Connecting For Growth— 'Internetivity' And The Semiconductor Industry

1997 Dataquest European Semiconductor Industry Conference

May 20-21, 1997
Golden Tulip Barbizon Palace Hotel
Amsterdam, The Netherlands

Dataquest—A Gartner Group Company
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Dataquest Global Events Conferences 1997

May 22	Dataquest Predicts... The PC Industry	Amsterdam	The Netherlands
Jun 4-5	StorageTrack	Monterey	CA, United States
Jun 17-18	European StorageTrack	London	United Kingdom
Jul 14-15	PC Trends	San Jose	CA, United States
Jul 16	Channel Trends	San Jose	CA, United States
Jul 16	SEMICON/West	San Francisco	CA, United States
Aug 5-6	Document Management	Chicago	IL, United States
Sep 15-16	Remote Access	San Jose	CA, United States
Sep 24-25	European Telecommunications Forum	Amsterdam	The Netherlands
Oct 15-16	European Printer/Copier Conference	Edinburgh	United Kingdom
Oct 20-24	Semiconductors	San Diego	CA, United States
Dec 3	Dataquest Predicts... The PC Industry	London	United Kingdom

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Egham, Surrey TW20 9AW
United Kingdom
Tel: +44 (0) 1784 431611
Fax: +44 (0) 1784 487545

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List of Attendees by Company

Advanced Micro Devices (UK) Ltd	Wayne Godwin	Northern Europe Field Manager
Advanced RISC Machines Ltd	Robin Saxby	President and CEO
Air Products plc	Suzanne Lowe	Marketing Manager
Air Products plc	David Asin	Marketing Engineer, Electronics - Europe
Altec SA	George Valsamidis	Chief Executive Officer
Amkor Anam Euroservices	Garry Pycroft	Director of Strategic Accounts
Anadigics Inc.	Roland Rosenzweig	President and CEO
Bloomberg News	Raymond Frenken	
Carsem (Europe)	Andy Longford	Project Manager
Cyrix International Ltd	Brendan Sherry	European General Manager
Dataquest	Gene Norrett	Vice President and Director
Dataquest Europe	Joe D'Elia	Senior Analyst
Dataquest Europe	Mike Williams	Senior Analyst
Dataquest Europe	Mike Glennon	
Dataquest Europe	Paul O'Donovan	Industry Analyst
Dataquest Europe	Jim Eastlake	Vice President and Director
Dataquest Europe	Robin Daines	Industry Analyst
Dataquest Europe	Jim Tully	Principal Analyst
Dataquest Europe	Ellie Babaie	
Dataquest Europe	Richard Gordon	Industry Analyst
Dataquest Europe	David Moorhouse	Associate Director
Dempa Publications	S. Nakata	European Correspondent
Electronic Engineering Times	Peter Clarke	
Electronics Times	Nick Flaherty	Technology Editor
Electronics Weekly	David Manners	Components Editor
Elektroniktioningen	Per Henricsson	Editor
Epson Europe Electronics GmbH	Hiroshi Haranosono	Senior Marketing Manager
Financial Times	Paul Taylor	Senior IT Correspondent
Finmeccanica SpA	Bruno Piano	Manager Strategic Finance
France Telecom	Jean Pierre Coustel	Director of France Telecom, Pay TV
France Telecom	Marc Du Peloux	Product Manager, France Telecom, Pay TV
Fujitsu Mikroelektronik GmbH	Günther Junge	ASIC Design Centre Manager
Gartner Group	Mark Meijer	
Gartner Group	Joerg Matschke	
Gartner Group	Jon Ticehurst	

