The **TANDEM** computer directs all messages to the customer through the ARU. If the **TANDEM** system decides that customer funds are insufficient for a reset, the ARU is prompted to deny the request for a new combination and instructs the customer to speak to a customer assistance clerk. At this point, the **TANDEM** computer automatically switches the customer's call to a service representative.

The **TANDEM** computer then deducts amount of reset from the customer postage account, and updates the file of amount owed by *Pitney Bowes* to the U.S. Postal Service. Meter activity records and other elements of the data base are also updated to indicate customer activity.

The **TANDEM** computer then generates a statement on reset activity, which is mailed to the customer the following day, showing transaction information and the amount of money remaining on account. In some cases, the statement is also a request for customer remittance of additional advance deposit funds for a future meter reset.

If the customer has sufficient funds on account, the **TANDEM** computer can issue multiple resetting combinations. If the customer has failed to enter combinations previously issued, the **TANDEM** system issues the old combinations by automatic default but does not decrement the customer account again.

The system is available for customer transactions six days/week, from 7 AM–8 PM EST. The peak time for customer calls is 2:30 – 3:30 P.M.; frequency of reset requests per customer is approximately once a month. If customer calls are spaced evenly over twenty working days, the company estimates that the system may be handling up to 10,000 calls during a peak hour. RMRS managers predict that in the worst case, the system will be handling 1,500 ARU transactions an hour by 1983, involving an average of five disc accesses per transaction.

The RMRS data base can be accessed via terminals by customer assistance clerks to establish new accounts and handle inquiries. Remittance exception clerks also access the data base to input checks processed by the lock-box bank but not automatically applied to the data base. The remittance clerks determine daily which checks have been processed but not applied and initiate transactions reconciling the

check's data to the RMRS account. *Pitney Bowes* has developed a unique data base server program for applications programs that receives information before it is passed on to **TANDEM's** ENSRIBE data base management system, for additional security.

The **TANDEM** computer also interfaces with existing *Pitney Bowes* Univac systems, transmitting data for sales analysis, marketing, and financial information.

To implement this complex application, *Pitney Bowes'* internal software staff designed and wrote over 100 programs in **TANDEM**-supported COBOL and TAL. **TANDEM** software packages utilized in the application are: the ENSCRIBE Data Base Manager; the EXCHANGE package, for receiving data from the lock-box bank's IBM 370 and Merrimatic Telecommunications system; the ENVOY Data Communications Manager; and **TANDEM's** GUARDIAN Operating System. RMRS went on-line in April, 1979 after several man-months of development, using a staff of approximately 10 programmers and five system analysts.

A **TANDEM** system has been purchased to implement a nine-month field test of RMRS in the United Kingdom. The application will closely resemble the American system, with the exception of changes in currency and post office regulations.

Benefits of the TANDEM System:

"It works!" says a *Pitney Bowes* technical support representative. "We made our selection on reliability and our highest criterion has been satisfied. . . . The reliability of the **TANDEM** system really is superior."

Confirms another *Pitney Bowes* DP manager, "This system is ahead of the competition. Our search proved that 100%. When **TANDEM** talks about maintenance, the term takes on a new meaning. The **TANDEM** system runs "NonStop," and "NonStop" means that when a component failure occurs it doesn't halt your application . . . and the **TANDEM** field engineer fixes the problem without bringing the system down. **TANDEM** really does what it claims to do."

CASE HISTORY HIGHLIGHTS

User	• *Pitney Bowes* Stamford, Connecticut
Industry	• Major manufacturer of postage meters and mailing equipment
Application(s)	• Remote Meter Resetting System for customer postage meters
Problem	• Needed fail-safe, fault tolerant system to implement new remote Meter Resetting System application
	• System availability vital to application
Competition	• DEC, Burroughs
Why **TANDEM**?	• Only truly fault-tolerant, "NonStop" computing system at this time
	• On-line maintenance
Date of installation	• October 1978

— LIEBERMAN ENTERPRISES —
Order Entry and Inventory Control

Lieberman Enterprises is a privately controlled holding company composed of four separate corporations. The primary revenue stream is generated by operating and managing a national network of wholesale record warehouses which recently absorbed ABC Records and Tapes. *Lieberman Enterprises* also include the Carrousel Snack Bar chain and a division that wholesales coin-operated vending equipment. Headquarters are in Minneapolis, Minnesota, with branches nationwide. Combined gross sales volume was approximately $150 million during 1978.

Problem:

Lieberman's first problem was to select a data processing system to accommodate a compound growth rate of 30% annually, without incurring extensive conversion costs to change their data processing system every 20 to 26 months. The company started with an IBM 360 batch system. In the next seven years, *Lieberman*'s growth took them through four (4) major mainframe conversions — Honeywell 115, 2040A, 6420, and 6440. Along the way, they changed data base systems twice and added teleprocessing. *Lieberman* finally examined the cost of conversion from the viewpoint of its impact on their business. They estimated that the lack of system availability during conversion to a larger system would entail a loss of $2,000,000 in sales orders each week.

A second major problem was a business requirement to go on-line with all applications and to focus on operating a distributed data processing system to control the profitability of their remote warehouses and fast food outlets. *Lieberman*'s four remote record distribution centers in Chicago, St. Louis, Kansas City, and Dallas, individually do the same business volume as the main warehouse in Minneapolis.

"Perishability is the name of the game in the record distribution business. A particular recording may reach its zenith in terms of sales and hold that peak popularity for a period of days or weeks. Speed and accuracy of telephone order processing is our blood line," said one *Lieberman* manager. "It's much like fresh produce — our records have a predictable shelf life. For disco albums, it is generally less than 15 days. Inventory movement and control equals profitability. It's simple, we can't afford to be down . . . it costs us $400,000 a day or $50,000 an hour in lost sales and stale inventory."

The record distribution business focuses directly on the control of floor and rack sales space at large retail outlets. *Lieberman* offers a complete retail rack service to the record retailer; i.e., no store personnel are involved with the records in terms of merchandising, promotion, stocking, repricing, or inventory control. This is known in the trade as the "rack business."

Lieberman also acts as a total product supplier for small retailers in metropolitan areas. In the trade, these outlets are known as "one-stop" shops. One-stop retailers manage their own inventory. They can trade with several suppliers or pay an additional cost to obtain all labels through a major distributor like *Lieberman* — if the service warrants the cost.

Timeliness and accurate stock status information are especially critical for "one-stop," which works like a newspaper's city desk. With *Lieberman*'s old batch system, the customers called in, orders were written up manually, and items were picked without reference to current inventory levels. Data capture of the transaction took place after the goods had left the warehouse. Adjustments to an order for partial shipments or back-orders involved several manual steps vulnerable to clerical error and difficult for a customer to reconcile.

"In short, the old system worked because there was no alternative. But we could not service the growth in terms of new customers and existing business without an on-line system such as **TANDEM** offered," commented one Lieberman supervisor. "This business is time-dependent — we stay in business by delivering to the retailer 98.5% of the items ordered, within four days of receipt of the order."

Lieberman needed a data processing system that could handle a high volume of telephone orders, provide immediate access to stock status, and automatically generate inventory reports during the order process. "Untimely delivery or failure to fill doesn't simply mean the loss of an order — it means the loss of customer loyalty and the long-term business relationship."

Alternatives Considered:

Expanding the size of the Honeywell mainframes involved too much time, expenditure, and complex software conversions. *Lieberman*'s first decision was to look at minicomputer systems as an alternative to support on-line terminals for order capture at the telephone desks, and line printers to prepare the picking slips for the warehouse personnel. *Lieberman* management worked on this design concept for several months during 1976 and then committed it to paper in order to begin their search for a vendor.

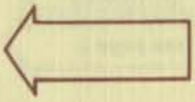
Prime, Hewlett-Packard, Data General, the Data 100, and the Honeywell 6 were considered. *Lieberman* then decided to purchase a DEC PDP 11/70. The reason was simple — DEC could support up to sixteen I/O peripheral devices.

"The 11/70 was actually more computer than we needed at the time," said a company representative. "We also knew we were going to outgrow the system and face a costly conversion to the DEC 20." Within 24 hours of signing with DEC, the search team decided to visit the Chicago Computer Caravan to look for a scanner.

The search team was not looking for a fault-tolerant system but happened to pass the **TANDEM** exhibit. Their first reaction was disbelief — "Other companies have been trying to develop a truly fault-tolerant system for over twenty years," one representative commented. Intrigued, they decided to stay for a seminar. "We wanted to see if **TANDEM's** claims were true or only a technological pipedream."

Why TANDEM?

After further investigation of the **TANDEM** system and business operation, the search team halted the DEC order. Next, they convinced management to purchase a **TANDEM** system for the Minneapolis warehouse. "We would be getting two computers for the price of one and one-fifth. With a **TANDEM** system, *Lieberman* could start small; growth in business volumes could be matched by increasing the number of CPUs in the configuration without any reprogramming."



The **TANDEM** system offered all the features the search team was looking for: modular expandability to accommodate forecasted growth in business volumes, software, mirrored disc drives for data base integrity, and distributed data processing options. The other systems considered by *Lieberman* offered some of these features — **TANDEM** offered all of them. *Lieberman* became **TANDEM's** third installation.

Said one *Lieberman* representative: "With **TANDEM**, we could have our cake and eat it too — start small and expand modularly without impacting the daily operations of each warehouse. Our move into distributed data processing is native to the architecture of the **TANDEM** design." The **TANDEM** system also offered fault-tolerance, i.e., continuously available processing with a NonStop system, data base integrity, and on-line, instantaneous access to up-to-the-minute stock information. "We were looking for a **TANDEM** system but we hadn't known that **TANDEM** existed."

The TANDEM Solution:

Lieberman purchased a two-processor system, with 128 KB memory each, which was installed in August 1976. Currently, the system has expanded to four processors — two processors with 384 KB memory each and two processors with 352 KB memory each; three tape drives; four 160 MB disc drives; two 10 MB disc drives; one 600 lpm line printer; four hard copy consoles; five serial line printers, and 40 terminals.

The system also has dual controllers, a mirrored data base, and direct communication links with the Honeywell mainframes and handheld Telxon devices for order entry through phone lines by sales representatives in the field.