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General Semiconductor GmbH	Jos Van Loo	Technical Marketing Manager
Hewlett Packard GmbH	Chris Attwood	Sales Account Manager
Hitachi Europe	Keith Kidd	Marketing Segment Manager
Hitachi Europe	John Hannah	Business Planning Manager
Hitachi Europe	Jean-Louis Fréart	Market Research
IDA Ireland	James Fox	
IDT Europe Ltd	Bill Proudfoot	Regional Manager
IMEC	Roger De Keersmaecker	Associate Director
Ing Barings	Eric De Graaf	Senior Equity Analyst
Intel	Steve Poole	Director of Operations, Europe
IPA Niedersachsen	Bernd Niermann	Director
Italtel SpA	Roberto Costella	Purchasing Manager
Italtel SpA	Francesco Marchelli	Purchasing Manager
LG Semiconductors GmbH	Kwang-Ho An	Technical Marketing
LSI Logic Europe Ltd	David Lamb	Market Development Manager
LSI Logic Europe Ltd	Barry Mohan	Field Applications Engineer
LSI Logic GmbH	Nick Phillon	Consultant
LSI Logic SpA	Giuseppe Staffaroni	Director, Wireless Business Unit
Lucent Technologies, Microelectronics	Victor Hrovat	Director, Sales & Marketing, Europe
Magnetic Marelli TECmobility	Fabrizio Righetti	Head of Marketing and Sales
Matra Communications	Franck Aveline	Technologist Engineer
Micronas Semiconductor SA	Traudl Kurb	Vice President Corporate Communications
Micronas Semiconductor SA	Gery Oberrauter	Telecom Business Unit Manager
Mitsubishi Electric BV	Peter Mies	Central Europe Sales Manager
Mitsubishi Electric Europe	Neville Rayner	Executive Vice President
Motorola	Jean-Jacques Berneron	Marketing Manager
National Semiconductor GmbH	John McKenna	Business Support Group Manager
National Semiconductor GmbH	Roland Andersson	VP and General Manager, Europe
Navigation Technologies	Roy Metcalfe	Strategic Business Development, Europe
NEC Electronics (Europe) GmbH	Stefanie John	Business Analyst
NEC Electronics (UK) Ltd	Susan Walder	Business Planning Analyst
New Electronics	Lou Reade	News Editor
Nikkei (The Nihon Keizai Shimbun)	Tetsuya Iguchi	Chief Correspondent
Nikon Precision Europe	Bill Sherlock-Lynn	Technical Marketing
Nokia Multimedia Network Terminals	Ari Nieminen	Assistant Vice President
Nordic VLSI ASA	Saether Trond	Vice President
Nordic VLSI ASA	Olave L. Lindquist	Marketing Director
Oki Electric Europe GmbH	Fred Brunner	Senior General Manager, Mktg & Sales
Philips Electronics NV, Sound & Vision	Jan Arisse	Product Manager, WebTV
Philips Electronics NV, Sound & Vision	Robert Bense	
Philips Semiconductors	Guido Bekkers	Product Market Analyst
Samsung Semiconductor GmbH	Anne Rooney	Market Analyst, Strategic Marketing
Samsung Semiconductor GmbH	Werner Diesing	Associate Director, Memory Marketing

Samsung Semiconductor GmbH	Young Nam Lee	Manager, Memory Applications
Schlumberger ATE	Luca Sartori	Director, Sales
SGS Thomson	Patrice Vaslot	Corporate Market Research
Sharp Electronics Europe GmbH (MED)	Toshiharu Kikuchi	Assistant Manager, Product Planning
Siemens Semiconductors	Peter Tillmanns	Vice President
Silicon & Software Systems	Ray Bulger	Managing Director
SiRF Technology Inc.	Kanwar Chadha	Vice President, Marketing
Sony Semiconductor Europe	Richard McPartland	Wireless Products, Planning & Mktg Mngr
SPOERLE Electronic	Carlo Giersch	President
Sun Microelectronics Europe	Peter Harverson	Director and General Manager
Sunrise Electronics Ltd	Paul Tourret	Sales Director
Symbionics Ltd	Jeremy Hendy	IC Technology Business Manager
Synopsis GmbH	Andreas Hohl	Business Development
Texas Instruments	Gilles Delfassy	Vice President, Semiconductor Group
Texas Instruments	Dave Richardson	President
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CONNECTING FOR GROWTH—
'INTERNETIVITY' AND THE SEMICONDUCTOR INDUSTRY

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TUESDAY, May 20

1200 to
1330 **Registration And Buffet Lunch** .... *Hotel Main Reception And Café Barbizon*

1330 **Opening Remarks** .... *St Olof's Chapel*
Jim Eastlake
Vice President and Director
European Semiconductor Group
Dataquest Europe

1345 **Semiconductor Outlook Towards 2000** .... *St Olof's Chapel*
1:40 *Gene Norrett*
40 MIN Vice President and Director
Semiconductor Group
Dataquest

2:25 **EUROPEAN APPLICATIONS MARKET ANALYSIS** .... *St Olof's Chapel*
~~1415~~ 2:15 **Overview And Communications**
David Moorhouse
Associate Director
European Semiconductor Group
Dataquest Europe

1445 **EDP** *St Olof's Chapel*
2:45 *Robin Daines*
Industry Analyst
2:54 European Semiconductor Group
Dataquest Europe

1500 **Consumer** *St Olof's Chapel*
3:05 *Paul O'Donovan*
Industry Analyst
European Semiconductor Group
Dataquest Europe

1515 **Automotive** *St Olof's Chapel*
3:15 *Mike Williams*
Senior Industry Analyst
European Semiconductor Group
Dataquest Europe

1530 **Applications Summary** *St Olof's Chapel*
3:30 *David Moorhouse*
Dataquest Europe

1545 3:45 **Coffee** .... *St Olof's Chapel Foyer*

EUROPEAN DEVICE MARKET ANALYSIS .... *St Olof's Chapel*
1615 **Memories**
Richard Gordon
Industry Analyst
European Semiconductor Group
Dataquest Europe

1630 **Microcomponents** *St Olof's Chapel*
Joe D'Elia
Senior Industry Analyst
European Semiconductor Group
Dataquest Europe

1645 **ASICs, SLI And Design** *St Olof's Chapel*
Jim Tully
Principal Analyst
European Semiconductor Group
Dataquest Europe