The primary application language is TAL; software packages include the ENSCRIBE Data Base Manager with Data Definition Language (DDL), the ENTRY package for page formatting, the ENVOY Data Communications Manager, **TANDEM**/COBOL, the XRAY package for system diagnostics, and the ENFORM Query/Report Writer. Conversion and program development is done by internal DP staff with some assistance from consultants and **TANDEM** support.

For more on Distributed Data Processing, see page 2.

Lieberman is considering distributed data processing with twelve **TANDEM** systems in a network supporting 20 branches.

Current Applications:

"Although we weren't looking for a NonStop system, we now consider continuous availability to be an essential building block in our applications," said one member of the *Lieberman* DP staff. "Because of time pressures and data volumes, we need the system every day."

The first application *Lieberman* coded to run continuously was order entry. A roomful of clerks with terminals receive phone orders from record retailers, give the customer immediate stock status information, and key in the entire order by stock number during the phone conversation. A picking list generated by the system is sent periodically to the warehouse. The orders are then picked, boxed, and shipped with an invoice. Simultaneously, the system prepares accounts receivable information, inventory status, and sales analysis data for management.

A second application programmed to run continuously on a **TANDEM** NonStop system supports the "rack business," or complete retail service. *Lieberman* representatives are responsible for inventory; 160 salespeople are in the field, reviewing customer racks and entering orders on handheld Telxon units. The Telxon devices are equipped with acoustic coup-

lers and communicate directly to the **TANDEM** system over phone lines. The sales representative calls the system and gives the order directly to the **TANDEM** computer.

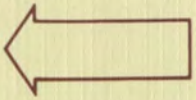
Currently, orders are accumulated and transferred on magnetic tape for batch processing by the Honeywell.

The **TANDEM** system supports an on-line accounts payable and general ledger application for the Carrousel Snack Bar chain. Clerks enter accounts payable data on their terminals and reconcile details to the vendor statement. Checks are then created to pay the vendors.

Although most accounts payable applications are typically not on-line, *Lieberman*'s Accounting Department developed the application for better cash flow control.

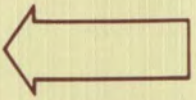
All program maintenance and development have been transferred to the **TANDEM** system. Source libraries for both the **TANDEM** and Honeywell systems are kept on the **TANDEM** computer. New programs are written on the **TANDEM** computer using the **TANDEM** system's text editor. The on-line maintenance feature with the **TANDEM** system facilitates uninterrupted program development.

All new critical applications are now done on the **TANDEM** system. For example, the master customer name and address file for ABC Records was absorbed by the **TANDEM** system in three weeks, including the time required for writing the program. *Lieberman*'s DP staff employs the **TANDEM** system for complex data capture problems such as updating cost/price changes and posting customer remittances to the account payable ledger. The Accounting Department estimates that the latter application will produce a 50–60% savings in personnel.



Benefits of TANDEM System:

The **TANDEM** NonStop system has produced a variety of anticipated and unanticipated benefits. The first major benefit is that *Lieberman* has cornered the record distribution market in the area serviced by the Minneapolis warehouse. The ability to confirm to the retailer the availability of stock from inventory at the time he is ordering gives *Lieberman* a distinct competitive edge.



TANDEM's profile of high systems availability ensures that customers and management have uninterrupted access to the data base. "The actual dollar loss of our system going down for a day isn't that important, although it could involve losing 30,000 orders on a peak day. Customer goodwill is our

stock in trade — failure to deliver means we can lose the entire business relationship. This fear has been eliminated by the **TANDEM** system's reliability."

The **TANDEM** system has provided a cost-effective solution to servicing the "rack business." Orders entered by the field representatives to the **TANDEM** computer via the Telxon devices are now processed within one day. Previously, the orders were written manually, sent by mail, keypunched, and processed in three days. The new Telxon-to-**TANDEM** system has resulted in sales staff covering more territory; easier absorption of new sales personnel; increased productivity from sales territories; lower costs per order processed; and elimination of the keypunch function.

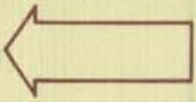
An unanticipated benefit involves greater efficiency in warehouse operations. "We weren't aware of this, but our warehousemen had been spending 50% of their time retracing their steps . . . in our old batch system, orders were processed and picked in random sequence. Warehouse personnel were crisscrossing the floor to fill orders because the orders weren't presorted by warehouse locations, nor were out-of-stock conditions noted on the picking slip." Today, using the **TANDEM** system, all orders are sorted to warehouse location; remote terminal printers on the warehouse floor print the picking slips. "Out-of-stock's" are not on the picking slip, but instead appear on management reports, and on the back-order section of the invoice enclosed with the shipped order.

"Warehouse productivity has increased 200%, while the number of employees on the floor has remained constant. Two more added benefits that we have seen since the **TANDEM** system was installed is a dramatic drop in inventory shrinkage and the absolute ability to trace the bin location of all new goods received into stock. This is especially critical for the 5% of our 'hot' records that have an extremely short shelf life."

Lieberman's DP staff estimates that using TAL has resulted in a 50% increase in programming productivity. Program documentation took 50% of the time forecasted, generating a cost savings of $35,000.

TANDEM's TAL language and text editor capabilities make rapid programming turnaround time possible. "ABC Records forecasted a 16-month schedule for us to absorb their master customer name file. It actually took 6 weeks because we used **TANDEM's** TAL programming language. That 6-week schedule includes file conversion and training of their staff on the terminals."

Says a member of the original *Lieberman* search team: "**TANDEM** is a great asset to our business. We haven't even begun to use our **TANDEM** system to its full capacity. It's been a happy marriage. We've been up and running for three years — without a single day of down time."



CASE HISTORY HIGHLIGHTS

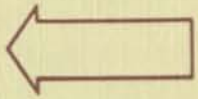
User	• *Lieberman Enterprises Incorporated* Minneapolis, Minnesota
Industry	• National distributor of records, coin-operated vending systems, and regional fast food outlets
Application(s)	• On-line Order Entry, Inventory Control.
	• On-line Order Entry to the TANDEM system via Telxon devices in the field
	• On-line Accounts Payable, Sales Analysis, General Ledger
	• Invoicing
	• Warehouse picking slips sorted by item location
	• Program documentation and development
Problem	• Frequent and costly conversions to accommodate rapid growth
	• Need to convert all applications from batch to implement high-volume transaction-oriented record distribution application
	• Need for data base integrity for inventory control and order processing
	• Need for distributed data processing option
Competition	• Prime, Honeywell, Hewlett-Packard, DEC, Data General
Why **TANDEM**?	• Modularity
	• Systems availability
	• Ease of programming
	• Cost
	• Fault-tolerant distributed data bases at remote warehouse sites
	• Data integrity
Date of installation	• August 1976

INSURECO
On-Line Inquiry

Insureco Inc. provides collaterized loan insurance services for Banks and Credit Unions, primarily in the area of motor vehicles and real estate. Among *Insureco's* customers are United California Bank (UCB), Wells Fargo Bank, First National Bank of Arizona, First National Bank of Albuquerque, and the Telephone Employees Credit Union.

Insureco functions as a department of the lending institution, although operations are completely independent. Mail is forwarded from the bank to *Insureco*. *Insureco* then takes the responsibility of verifying if the vehicle or collateral is insured, writes policies for both the bank and borrower, and helps the borrower to continue payments if the collateral is damaged by helping to pay repair costs. *Insureco's* goal is to protect the lending institution against any loss due to lack of insurance.

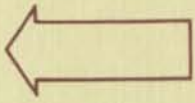
Problem:



Insureco's growth and level of service were severely limited by a data processing system that had reached saturation. The company had outgrown their minicomputer system. There was literally no room to add more CRT's to the 12 terminals already on-line or to increase the memory size.

Insureco had also discovered basic design limitations in their minicomputer that hampered operations, including slow CPU speed, inefficient ROM, restrictions in the assembler language, and faulty error correction. Errors took place without error messages — entire discs could be invalid without warnings from the system!

Fast access to an accurate data base was essential to maintain the level of customer service *Insureco* wanted to provide. The company could no longer afford to stay with their data processing system. *Insureco* initiated an extensive search for a system that provided data base integrity and modular expandability.



Alternatives Considered:

Insureco's president "clipped coupons," soliciting information from a wide range of minicomputer companies. DEC, Hewlett-Packard, Perkin Elmer, and CDC were considered initially. The company worked with CDC for a year before deciding that CDC could not produce a system that satisfied *Insureco's* needs.

Insureco's first contact with **TANDEM** was an art cle on **TANDEM** support of COBOL in COMPUT ERWORLD. *Insureco's* first impression was that th description of the **TANDEM** NonStop system's capa bilities must be exaggerations. *Insureco's* presiden investigated further. He was impressed that th **TANDEM** representative did not try to sell him a sys tem. In fact, the **TANDEM** representative suggeste that the system might be more powerful than *In sureco* required.

Faced with a time crunch, the final decision wa between Prime and **TANDEM**.

Why TANDEM?:

The key reasons *Insureco* chose **TANDEM** were modularity, file structures, and communications. *In sureco* needed expandability to incorporate an ever growing data base without a large capital outlay for hardware that would not be utilized immediately. **TANDEM** offered the option of starting with a dua processor system and adding hardware as needs re quired without extensive reprogramming.

Insureco also needed communications capabilities that did not require a major investment of capital. The system's front-end flexibility was the second most important reason for choosing **TANDEM**. *In sureco* uses one CPU for applications, the other for communications. Both processors talk to each other at very high speeds through the **TANDEM** DYNABUS hardware that provides dual communications paths among processors to transmit data at an aggregate rate of 26 megabytes/second (13 megabytes on each of the two independent buses).

For more on the DYNABUS Structure, see page 44.

GUARDIAN, **TANDEM's** comprehensive fault-tolerant operating system impressed *Insureco*.

Other **TANDEM** features met, and surpassed, the company's applications requirements. One of these was the availability of 240 megabyte disc drives and the ability to spread one file over multiple disc drives, thereby overlapping seek time.

A **TANDEM** software feature important to *Insureco* was program execution. With the **TANDEM** system, object code can be shared by as many copies of a program as are needed (one per terminal), which saves memory.

TANDEM's ENSCRIBE relational data base manager offered file structures well-suited for *Insureco's* applications requirements. With the ENSCRIBE software, 255 alternate keys are available by which an application may access the data base. *Insureco*

also found that rebuilding of key files on the **TANDEM** system's relational data base was very fast in comparison to other vendors they considered.