1700 **European Market Summary** *St Olof's Chapel*
Jim Eastlake
Dataquest Europe

5:45 ~~1715~~ 5:15 **Dataquest European Semiconductor Procurement Survey Results** .... *St Olof's Chapel*
Jim Tully
Principal Analyst
European Semiconductor Group
Dataquest Europe

6:00 ~~1740~~ ~~5:40~~ **Dataquest European Vendor Of The Year Awards 1997**........ *St Olof's Chapel*
Gene Norrett and *Jim Eastlake*
Dataquest

1930 **Meet For Transport To Off-Site Dinner** .... *Hotel Main Reception*

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WEDNESDAY, May 21

0845 **Opening Remarks** .... *St Olof's Chapel*
Jim Eastlake
Dataquest Europe

0900 **SEAMLESS CONNECTIVITY: THE ROLE OF WIRELESS** .... *St Olof's Chapel*
Chairman: David Moorhouse

0905 **Integrated Cellular And Cordless—The Next Generation**
Jeremy Hendy
IC Technology Business Manager
Symbionics Ltd

0935 **Integrated Digital Baseband Platform For Digital Wireless Communications**
Gilles Delfassy
Vice President and General Manager
Wireless Communications Business Unit
Texas Instruments

1005 **Problems With Future Baseband**
Ronald Rosenzweig
President and CEO
Anadigics Inc

1035 **Coffee** .... *St Olof's Chapel Foyer*

1105 **THE AUTONET** .... *St Olof's Chapel*
Chairman: Mike Williams

1110 **The Future Of The Navigation System Market**
Roy Metcalfe
Market Development Manager
Navigation Technologies

1140 **The Market Of GPS Navigation**
Fabrizio Righetti
Manager of Marketing and Sales
Magneti Marelli *Tec*mobility

1210 **Instant Location Information Using GPS Technology**
Kanwar Chadha
Vice President, Marketing
SiRF Technology

1240 **Lunch** .... *Café Barbizon*

(Over)

1400 **CONNECTING THE INTERACTIVE CONSUMER VIA MULTIMEDIA** .... *St Olof's Chapel*
Chairman: Paul O'Donovan

1405 **Nokia Mediamaster—Bringing Interactive Services To The End-User**
Ari Nieminen
Assistant Vice President, Business Development
Nokia Multimedia Network Terminals

1435 **Providing Interactive Needs To The Consumer**
Jean-Pierre Coustel
Director of Pay TV
France Telecom

1505 **Internet Access For The Consumer From The Armchair**
Jan Arisse
Product Manager, WebTV
Philips Electronics NV - Sound and Vision Division

1535 **Coffee** .... *St Olof's Chapel Foyer*

1600 **PROCESSOR SOLUTIONS FOR CONNECTIVITY** .... *St Olof's Chapel*
Chairman: Joe D'Elia

1605 **Connecting With Embedded Devices**
Robin Saxby
President and CEO
Advanced RISC Machines (ARM) Ltd

1635 **Java™—The Answer For Connectivity**
Peter Harverson
Director and General Manager
Sun Microelectronics Europe

1705 **Microprocessors For Networked Computing**
Steve Poole
Director of Operations, Europe
Intel

1735 **Closing Remarks** .... *St Olof's Chapel*
Jim Eastlake
Dataquest Europe

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Conference Welcome And Overview

Jim Eastlake
Vice President and Director
European Semiconductor Group
Dataquest Europe

Jim Eastlake is Vice President and Director of Dataquest's European Semiconductor Group, based in Egham, and has more than 15 years of experience in the electronics industry. Before joining Dataquest, Jim was with Texas Instruments' Northern European Semiconductor Division. In his most recent post at TI, he ran the European Distribution Program for the Linear Functions Business Group. Earlier, he managed TI's advanced bipolar logic families and was responsible for launching TI's programmable logic families and bit slice functions in northern Europe. He also held a product marketing position for 8- and 16-bit microprocessors and peripherals. Jim graduated from the University of Newcastle-on-Tyne, UK, with an Honours degree in Physics.

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Connecting For Growth—
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Semiconductor Outlook Towards 2000

Gene Norrett
Vice President and Director
Semiconductor Group
Dataquest

Gene Norrett is corporate Vice President and Director of Dataquest's Semiconductor Group and is responsible for all worldwide semiconductor research, including Asia/Pacific, Europe, and Japan-based semiconductor research. Before this, he was Director of Marketing, responsible for the worldwide marketing strategies. Previously he was General Manager for all North American technology services. Gene was also the founder of Dataquest's Japanese Semiconductor Industry Service. Before joining Dataquest, he spent 14 years with Motorola's semiconductor product sector, serving in various marketing and management positions. Gene was also a founder of the World Semiconductor Trade Statistics Program and was Chairman of the Board of Directors of the Statistics Committee. He speaks frequently at Client Industry and Trade Association conferences. In 1987 he was voted by the San Jose Mercury News as one of Silicon Valley's top 100 influential people. Gene's education includes a B.S. degree in Mathematics from Temple University and an M.S. degree in Applied Statistics from Villanova University.

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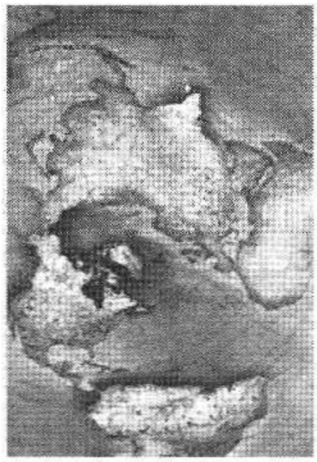

European Semiconductor Conference
May 20, 1997

Semiconductor Outlook toward 2000

Gene Norrett
Vice President
Semiconductors Group

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A Gartner Group Company

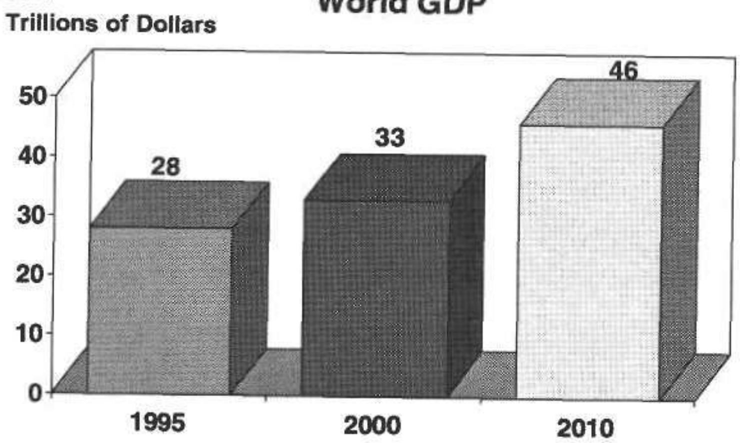
Agenda

- **Macroeconomic factors driving electronics**
- **Electronic equipment production forecast**
- **Semiconductor market status**
- **Structural Changes in the industry**
- **Semiconductor forecast**
- **Semiconductor capacity**
- **Summary**

Source: Dataquest (May 1997)

What Are the Macroeconomic Trends?
The world is getting richer and more can afford electronics

World GDP



Source: Dataquest (May 1997 Estimates)

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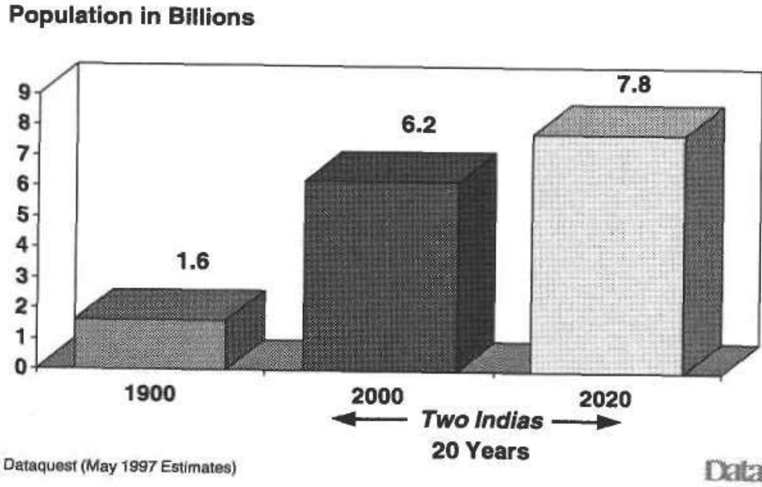
What Are the Macroeconomic Trends?
The globe is getting a lot more crowded



Source: Dataquest (May 1997 Estimates)

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What Are the Macroeconomic Trends?

The Far East population is getting richer, faster

	GDP Growth (%) 1995-2000	Middle-Class Population 1994
Korea		
Taiwan		
Hong Kong	7 to 9	200 million
Singapore		
China		
Philippines		
United States	3.1	150 million
Europe	3.0	530 million
Japan	2.7	100 million
India	6 to 8	140 million

Source: Dataquest (May 1997 Estimates)

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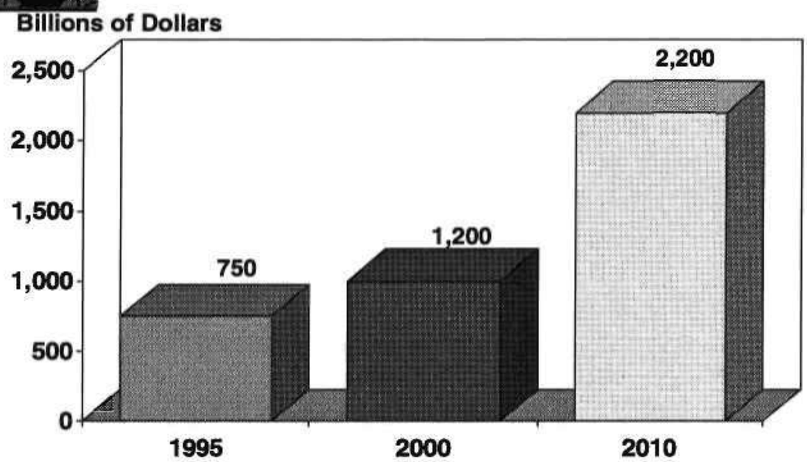
What Are the Trends in Electronics Production?