The **TANDEM** system's fault-tolerant capabilities were not a major consideration for *Insureco* at the time of selection. "NonStop programming capabilities are a beautiful feature of the system," a company representative explained, "but not essential at present to our application. Fast access to the data base; data base integrity; and general system reliability are the criteria that were central to our decision. The **TANDEM** system satisfied all these requirements."

The TANDEM Solution:

Insureco purchased and installed in July 1978 a dual processor system with 288 KB semiconductor memory per processor; two 300 MB disc drives; two asynchronous controllers; one 600 line-per-minute printer; and 24 terminals. Initial software purchases were **TANDEM** COBOL; the ENSCRIBE data base management system; the ENTRY screen formatter; the SPOOLER utility; and the XRAY package for system diagnostics.

The conversion process from *Insureco's* previous system took about six man-months, using *Insureco* DP staff, and a **TANDEM** communications consultant for an equivalent of two man-months. *Insureco's* internal staff maintains the application software while the hardware maintenance and support are provided by **TANDEM**.

True to growth predictions, *Insureco* is in the process of adding a third processor, has purchased more memory and another 240 MB disc, and will be ordering up to thirty more terminals in the coming months as their operations expand to Texas, New Mexico, Washington, and Arizona.

Current Applications:

Insureco's clerical staff processes thousands of forms daily on the **TANDEM** system, as well as making on-line updates and corrections in response to borrower phone calls and inquiries.

Immediate access to the data base and the ability to make corrections immediately are essential requirements for *Insureco's* service. Staff must make non-unique searches using alternate keys such as name, address, collateral description, policy number, or any combination of the above. They may have little information to start with, such as "Joe Smith" or "1977 Ford station wagon." The CRT operator must respond

to the borrower, update the data base, and key in ne status of insurance within seconds during the phon call.

Mail is forwarded directly, unopened, from th bank, credit union, or insurance company. *Insureco* matches the policy with information in the data base verifies that the collateral is insured, and checks to see if the data is current. If coverage does not show up in the data base, two letters are sent to the bor rower informing him of his legal responsibility to provide insurance. If there is no response within a se time period, *Insureco* writes up a policy and sends copies to the lending institution and the borrower.

All inquiries, verification, corrections, and policy cycles are carried out on-line on the **TANDEM** system during the normal business day by clerical personnel.

Benefits of the TANDEM System:

Evaluating the system less than a year after purchase, *Insureco* states that the **TANDEM** system has been a cost-effective solution.

"The **TANDEM** system provides more than twenty times the power and capacity of the previous data processing system, in addition to modular expandability," states *Insureco's* president.

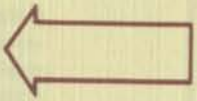
"Throughput has increased by multiple factors and the compiler languages available on the **TANDEM** system have greatly facilitated programming. The multiprocessor enviroment also gives *Insureco* programming staff the option of working on the system while the applications are running without disrupting operations. Staff can now easily build parameter files to hold user-elected options without hard coding them into the programs. Multiple reports can be processed simultaneously because of the print spooler, and sorts that took three to four hours on the old system can now be done in five to six minutes on the **TANDEM** system."

An unexpected benefit to *Insureco*, a company representative states, is **TANDEM**'s new XRAY performance monitor. The XRAY software locates processor and I/O bottlenecks, facilitating program load balancing for multiple terminals.

Features available on the **TANDEM** system, including the GUARDIAN operating system; the ENSCRIBE data base management system; availability of higher-level languages; increased CPU speed; and mass storage devices; all have resulted in increased speed, efficiency, and capacity. *Insureco* can now access and update a reliable data base in seconds and expand the master record files and accommodate increases in

customer volume and services without fear of "bottoming out."

Says *Insureco's* President: "I don't anticipate the need, but we could expand up to 16 processors in our system and disc space is almost infinite. . . . I'm happy with the system. I walked into this decision with my eyes open and I've got what I wanted."



CASE HISTORY HIGHLIGHTS

User	• *Insureco Inc.* Los Angeles, California
Industry	• Collateralized loan insurance service for banks and credit unions
Application(s)	• On-line inquiry
Problem	• DP sytem saturated • Needed: Expandability Fast access to data base Data base integrity
Competition	• Prime, DEC, H-P, CDC
Why **TANDEM?**	• Modular expandibility, • Communications capabilities • Data base integrity • System availability and reliability
Date of installation	• August 1978

Autotote Limited

With automated wagering systems operating at over 50 parimutuel facilities, Delaware-based Autotote Limited placed its bets on Tandem's NonStop capabilities when going on-line at user sites with its new Autotrak system in 1979. At Autotrak-equipped facilities — the first three are at Harrisburg area's Penn National Race Course, Cleveland's Northfield Park and Miami's World Jai Alai — bettors need not go to separate windows for different denomination wagers or to cash-in winning tickets. All windows handle all types of bets of any dollar amount, and all windows are cashiers. The new Tandem-based system with four processors at each track continually updates odds and posts them; writes computerized tickets; validates winning tickets, and calculates payouts. The system also provides detailed analysis of every transaction at every window, automatically determines the state's share of revenues, and generates management reports. In another Autotote division, the company operates revenue control systems at a number of major airport and municipal parking facilities. That division's first Tandem-powered on-line system is controlling revenues from the 28 entry-exit lanes at Detroit Metropolitan Airport.

Busch-Jaeger-Elektro

Busch-Jaeger-Elektro, the West German subsidiary of BBC, Brown Bovery Cie AG, automated its huge warehouse in Luedenscheid with a Tandem system in 1979 to significantly improve shipping rates and productivity. The inventory control system manages the distribution throughout Europe of some 1,700 electrical products ranging from small parts such as switches and power breakers to all kinds of electrical devices. The warehouse stocks up to 13,000 different products, both finished goods as well as parts, with a total well in excess of 1,000,000 items in stock. The Tandem system automatically processes orders for 18,000 different locations in the warehouse.

These application stories are reprinted with permission from the Tandem Annual Report 1979: Business Review.

Fred Meyer

In the early 1970s, Fred Meyer, the largest retailer in the northwest, reasoned that it was cashing so many checks that it should be in the banking business. Today, Fred Meyer Savings & Loan has over a half billion dollars on deposit at in-store facilities and freestanding branches. A Tandem System went on-line at Fred Meyer at the outset of 1979 to provide control and all data processing for the S&L's 30 automatic teller stations in Oregon that handle some 5,000 customer transactions daily. Another 5,000 daily transactions run through the system via 50 terminals to manage administrative and loan functions. In 1980, the growing Tandem system will begin driving all of the 150 regular teller terminals at the S&L's Oregon locations. The original applications software for Fred Meyer was developed by Applied Communications, Inc., of Omaha, Nebraska, which specializes in programs for financial institutions.

Girmes AG

Girmes AG, one of Europe's principal manufacturers of textiles and carpets with annual revenues in excess of DM 600 million, acquired its Tandem system in the autumn of 1977 and has never experienced a hardware or operating system failure. The initial two-processor Tandem went on-line in June 1978 with completion of software development for an order processing system that now ties-in the company's three factories with some 50 terminals. The system size was doubled in the summer of 1979 to handle increased workloads. Girmes is now developing applications software for a new manufacturing data capture system that is scheduled to come on-line during 1980. The company employs 3,500 people in West Germany.

Jóvan

Jóvan, the U.S. producer of fragrance products, went on-line with their new Tandem-powered warehouse control system in 1979 and quickly experienced a near-tripling of productivity. By converting to the automated system to fill up to 4,000 orders daily for the company's 456 different products, Jóvan has improved order delivery by more than a week with dramatically greater accuracy. Further cost savings emanate from automated freight consolidation of the typically small packages. The system receives all orders; allocates inventory; selects orders; generates the transportation plan; weighs each order; provides freight rates; and prints shipping labels, bills of lading, packing slips, shipping manifests and order confirmations. Jóvan selected Tandem because of the critical importance of continual operations and the ability to add computing power without interrupting shipping of products.

Karstadt AG

Europe's largest department store chain, Karstadt AG of West Germany, has 162 outlets, annual sales of over DM 10 billion, and a growing Tandem system committed to on-line management of the company's DM 560 million furniture business. Karstadt took delivery of its first Tandem system at company headquarters in Essen in mid-1977 to develop application software to service six stores with massive furniture departments. The inventory control system with some 50 terminals enables clerks to immediately verify warehouse stock, write the order, generate shipping papers and invoice the customer. A future software development will enable sales personnel to make entries to allow a customer to customize the furniture ordered. A second Tandem system was installed in late 1978.

Memphis Light, Gas & Water

Memphis Light, Gas & Water took delivery of its initial Tandem system, a four-processor unit, during 1979 with the intent of standardizing its computer operations on a single manufacturer's system. The utility selected Tandem because of the system's unique ability to handle all mini-based functions while growing into a mainframe configuration. The first major usage of the Tandem system is an on-line, automated billing system for the utility's approximately 3,500 large industrial customers. During 1980, the system is scheduled to take over all customer billing operations. MLG&W has approximately 300,000 electric customers, 230,000 gas customers and 200,000 water customers.

Telecredit, Inc.

On opposite coasts of the U.S., seven days a week, thousands upon thousands of credit card purchases and personal checks are being instantaneously approved via Tandem systems at Telecredit, Inc., a national leader in check guarantee and credit card processing services. Since mid-1978 at Florida Service Center, a wholly-owned subsidiary of Telecredit, a Tandem system has been on-line providing complete bank credit card services involving some $15,000,000 in purchases and 650,000 transactions weekly for Master Charge and Visa. During 1979, Telecredit's second Tandem system came on-line, and is currently servicing some 8,000 on-line point-of-sale terminals providing national credit card authorizations and check approvals for many major U.S. banks and over 70,000 merchants.

U.S. Treasury Department

When the U.S. Treasury Department's new Tandem system comes on-line in 1981, it will make electronic funds transfers of some $100 billion annually between the Treasury and more than a hundred different government programs. In addition, the system will record and monitor the sale of U.S. government gold and service grant programs such as letters of credit. The Tandem system will be dedicated to the Treasury Financial Communications System — previously run on a shared computer — to improve security and reliability, and to provide for easy add-on of computer power.