Worldwide electronics production —$1.2 trillion by 2000



Source: Dataquest (May 1997 Estimates)

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Major Product Transitions

- Sales Calls to E-Commerce
- VCRs to VCDs
- Primitive to Advanced Network Infrastructure
- Wire to Wireless
- Disk Drives to CD ROMs Drives (DVD)
- Win '95 to Win NT
- PC to Net PC

Source: Dataquest (May 1997)

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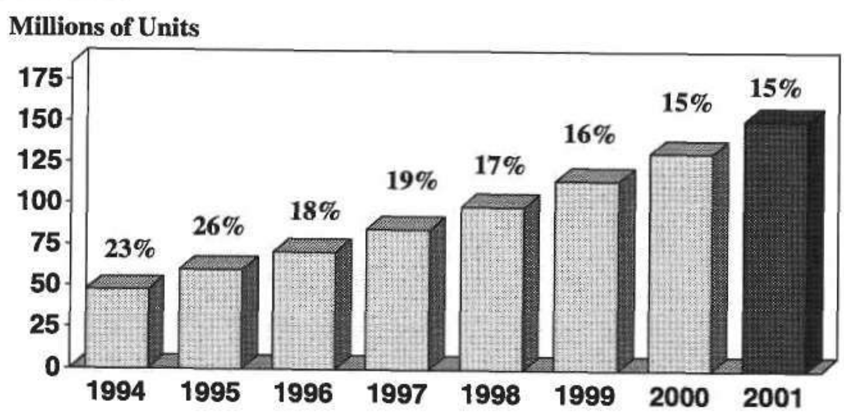
Latest Worldwide PC Forecast? Up 19% in '97



Source: Dataquest (May 1997 Estimates)

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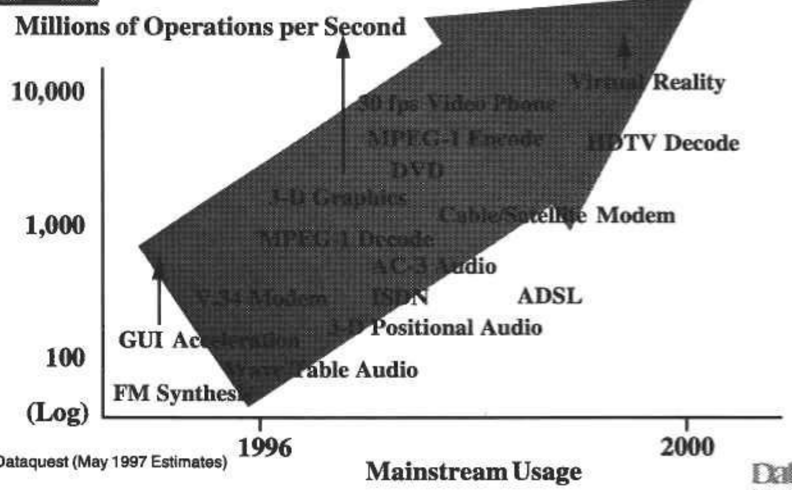
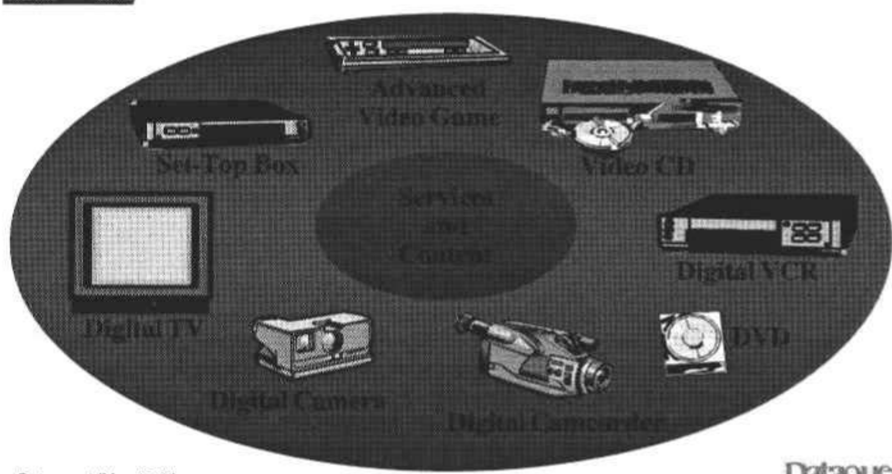
Multimedia Computing