Vingresor AB

Some 300,000 packaged holiday tours by air to 50 resorts and 600 hotels are booked on-line annually by Vingresor AB, Sweden's largest tour operator and wholly-owned subsidiary of SAS (Scandinavian Airlines System). Vingresor has 28 bureaus in Sweden and Norway with 190 terminals connected via leased telephone lines to an on-line Tandem System. The rapidly growing tour operator computerized its business in 1972 and converted to Tandem in 1978 to overcome computer failures and to acquire the capability of easy expandability of computer power. "The luxury at no extra cost of Tandem NonStop has become second nature to us. It is hard to imagine how we lived without it, or how others are still living without it." Vingresor's original two-processor system was expanded to six in 1979 to accommodate peak loads and development.

REPRESENTATIVE CUSTOMER LIST

CHASE MANHATTAN BANK New York City, New York	Banking
CITIBANK New York City, New York	Banking
CLAY BERNARD SYSTEMS, INC. Tulsa, Oklahoma	Systems House
COMMODITY NEWS SERVICES, INC. Kansas City, Kansas	News Service
COMPUTER SYSTEMS DESIGN, INC. Affiliate of SUTRO & COMPANY San Francisco, California	Financial Software Securities
CROCKER NATIONAL BANK San Francisco, California	Banking
DATX CORPORATION Chicago, Illinois	Hospital Services
FIRST NATIONAL BANK OF CHICAGO Chicago, Illinois	Banking
FORD MOTOR COMPANY Dearborn, Michigan	Automotive
FRED MEYER SAVINGS & LOAN Portland, Oregon	Savings & Loan
GENERAL DYNAMICS Fort Worth, Texas	Aerospace
INSURECO Los Angeles, California	Insurance Services
LIEBERMAN ENTERPRISES Minneapolis, Minnesota	Distribution
THE MAY DEPARTMENT STORES COMPANY St. Louis, Missouri	Retail
MCDONNELL DOUGLAS AUTOMATION – HSD St. Louis, Missouri	Hospital Services
MEMPHIS LIGHT, GAS & ELECTRIC COMPANY Memphis, Tennessee	Public Utility
Missouri/Illinois Regional RED CROSS St. Louis, Missouri	Blood Bank
NORTHERN TRUST COMPANY Chicago, Illinois	Banking
OCLC Columbus, Ohio	Library Administration
PENN CORPORATION/ RITEPOINT DIVISION Fenton, Missouri	Manufacturing

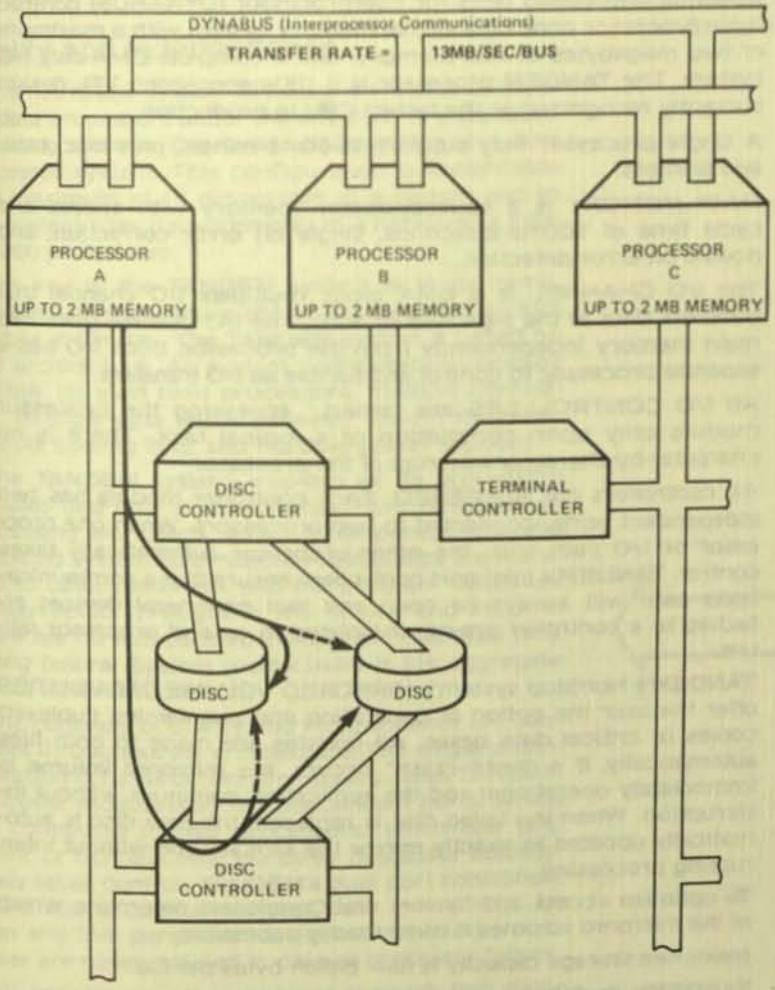
REPRESENTATIVE CUSTOMER LIST
Continued

PITNEY BOWES Stamford, Connecticut	Business Machines & Postage Meters
RAMADA INNS (MICOR) Phoenix, Arizona	Lodging
RAYTHEON Lexington, Massachusetts	Editorial Systems
SACHS ELECTRIC COMPANY St. Louis, Missouri	Electrical Contractors
ST. LOUIS UNIVERSITY SCHOOL OF MEDICINE St. Louis, Missouri	Department of Pathology
3M COMPANY St. Paul, Minnesota	Manufacturing
UNIVERSITY OF CALIFORNIA AT BERKELEY Berkeley, California	Registrar's Office
UNIVERSITY OF COLORADO HEALTH SCIENCES CENTER Denver, Colorado	Health/Medical Services
WASHINGTON FEDERAL SAVINGS & LOAN OF SEATTLE Seattle, Washington	Savings & Loan
WELLS FARGO BANKS, N.A. San Francisco, California	Banking
XEROX Computer Services Los Angeles, California	Computer Services

International

BARCLAYS BANK INTERNATIONAL England	Banking
FEGRO West Germany	Retail
KARSTADT West Germany	Retail
LINJEFLYG Subsidiary of SAS Sweden	Airline Ticket Services
THYSSEN West Germany	Manufacturing
WESTDEUTSCHE LANDESBANK West Germany	Banking

TANDEM NonStop Systems Architecture with MIRRORED VOLUMES



This diagram shows a three-processor **TANDEM** NonStop System, designed for high volume on-line transaction-oriented data processing. The minimum configuration is a dual processor system, expandable by small or large increments to sixteen processors in a system without reprogramming, and up to 255 nodes in a network.

The processors are connected by **TANDEM's** high-speed dual interprocessor busses — the DYNABUS structure. These independent bidirectional "data freeways" transfer data at the rate of 13 megabytes per second per bus. This structure ensures that there

are always two communications paths among processors, independently and simultaneously transferring data at high speeds.

The individual PROCESSOR module is divided into microded, pipelined processing units for interprocessor (DYNABUS) control; main processor control; a virtual memory system with a maximum of two megabytes of real memory; and a complete DMA-only I/O system. The **TANDEM** processor is a 100-nanosecond TTL design currently recognized as the fastest CPU in production.

A single processor may support 35-50 terminals, plus disc, tape, and printers.

MAIN MEMORY is a semiconductor memory with access and cycle time of 500-nanoseconds, single bit error correction, and double bit error detection.

The I/O CHANNEL is a DMA block multiplex I/O channel that transfers data at the high rate of 4MB. The I/O channel goes into main memory independently from the processor. Each I/O has a separate processor to control and handle all I/O transfers.

All I/O CONTROLLERS are "smart," accessing the processor module only upon completion of a logical task. There is no character-by-character interrupt of the processor.

All controllers are BUFFERED. Each controller module has two independent ports, connected to two processors. When one processor or I/O path fails, the other processor automatically takes control. **TANDEM's** dual port controllers ensure that a communications path will always be open and that peripheral devices attached to a controller are never isolated in case of processor failure.

TANDEM's NonStop system's MIRRORED VOLUME CAPABILITIES offer the user the option of generating and maintaining duplexed copies of critical data bases. All updates are made to both files automatically. If a "head crash" occurs, the mirrored volume is immediately operational and the application continues without interruption. When the failed disc is replaced, the new disc is automatically updated to exactly mirror the safe volume without interrupting processing.

To optimize access, I/O Drivers and Controllers determine which of the mirrored volumes is most readily accessible.

Maximum storage capacity is four billion bytes per file.

TANDEM's multiprocessor architecture is truly fault tolerant, providing multiple controllers, multiple data paths between system modules, multiple cooling fans, and multiple power supplies, under the direction of **TANDEM's** NonStop operating system.

TANDEM NonStop Systems Architecture

For a concise summary, see EXECUTIVE PRODUCT SUMMARY, page 1.

Duality and Independence

The **TANDEM** system is based on multiple, independent processors under the direction of a standard operating system. The basic configuration is a dual processor system. This configuration is expandable to a maximum of 16 processors in a system and to 255 system sites (local/remote) in a network: a total of 4080 processors.

The key to the **TANDEM** system is in its name. "Tandem" means a group of two or more entities that execute in parallel. The **TANDEM** system is based on dual architecture. All system configurations employ multiple (at least two) processors, multiple controllers, multiple data paths between system modules, multiple cooling fans, and multiple power supplies.

The **TANDEM** system employs all its processing modules and data paths for maximum efficiency in processing workloads. When a component fails, the operating system automatically reallocates the workload to other resources and the program continues uninterrupted throughout the failure and repairs. There are no idle back-up components, utilized only during failure. System productivity is the aggregate sum of all its components.

The concepts of duality and independence are consistent throughout the architecture. The smallest configuration consists of two processors. Each **TANDEM** controller module has two independent ports, which are connected to two processors. When one processor or I/O path fails, the other processor automatically takes control. **TANDEM's** dual port controllers insure that a communications path will always be open and that peripheral devices attached to a controller are never isolated in case of processor failure.

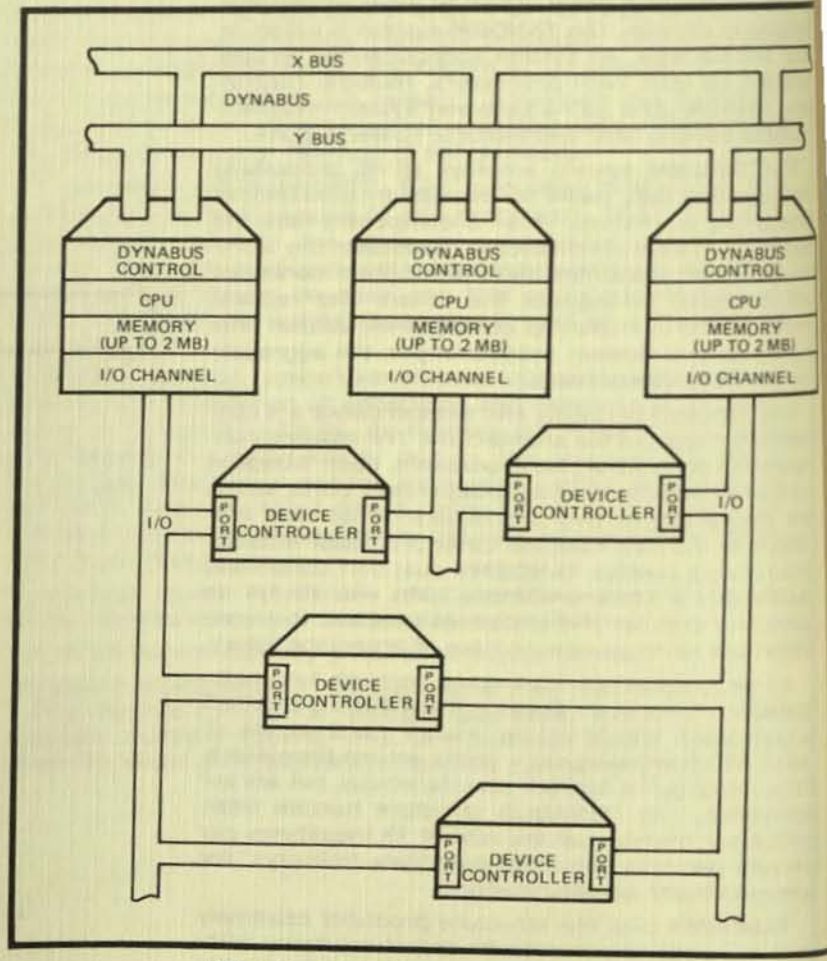
All processors are connected through two high-speed interprocessor buses — **TANDEM's** DYNABUS architecture. This structure insures that there are always two communications paths among processors. These data paths operate simultaneously, but are autonomous. The DYNABUS structure handles interprocessor transfers at the rate of 13 megabytes per second per bus, providing two "data freeways" for interprocessor communications.

TANDEM's dual bus structure produces extremely low overhead interprocessor communications without impacting normal communications between the processors and peripheral devices. The DYNABUS

architecture is capable of handling peak transacti and message loads, even when the system is ful expanded to sixteen processors.

The DYNABUS structure is also used for period interprocessor checks. These checks isolate any pr cessor failure from the rest of the system and allo other system resources to pick up and continue th assignment. (This process is performed instantane ously so program operation is uninterrupted durin system resource reallocations.)

The individual processor is a module divided int microcoded, pipelined processing units for CPU an interprocessor (DYNABUS) control; a complet DMA-only I/O system; and a virtual memory syste with up to two megabytes of real memory.

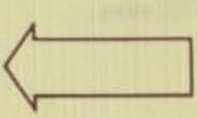


The NonStop System Architecture — The DYNABUS Dual Bus Structure

The basic configuration is a dual processor system with MOS memory, system cabinets, and a magnetic tape drive. Packaged system components also include hardware multiply/divide; power fail/auto restart; bootstrap loader; interval timer; control panel; the DYNABUS controller and interface; provision for 32 I/O controllers; 173-member instruction set; and two power supplies. The **TANDEM** system also provides disc packs from 10 to 240 MB and communications interfaces for networking capabilities.

The NonStop Operating System

TANDEM's GUARDIAN Software



Earlier vendors of fault-tolerant systems provided the end-user with redundant hardware, but left the job of making the system work to the end-user. **TANDEM's** philosophy is that the end-user is responsible for his individual applications only. **TANDEM** is responsible for the operating system software that manages interprocessor communications, interprogram communications, device communications, security, and dynamic allocation of resources in the event of a component failure. This operating system software — **TANDEM's** GUARDIAN package — is the essential component that makes the **TANDEM** NonStop System work.

TANDEM's GUARDIAN Operating System:

- *Provides the end-user with a transaction-oriented operating system.*
- *Resides in each individual processor.*
- *Is capable of instantaneous, automatic response to a failure anywhere in the system.*
- *Provides dynamic reallocation of tasks in the event of a failure anywhere in the system.*
- *Provides for checkpointing of tasks.*
- *Allows processors to be assigned work based on end-user priorities for applications programs.*
- *Handles all communications among programs, and between programs and the user terminal.*
- *Extends the capability to start program execution in any available processor module from any processor.*
- *Provides geographic independence of programs and data.*

The GUARDIAN operating system acts as the traffic controller and general overseer, handling all communications between **TANDEM** processors, system processes, and application programs. It relays messages to the correct processor, verifies that the message has been received, and routes the message to the appropriate program or device within the receiving processor.

GUARDIAN software also insures data integrity by performing comprehensive data validation on all transfers. Operating system software is capable of detecting an error or non-response anywhere in the system, logging the failure, and rerouting communications away from the faulty module without disturbing system operation.

At the heart of the GUARDIAN package's ability to reallocate resources is a concept called geographic independence. Programs can access any device in the system, even those not physically connected to the processor running the program. Application programming does not depend on the processor, or even the node in a network on which a program runs. It may run simultaneously in all processors or in multiple nodes.

The GUARDIAN software's ability to manage data and applications that are geographically independent is the basis of the **TANDEM** system's second building block — easy modular expansion. The GUARDIAN/EXPAND operating software for distributed data processing, extends the **TANDEM** system's modular expansion capabilities to a world-wide network.

Modular Expansion

Growth Without Reprogramming

- The ability to size a **TANDEM** NonStop System precisely according to end-user application requirements.
- Configurations are expandable to sixteen processors, and 2 MB of memory each.

With GUARDIAN/EXPAND:

- Up to 255 nodes in a network.
- Up to 4,080 processors in a network.

DISTRIBUTED DATA PROCESSING:

- Message and packet switching capabilities.
- X.25 compatibility.
- Communication with IBM or other mainframes using standard industry protocols.

Every **TANDEM** system is already a network — a network of processors, managed by an operating system that sees all programs and data transfers as communications distributed over several processors. Programs can access any device anywhere in the system, even devices that are not physically connected to processors running the program. Conversely, the program is unaffected by the processor on which it runs. The operating system sees all physical resources as logical files. Only the message-routing

part of the GUARDIAN operating system knows the geographic locations of resources, enabling GUARDIAN to route data and dynamically reallocate resources during failures.

Distributed data processing or networking on the **TANDEM** system is simply a logical extension of system design. Expansion becomes a relatively simple matter of adding resources.

See INSURECO Case History, page 27.

The first benefit to the end-user is the ability to precisely size the system he wants and to start with only the system resources he needs. Typically, growth is anticipated, but hard to predict. No end-user wants to tie up working capital indefinitely in a system that is too large for current needs. Many end-users are forced into an initial over-investment in an effort to delay the costly conversions that are required when the system reaches saturation.

In contrast, the user of the **TANDEM** system can start with a dual processor configuration and expand by adding one or more processors as growth needs require — without reprogramming. The GUARDIAN operating system and existing application programs simply absorb the additional processors into the configuration. The user can expand up to sixteen processors within the same system without additional programming.

The GUARDIAN/EXPAND software package makes global networking possible for the end-user whose applications require distributed data processing. This extension to the standard operating system generalizes the capabilities of the **TANDEM** system to a geographically distributed network.

Under EXPAND, the network can grow to 255 nodes viewed logically as a system. Each node can be a dual processor system or a fully expanded 16-processor NonStop system. Once the network has been configured, nodes can be added or removed without the need for re-configuration.

Each processor is capable of accessing geographically distributed data exactly as if it were part of the local system. EXPAND's "best path routing" enables the system to choose the fastest path between nodes; packets of data are rerouted automatically if a failure occurs in a communication line. **TANDEM's** End-to-End Protocol ensures data integrity from sender to receiver and from node to node. EXPAND oversees each node, establishing communication paths to other nodes, maintaining routing information, determining the best data communications path, and logging network status.

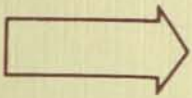
An EXPAND network can be connected using leased lines or an X.25 public packet switching network. The Network Utilities monitor the network – tracing the path of data through the network, noting line connections and other network events, displaying network-related statistics, and determining the status of individual processors throughout the network.

Data Integrity and Ease of Application Development

The ENCOMPASS Distributed Data Management System

The ENCOMPASS distributed data managment system

- Is built according to the relational model, for simplicity and ease of use.
- Simplifies design, implementation and operation of on-line transaction processing applications.
- Provides unique transaction auditing and backout capabilities – in both centralized and distributed data base environments.
- Maintains high performance by automatically adjusting to varying transaction loads.
- Includes the powerful ENFORM query/report writer – used easily by both programming and non-programming personnel.
- Ensures data integrity through automatic on-line protection from failures of disc, processor, I/O channel or communication line.
- Is expandable over a single system or a distributed network without application program modification.