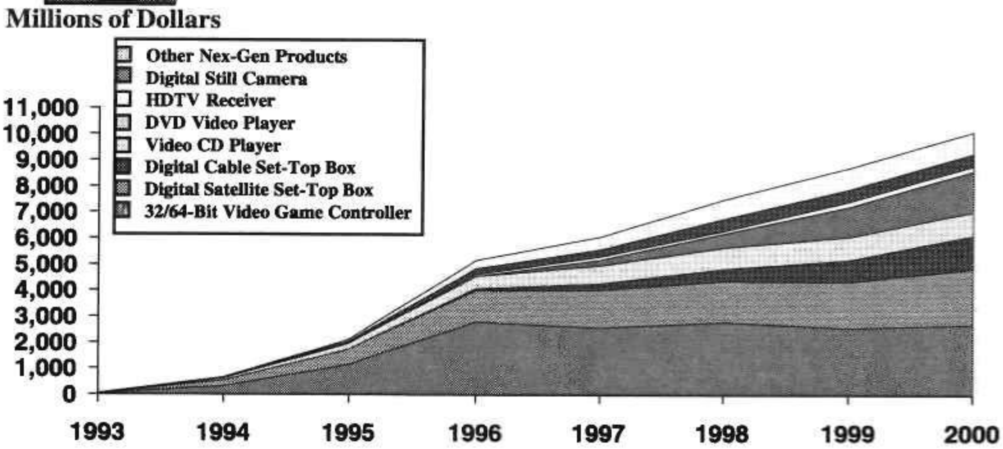
Source: Dataquest (May 1997 Estimates)

Digital Consumer Systems



Source: Dataquest (May 1997)

The Chip Market for Next-Generation Consumer Electronics Will Top $10 Billion by 2000



Source: Dataquest (May 1997)

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Summary of 1996 Semiconductor Market

- **1996: Excess inventories and a DRAM ASP cycle**
- **DRAM revenue declines 46%**
- **Non-DRAM semiconductors show 5% growth**
- **Recovery started in fourth quarter**
- **Asia/Pacific growth slowed**
- **Technology and product cycle transition**

Source: Dataquest (May 1997)

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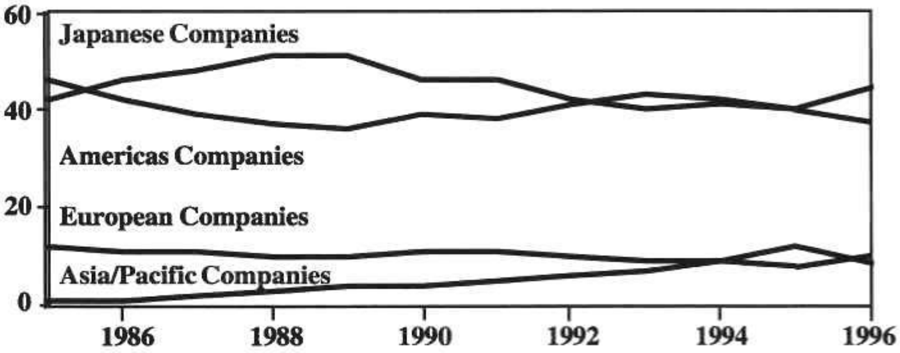
Regional Supplier Growth



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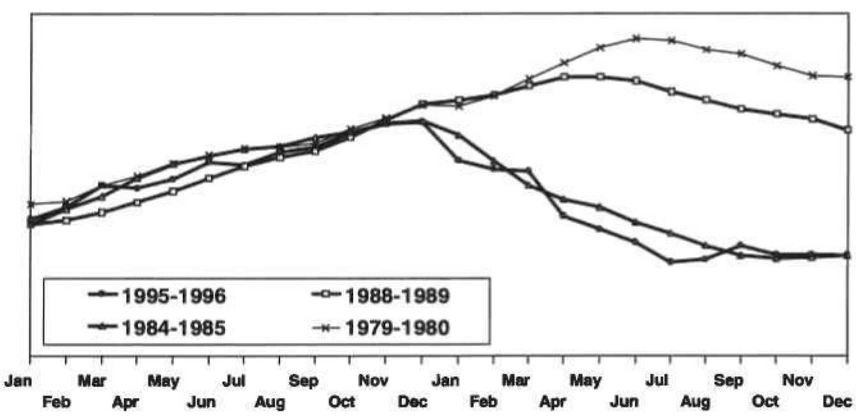
MOS Memory— Four "Downturns" Compared



Source: Dataquest (May 1997 Estimates)