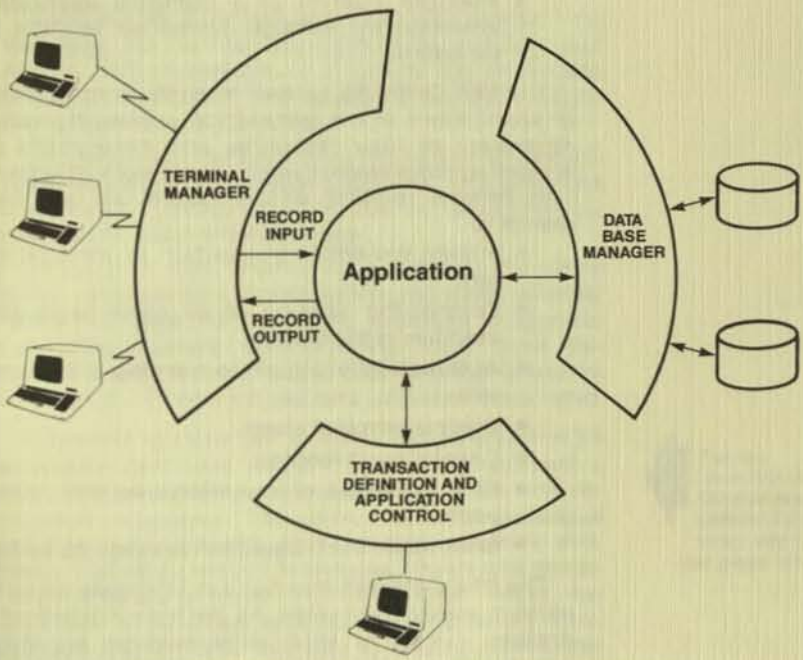
ENCOMPASS successfully manages both the front end and the back end functions required in on-line centralized or distributed processing. The front end functions of the system provide terminal management and transaction/application control. This segment of ENCOMPASS (designated as the PATHWAY transaction processing system) provides the following terminal management capabilities:

- Support for different terminal types connected by a variety of communication lines.
- Screen formatting.
- Data validation.
- Screen sequencing and data mapping.
- Sequencing and control of multiple terminals.

The terminal management capability of the ENCOMPASS system provides the application designer with a high-level language known as Screen COBOL.

ENCOMPASS

Distributed Data Management System



The ENCOMPASS distributed data management system simplifies on-line transaction processing applications with terminal management, data base management and transaction definition and application control.

With this language the application programmer needs to write one simple program to determine screen sequencing, specify data mapping and define field validation. An interactive screen definition facility lets the programmer design screen formats directly on the terminal with automatic generation of the appropriate Screen COBOL source statements for inclusion in Screen COBOL programs.

Although the ENCOMPASS system provides capabilities involving multiple terminals, the application designer basically deals with one terminal.

Transaction definition and application control capabilities provide:

- Centralized but flexible control and monitoring of functions and applications which are spread across a single system or network.

- Dynamic creation and deletion of application modules to ensure good response time.
- On-line addition, modification or deletion of screen characteristics, applications and terminals.
- Flexible control of a complex application environment through simplified terminal interactions.

The ENCOMPASS system provides overall control of applications in the transaction processing system regardless of how resources and applications are spread across a single system or network of systems. This flexible monitor of the system accepts commands to

- Initiate the entire transaction processing system.
- Control the start-up of all other application modules in the system.
- Automatically adjust to varying transaction rates.
- Control terminal states.
- Control error logging.
- Display status of requested system components.
- Shut down the transaction processing system.

The ENCOMPASS monitor automatically adjusts to varying transaction rates. As the transaction load increases, copies of application modules are started which will process additional incoming transactions so that throughput is not slowed. Likewise the system will adjust to a decrease in transaction loads by deleting copies of applications when they are no longer needed.

The back end capability of the ENCOMPASS distributed data management system (designated as the ENSCRIBE data base manager) distributes data across multiple processors and discs, providing multiple points of control and a natural growth path in a distributed data processing environment.

The ENCOMPASS data base manager

- Ensures data integrity through automatic recovery in case of processor, I/O channel, disc drive or communication line failure — in a single system or network.
- Protects disc volumes with its mirror volume capability.
- Provides both record and file level locking for concurrency control.
- Finds a record with logical keyed access in average of 1 disc I/O.
- Handles up to four billion bytes per file.

- Provides read, write and purge security at several levels.
- Partitions files into separate volumes, providing larger system capacities and greater throughput.

The ENCOMPASS data base manager protects the data base by maintaining control information and data in two processors. If a failure occurs in one processor, the other CPU accesses the disc volume and completes the operation.

The data base manager also maintains all indices. When new records are added to the file or a key value is changed, ENCOMPASS software automatically updates the appropriate indices.

Transaction rates may be optimized by the cache buffer management, which keeps the most recently referenced data blocks readily available to application programmers. By buffering these most frequently used pieces of information in main memory, disc activity is reduced and data access is more rapid.

If failure occurs on a disc, the ENCOMPASS package's mirrored volume capabilities prevent a shutdown and protect the operating system and application programs. The mirror volume technique simultaneously records data on two separate disc packs. If a failure occurs in one disc, reads and writes are automatically made from the other. When the failed disc is replaced, ENCOMPASS software automatically updates the new disc to exactly mirror the safe volume without interrupting the access of data. Even during a head crash, the data base manager automatically protects data.

For an illustration of **TANDEM's** *MIRRORED VOLUMES, see page 41.*

The ENCOMPASS package also provides:

- Record locking and file locking for protecting concurrent access to the data base.
- Data definition language for automating changes to data base layout.
- Multiple file structures for optimum access.
- Data manipulation through extended read and write operations.
- File utility program for easy file creation, loading, and reorganization.

The ENCOMPASS package provides record locking and file locking capabilities. All locks are queued behind outstanding reads and writes; and all new reads, writes, and locks are queued behind current locks. Optionally, the user can request that the system indicate a file error if a lock is not granted immediately.

Use of **TANDEM's** Data Definition Language (DDL) provides management of data base record layout, simplifying additions of new record types or alternate keys. The DDL sees the data base as a "schema" and defines the fields to be used as keys (access paths) to retrieve records. The DDL compiler produces COBOL, FORTRAN, and TAL (a Pascal or Algol-like language) source code from one common data definition language. The DDL also produces a data dictionary that can be used to report the logical contents of files.

The ENCOMPASS package offers key, relative, entry or unstructured sequencing, accessible by the primary key or any of the possible 255 alternate keys. Location of records may be by approximate (range of key values), generic (partial key matches), or exact key value. ENCOMPASS software maintains the index of all key values. Data and index compression in key-sequenced files can be accomplished with an optional technique to reduce the number of disc head movements and to conserve disc space.

A powerful query/report writer operates under the ENSCRIBE date base manager's direction.

- ENFORM query/report writer — ease of use with powerful capabilities.

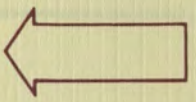
TANDEM's ENFORM query/report writer provides a powerful relational query language that is easily used by non-programming personnel. Its query language resembles English, but keywords can be easily redefined to resemble German, Spanish, French, or the language of choice. The ENFORM query/report writer automatically develops the most efficient strategy to extract data, including data from multiple files. In systems using the GUARDIAN/EXPAND operating system, the ENFORM package can perform queries from a distributed data base.

The ENFORM software's report capabilities automate many formatting details — centering headings, spacing columns of data, or skipping to a new page. The ENFORM report-writing capabilities automatically space information and supply headings, format numbers, and accumulate information through user-defined formulas, such as sales commissions. Special keywords provide totaling, subtotaling, and formatting numbers with commas, periods, or currency signs. If the user wishes, automatic settings can be overridden to produce an even more personalized report.

The ENFORM query/report writer also provides interfaces to TAL, COBOL, FORTRAN, or MUMPS programs, so that records can be accessed through a query that is executed by the ENFORM package.

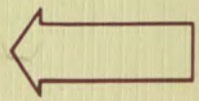
See **TANDEM's** *SOFTWARE TOOLS, page 55.*

ENCOMPASS introduces a unique transaction monitoring facility to maintain data base consistency during concurrent distributed transaction processing – even in the event of a program failure, power failure or total loss of communication between nodes.



The ENCOMPASS transaction monitoring facility

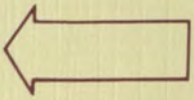
- Features transaction integrity control to produce a transaction backout capability of individual transactions while data base activity continues.
- Provides distributed audit trails which maintain before and after images of records being added or deleted.
- Uses before images of incomplete transactions to back out affects of failed transaction while other transactions continue to be processed against the data base.
- Enables transactions spanning a network to be backed out without causing audit records to be transferred over the network.
- Supplies on-line backup to tape of parts of the data base during simultaneous updating of the data base.
- Allows recovery from catastrophic failures by re-loading the most recent on-line dump and re-applying after images from the audit files.



TANDEM is the only computer manufacturer to address successfully the problems of transaction backout and audit trails in a distributed environment. The removal of an aborted or failed transaction is provided through a record-locking protocol which allows multiple transactions to be scheduled concurrently but also locks all data base records affected until completion to prevent transaction dependency. The ENCOMPASS transaction monitoring facility thereby ensures that the inputs for each transaction are not dependent on the success or failure of another concurrent transaction.

Combined with the capability to recover from catastrophic failures, the transaction backout capability ensures a totally correct and consistent data base in the distributed data processing environment.

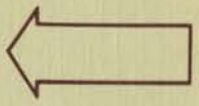
The ENCOMPASS distributed data management system is designed to simplify the development and testing of applications in a single system or in a network of systems. It will work equally well for centralized or distributed systems and can be easily expanded from a centralized to a distributed data base. Terminal management capabilities are provided either for one terminal or for hundreds of terminals.



The data base can be located in one system or it can be dispersed throughout the world. And transactions and applications are defined and controlled in a single system or throughout a network.

Combined with the capabilities of TANDEM NonStop architecture, ENCOMPASS provides application simplicity and efficient access to a flexible data base while ensuring high data integrity — all in the on-line distributed environment.

SUPPORT BUILDING BLOCKS
TANDEM's Software Tools



The **TANDEM** philosophy is to provide the end-user with a comprehensive software support system that enables the end-user to easily build his own application. These building blocks include languages, data base management, an interactive debugger, utilities, diagnostic software, forms creation software, and a data communications package.

- **TANDEM's** Transaction Application Language (TAL) is designed to provide fast, flexible programming in a multiprocessor, on-line environment. TAL is a powerful, high-level, block structured systems implementation language.

- **TANDEM**/COBOL (ANSI 1977 CCVS validated) is designed to utilize all the features of the GUARDIAN and GUARDIAN/EXPAND operating systems and ENCOMPASS distributed data management system for the COBOL end-user. **TANDEM**/COBOL features NonStop operation; shared, re-entrant code; virtual memory; geographic independence of I/O devices; and checkpointing of the GUARDIAN and GUARDIAN/EXPAND operating systems. Under ENCOMPASS (ENSCRIBE data base manager), **TANDEM**/COBOL provides key-sequenced, entry-sequenced and relative file structure; logical file size up to four billion bytes; up to 255 alternate keys per file; and optional mirror data base recording.