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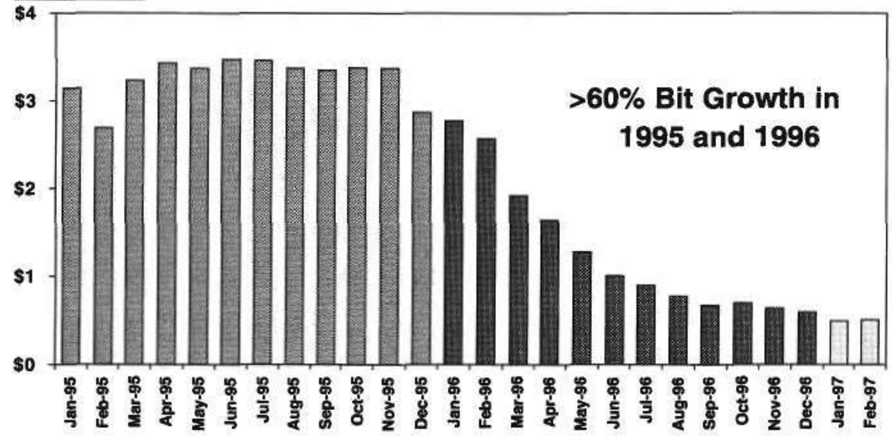
DRAM by Month
Price Per Megabit



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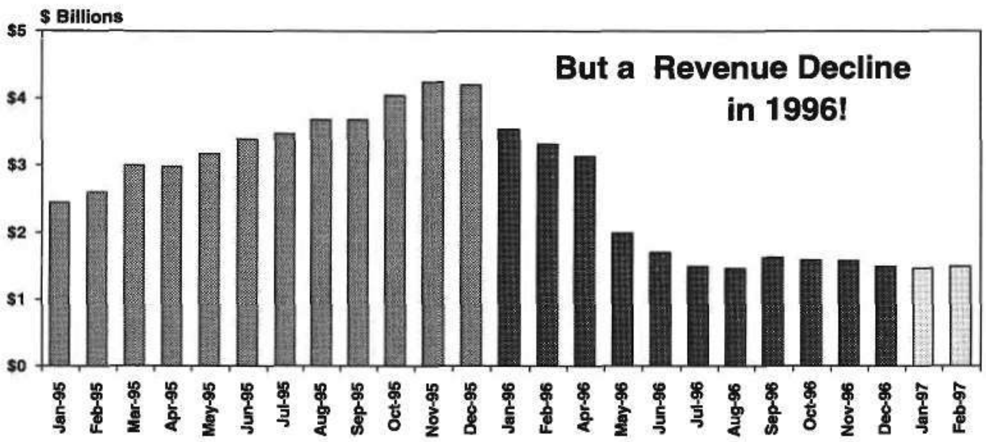
Source: Dataquest (May 1997 Estimates)

DRAM by Month
Revenue



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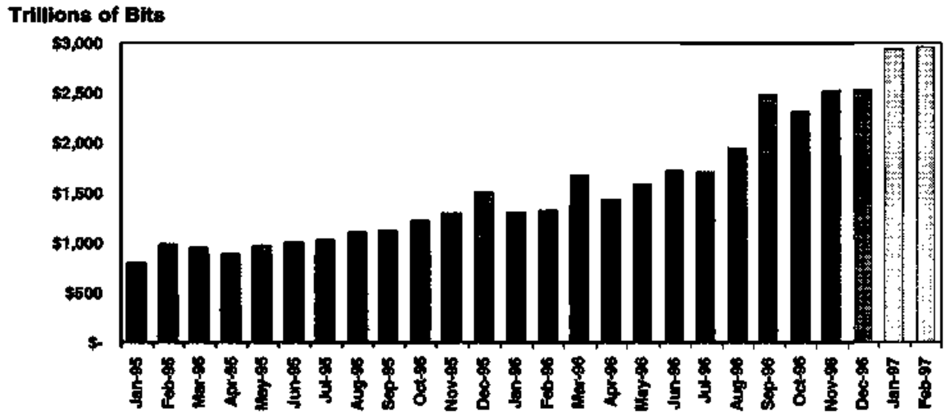
Bit Growth Continues Strong!



Source: Dataquest (May 1997 Estimates)

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Are there any Structural Changes?

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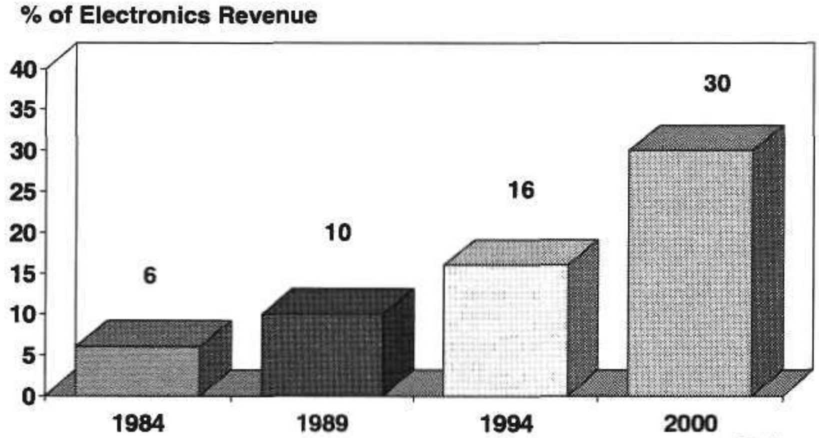
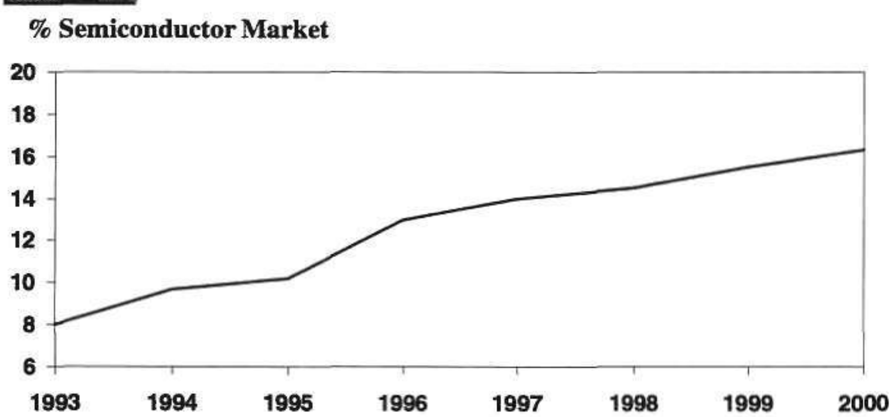
Any Structural Changes?
Semiconductor content skyrocketing