- **TANDEM**/FORTRAN (ANSI 1977, FCVS validated) is designed for optimum use with **TANDEM** operating system and data base management software. Benchmarks show **TANDEM**/FORTRAN fully capable of running efficiently in a high-throughput, multilanguage environment. It is a comprehensive FORTRAN package, featuring NonStop operation, re-entrant code, interprocessor communications, and virtual memory when used under the GUARDIAN and GUARDIAN/EXPAND operating systems. Its data base management facilities, used with ENCOMPASS (ENSCRIBE data base manager), include record management facilities for keyed, relative, and sequential access, multi-keyed data paths, and concurrent record access.

- **TANDEM**/MUMPS is the only version of MUMPS available for multiprocessor systems. It is a version of MUMPS developed specifically for use with the **TANDEM** system that complies with and surpasses MUMPS ANSI Standard 1976. **Tandem**/MUMPS is

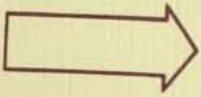
the only MUMPS package available that can be easily used in a multilanguage environment with a general-purpose operating system, making concurrent execution and data sharing with COBOL, FORTRAN, and TAL possible. **TANDEM**/MUMPS offers standard NonStop systems features and support, as well as the ability to access files created by other programs, to share global variables with other language systems, and to utilize networking.

MUMPS is similar in style and approach to BASIC, and well-suited to fast program development in an interactive, on-line environment. The TANDEM Editor built into T/MUMPS further facilitates rapid programming.

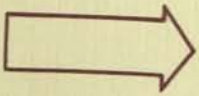
- **TANDEM's** ENVOY Data Communications Manager operates as an integral part of the GUARDIAN operating system. The ENVOY package is the interface between applications programs and data communications networks. It supports both binary synchronous and asynchronous communications, with single or multi-drop lines on a local or remote basis. ENVOY also supports SDLC and HDLC bit synchronous protocols.

- The AXCESS package is designed to ease programming of on-line applications supporting remote communication devices.

AXCESS software provides file system level access to multipoint communication devices such as IBM 3270 terminals and the Tandem 6520 and to either remote asynchronous devices or host computers attached to an X.25 public packet switching network. The AXCESS package shifts the responsibilities of handling the communication line from the user's application program to the various access methods that make up the AXCESS package.



The AXCESS package's X.25 Access Method in AXCESS is designed to allow **TANDEM** systems to communicate directly over public packet switching networks using standard protocols such as X.25 and X.29. **TANDEM's** X.25 Access Method is certified for use with TELENET and TYMNET and has been tested with DATAPAC (Canada).



The X.25 package provides Interactive Terminal Interface (ITI) support that allows remote terminals to access the host **TANDEM** systems from anywhere in the world. **TANDEM** application programs can communicate directly with ITI Terminals or any node on the public network capable of handling X.25 level 3 packets. The X.25 access method also can be used with the GUARDIAN/EXPAND operating system for automatic rerouting of communications in case of line failures during processing in a GUARDIAN/EXPAND network.

• The XRAY performance monitoring tool provides users with data that can help balance loads and fine-tune applications with less than 1% overhead. The NonStop XRAY software monitors total system performance and resource utilization and spots overloads in work distribution. The XRAY monitor performs its work during actual processing, without user intervention. Bottlenecks in programs, processors, controllers, and peripherals are displayed on the terminal or in hard copy printouts.

• The DIAGLINK package provides interactive analysis by remote diagnostics anywhere in the system. Any terminal in the end-user system, with proper security clearances or a connection with the **TANDEM** Field Service Center, enables service personnel to arrive fully prepared to make the replacement or adjustment required immediately.

• **TANDEM** UTILITIES include the **TANDEM** T/TAL Text Editor; its TGAL galley formatter, and the SORT and DEBUGGER utilities.

• The EXCHANGE remote batch workstation provides the NonStop system with the capability to emulate the functions of a 2780 or 3780 remote batch workstation. It also provides certain remote job entry capabilities.

• TIL (Tandem to IBM Link) is a hardware and software communications subsystem that links a single Tandem 16 or a network with any IBM 370-compatible system. Tape speed data transfers from the TIL device provide a burst mode transfer rate of approximately 300 kilobytes per second. Because the TIL device utilizes as much existing IBM hardware as possible, these data transfer rates are achieved at a reasonable cost and with a minimum of system overhead.

SAMPLE CONFIGURATIONS AND PRICES

	SMALL	TYPICAL MEDIUM	LARGE
TOTAL PROCESSORS	**2**	**4**	**8**
Total System Main Memory	768 KBytes	1.54 MBytes	2.4 MBytes
Aggregate instruction rate (in a transaction environment)	1.3 MIPS	2.5 MIPS	4.8 MIPS
Disc Drive Storage	128 MBytes	710 MBytes	1,096 MBytes
Asynchronous Communication lines up to 19.2 KBAUD	16	98	164
Multidropped Synchronous Communication Lines up to 80 KBAUD	4	8	20

Notes:

Very large systems (up to 16 Processors) are available with correspondingly greater capabilities.

Tandem systems range in price from $150,000 to $3 million at U.S. list prices.

TANDEM SOFTWARE OFFERED

The following are software products available from Tandem:

AXCESS – X.25 Communications Support
- AM 3270
- TR 3271
- AM 6520

COBOL – ANSI 74 Compiler

FORTRAN – ANSI 77/78 Compiler

ENCOMPASS – Distributed Data Management System which includes:

- ENFORM Query/Report Writer
- ENSCRIBE Data Base Manager
- Data Definition Language (DDL)
- PATHWAY Transaction Processing System
- Transaction Monitoring Facility (TMF)

ENVOY – Data Communications Manager

EXCHANGE – 2780/3780 Workstation Support

GUARDIAN – Operating System

GUARDIAN/EXPAND – Network Extension of GUARDIAN

MUMPS – Interpretive Program Language

SPOOLER – General and extended capability

TIL – Tandem IBM Link

XRAY – Performance Monitor

TANDEM BRANCH OFFICES—USA

ATLANTA, Georgia
(404) 953-2377

BOSTON, Mass.
(617) 964-6500

CHICAGO, Illinois
(312) 397-5200
(312) 856-1133

CINCINNATI, Ohio
(513) 984-2044

CLEVELAND, Ohio
(216) 261-9993

COLUMBUS, Ohio
(614) 764-2100

DALLAS, Texas
(214) 258-0103
(214) 647-2326

DENVER, Colorado
(303) 779-6766

DETROIT, Michigan
(313) 425-4110

GREENSBORO, North Carolina
(919) 294-6131

HASBROUCK HEIGHTS, New Jersey
(201) 288-6050

HOUSTON, Texas
(713) 861-6515

INDIANAPOLIS, Indiana
(317) 875-8144

KANSAS CITY, Kansas
(913) 649-9002

LOS ANGELES, California
(213) 595-7356

MEMPHIS, Tennessee
(901) 332-3702

MILWAUKEE, Wisconsin
(414) 476-2025

MINNEAPOLIS, Minnesota
(612) 854-5441

NEW YORK, New York
(212) 760-8440

PHILADELPHIA, Pennsylvania
(215) 245-0600

PHOENIX, Arizona
(602) 254-6728

PITTSBURGH, Pennsylvania
(412) 562-0262

SAN DIEGO, California
(714) 296-0121

SAN FRANCISCO, California
(415) 777-1230

SAN MATEO, California
(415) 349-9723

SANTA CLARA, California
(408) 496-6690

SEATTLE, Washington
(206) 881-8636

ST. LOUIS, Missouri
(314) 878-7180

TAMPA, Florida
(813) 877-7466

TULSA, Oklahoma
(918) 663-0940

WASHINGTON, D.C.
(703) 379-7900

INTERNATIONAL BRANCHES

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(403) 262-4077
740 Gulf Canada Square
401-9th Avenue S.W.
Calgary, Alberta T2P-3C5

Toronto, Ontario
(416) 441-6806
180 Duncan Mill Road, 6th Floor
Suite, 606
Don Mills, Ontario M3B-1Z6

Montreal, Quebec
(514) 284-9253
625 Avenue Du President Kennedy
Montreal, Quebec H3A-1K9

Langley (Vancouver), British Columbia
4708 209th Street
Langley (Vancouver), British Columbia

ENGLAND

Northolt, Middlesex
(011) 44/841-7381
Peel House 32-34 Church Road
Northolt, Middlesex UB55AB
England, United Kingdom

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(011) 33/1-687-34-66
1, Place Des Etats Unis
Silic 255
94568 Rungis Cedex
Paris, France

GERMANY

Dusseldorf
(011) 49-211-313084
Kirchfeldstrasse 61
4000 Dusseldorf 1
West Germany

Frankfurt
(011) 49-611-5007-1
Bernerstrasse 34
6000 Frankfurt/Main 56
West Germany

Hamburg
(011) 49-40-241-386 or 87
Geschaeftsstelle Hamburg
An Der Alster 5
2000 Hamburg 1
West Germany

Munich
(011) 49-89-492011 thru 14
Geschaeftsstelle Muenchen
Rosenheimer Str. 139
8000 Muenchen 80
West Germany

Stuttgart
(011) 49-711-790081 thru 84
Geschaeftsstelle Stuttgart
Postfach 2451
Gutenberg Str. 4
D-7022 Leinfelden-
Echterdingen 2
West Germany

ITALY

Milan
Viale Del Ghisallo 20
Milano, Italy

JAPAN

Tokyo
(03) 984-6000
P.O. Box 1126
Sunshine 60
Tokyo, Japan (170)

SWEDEN

Solna
(011-46) 8-730-52-15
Industrivagen 20 2TR
S-171 48 Solna, Sweden

SWITZERLAND

Zurich
(011) 41-1-663025
Zweierstr 138 Postf
Ch-8003 Zurich, Switzerland

WORLDWIDE COVERAGE SALES AND SUPPORT

Tandem has developed a world-wide support and maintenance organization including support located throughout North America, Europe and the Pacific Basin.

In **North America**, Tandem has over 40 sales and support locations. Each office is staffed with hardware and software support personnel which provide the first line of support to Tandem customers. Regional offices in San Francisco, Chicago, New York, Washington, Toronto and Dallas supply regional hardware and software specialists who are the second line of support.

Tandem has sales and support throughout nine countries in **Europe**. The Middle East is supported by a distributor in Greece. Regional offices for second level support are located in Frankfurt and London.

One of the fastest growing areas for Tandem is in the **Pacific Basin**. Tandem has five sales and support locations in the Pacific area including Tokyo, Hong Kong, Melbourne, Mexico City and Caracas.

In addition, Corporate Headquarters in Cupertino, California provides the third line of support in the form of a worldwide support center that is on call 24 hours a day, 365 days a year in the event that a problem cannot be solved in the field. Each hardware and software development group in Cupertino has people responsible for working with the worldwide support center.

TANDEM's Education Network: "TENET"

The goal of Tandem's education program is to help customers use their NonStop system productively. The courses take the student through the application cycle, using Tandem software as the tools of implementation.

The Tandem Education Network, "TENET," subdivides classes into a set of education paths tailored to individual needs. "TENET" emphasizes hands-on experience of the system and includes numerous and comprehensive sessions in the laboratory.

All students participate in the Concepts and Facilities course which covers system architecture, basic utilities and principles of operation. The paths than diverge into application-oriented courses which emphasize application design and development and system-oriented courses which emphasize system management and programming.

Tandem Concepts and Facilities:

- Provides an overview of Tandem and its products, hardware and software architecture including GUARDIAN file management, NonStop processing overview and data base management. The objective is to prepare a language-independent foundation for further study of the NonStop system. Hands-on lab work. (5 days)

The Application-Oriented courses offer:

- PATHWAY Server Development using COBOL – includes instruction for on-line data base update and retrieval, transaction processing (PATHWAY) and NonStop software. The objective is to provide structured design techniques to be utilized in the development of future COBOL applications on a NonStop system. (5 days)
- PATHWAY Server Development using FORTRAN – same as above except using FORTRAN as the implementation language.
- PATHWAY Requestor Development using Screen COBOL – provides an overview for the transaction processing software, instruction on the terminal control language – Screen COBOL, generation of screen formats and PATHWAY terminals. The objective is to formulate a model for future on-line applications using PATHWAY. (5 days)
- ENFORM Query/Report Writer – consists of instruction and practice using the ENFORM language including total system environment, file structures, performance considerations and Data Definition Language. The objective is to achieve the ability to create complex reports, source data definitions and obey files using ENFORM. (5 days)
- MUMPS Application Development – includes instruction on Standard MUMPS, the Tandem additions to Standard MUMPS and versions of MUMPS supported by other organizations. The objective is to learn to write MUMPS applications as well as the benefits derived from using MUMPS along with other resources of the NonStop system. (5 days)
- Advanced Design Techniques – explores all segments of the ENCOMPASS distributed data management system to create a practical methodology for data base and transaction design with emphasis on the Transaction Monitoring Facility (TMF) and the Data Definition Language (DDL); second part of class will provide performance

analysis for achieving optimum efficiency with ENCOMPASS. The objective is to provide the student with the means to utilize the NonStop system to full advantage. (10 days)

The System-Oriented courses offer:

- TAL System Programming Language — provides basic instruction in syntax, structure, and use of Tandem's system programming language. The objective is to learn to write short TAL programs using procedure calls, looping constructs, pointers and indirection. (5 days)
- GUARDIAN Operating System — supplies an introduction to the operating system procedures, interprocess communications and use of ENSCRIBE files. The objective of the course is to prepare the user to write a major application in TAL or to write TAL service routines for use by COBOL or FORTRAN programs. (10 days)
- Systems Operations and Management — course is designed to present the student with in depth knowledge aimed at a "System Manager" responsible for a Tandem 16 system. The objective is to provide the student with the ability to load the operating system and control the operating environment, to perform the necessary functions for a "down system," and to be able to install a new operating system release. (5 days)
- Introduction to Data Communications — overview of basic communications with instruction on Tandem communications where applicable; includes practice in the use of Tandem's communications product (ENVOY) with emphasis on the bisync environment. The objective is to familiarize students with basic communications terminology, data link control concepts and implementations plus additional communications architecture and links. (5 days)

Tandem has developed the Student Information and Reservation system (SIR) which will provide current information on all students and classes provided throughout the world by Tandem. This system will be used as a model for classes to illustrate an efficient, expandable, and flexible utilization of ENCOMPASS software and the NonStop system.

SIR will include information on all students who have ever registered for Tandem classes. It will also provide lists of classes offered, time offered, locations, number of students enrolled and all other relevant data. This data will be available to all users on the Tandem network and will enable participants to ascertain information such as which classes are available, data on previous students and location of classes available. Students can then be quickly and efficiently registered from the terminal at the most convenient location. The registration transaction automatically updates the entire SIR system throughout the network.

In the U.S. course instruction is offered at Tandem Field Offices in San Mateo, Cupertino and Los Angeles, California; Dallas, Texas; Minneapolis, Minnesota; Chicago, Illinois; Detroit, Michigan; New York, New York; Washington, D.C.; and Atlanta, Georgia. In Europe classes are available in Stockholm, Sweden; Dusseldorf and Frankfurt, West Germany; Paris, France; London, United Kingdom. In Canada courses are available in Vancouver, Montreal and Toronto.

For additional information on enrollment, schedules or course content contact local representatives [see pp. 60-61 for addresses and telephone numbers] or the Tandem California headquarters in Cupertino.
(800) 538-9360 toll-free (408) 725-6000

Company History

TANDEM Computers Incorporated was founded in 1974 by seasoned computer professionals experienced in the development of "cold-start" technology companies, including Amdahl, Diablo and Hewlett-Packard.

The Company was created to meet the market need for fault-tolerant multiprocessor systems with accompanying software, specifically designed for the on-line end-user whose applications require continuous availability of high volume transaction-oriented interactive data processing.

TANDEM shipped its first system nineteen months after the company was founded. The company became profitable in its second year and went public in December 1977. The shares are traded over the counter by more than twenty market makers, and several brokerage firms publish research reports on TANDEM on a regular basis. Effective June 30, 1980, Tandem stock was split two-for-one.

TANDEM believes that its success in the end-user market is based on its NonStop system's ability to meet an important end-user need. The TANDEM system's fault-tolerant architecture and comprehensive NonStop operating system and extensive software tools enable end-users to implement critical on-line applications such as credit verification, electronic funds transfer systems, medical life support systems, message switching, airline reservation systems, and distribution. Continuous system availability, modular expandability without reprogramming (up to 16 processors in a system and up to 255 nodes in a distributed data processing network), and data base integrity are all built into the TANDEM system.

Approximately 2/3 of sales are made directly to end-users; about 1/3 to OEM's. The ratio of repeat business is high — many users expand their systems within 12-24 months of initial purchase. The Company offers a comprehensive selection of software tools for the on-line end-user, and supplements its offering of support "building block" software packages with a staff of systems analysts for customer support on a consulting basis.

During the third quarter of fiscal year 1980, TANDEM shipped its 1000th processor. TANDEM has over 250 customers distributed among 26 industries. The company has over 1200 employees. Manufacturing, administration, marketing training and research and development are done at the Cupertino, California headquarters. In Watsonville, California, subassembly manufacturing is done. The Neufahrn facility in West Germany assembles and ships complete systems. In the third fiscal quarter 1980 over 10 percent of all NonStop systems came from Neufahrn.

TANDEM has over 50 sales and support offices in the U.S., Canada, Europe, the United Kingdom, Hong Kong, and Japan; and distributors in Australia, Finland, Greece, Mexico and Venezuela.

Revenues have grown rapidly from $24.3 million in fiscal 1978 to $56.0 million in fiscal 1979 to $74.9 million for only nine months of fiscal 1980 (as of June 30, 1980). TANDEM is shipping at an annualized rate of $117.2 million (as of June 30, 1980). Pretax profit margins were 19.6 percent for the third quarter ended June 30, 1980. Earnings per share were $.27 for the quarter ended June 30, 1980 compared to $.15 for the quarter ended June 30, 1979. In the third quarter 1980, 37.1 percent of revenues was

spent on cost of revenues; 8.0 percent on product development; 37.1 percent for marketing, general and administrative. The company has financed its growth with equity; paid in capital now exceeds $52 million.

TANDEM anticipates continued acceptance based on the company's computer products, reputation and responsiveness to the requirements of the on-line, transaction processing end-user.

TANDEM

1) Do you represent a company with annual revenues:
☐ under $1 million ☐ between $1 million and $10 million
☐ between $10 million and $30 million ☐ over $30 million

2) Prior to receiving this Executive Overview on Tandem, had you heard of Tandem NonStop™ systems? ☐ yes ☐ no

If YES, where? Advertisements _____
Trade journal articles _____
Trade shows _____

3) What position do you currently hold with your company?

_____

Are you participating in decisions to install an on-line, high volume transaction-oriented application within the next twelve months? ☐ yes ☐ no

4) Would you like to receive additional information about Tandem and its products? ☐ yes ☐ no

Would you like to be placed on a mailing list? ☐ yes ☐ no

Name _____
Job title _____
Firm _____
Address _____
City/State/Zip _____

Check box for those applications which are of interest to you:

☐ Communications/Message-Switching
☐ Distributed Data Processing
☐ Distribution/Order Entry & Inventory Control
☐ Education/Registration & Admissions
☐ Financial/Banking & Securities
☐ Manufacturing/Materials Flow & Job Entry
☐ Medical/Pathology and Patient Care
☐ Networking
☐ Printing and Publication
☐ Retail
☐ Service Bureaus
☐ Textiles/Cloth Grading & Cutting
☐ Utilities/Gas, Electric & Power Systems
☐ Word Processing/Information Retrieval

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FIRST CLASS PERMIT NO. 482 CUPERTINO, CA, U.S.A.

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TANDEM

Tandem Computers Incorporated
19333 Vallco Parkway
Cupertino, Calif. U.S.A. 95014

Attn: Marketing Communications

TANDEM

B098075

Tandem Computers Incorporated
Worldwide Headquarters: Cupertino, California U.S.A.
Offices throughout the United States, Canada, Europe, United Kingdom and Japan
Distributors in Australia, Finland, Greece, Mexico and Venezuela