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Any Structural Changes?
Foundry a bigger player



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Semiconductor Capital Spending

*Millions of U.S. Dollars**

1996 Rank	1995 Rank		1995	1996	Percentage Change	1997 Prelim.
1	1	Intel	3,550	3,400	-4.2	4,450
2	3	LG Semicon	2,258	2,748	21.7	2,250
3	12	TI	1,079	2,300	113.0	1,150
4	5	Samsung	1,946	2,248	15.5	1,875
5	9	Hyundai	1,492	2,124	42.3	1,750
6	4	NEC	2,010	1,809	-10.0	*
7	10	IBM Micro	1,150	1,550	34.8	1,400
8	16	Siemens AG	850	1,450	70.6	1,250
9	6	Toshiba	1,624	1,438	-11.5	*
10	14	Micron	960	1,400	45.8	550

*We estimate the average Japanese co. will spend 12-15% less in '97

Source: Dataquest (May 1997 Estimates)
970841

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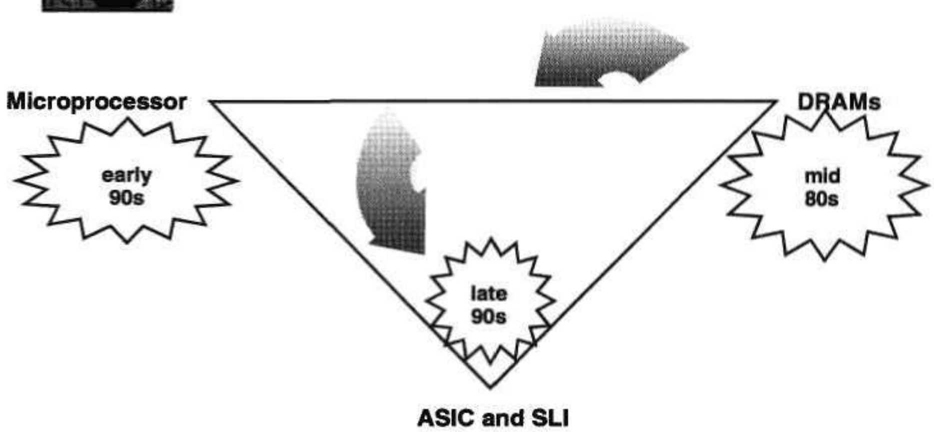
Any Structural Changes? Embedded and ASIC/SLI are the drivers

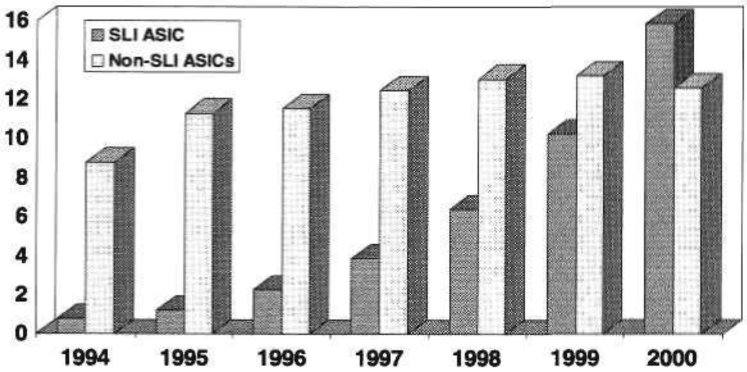


Dataquest
A Gartner Group Company

Source: Dataquest (May 1997 Estimates)

SLI Will Be the Dominant ASIC Technology by 2000

ASIC Worldwide Revenue (Billions of Dollars)



Source: Dataquest (May 1997 Estimates)

Any Structural Changes? Exploding Pipeline

- Cable Modems
- Digital subscriber line
- Broadband Satellite
- ATM
- Gigabit Ethernet

Faster ! Faster !! Faster!!!

Source: Dataquest (May 1997)

Summary of Some (not all) Structural Changes

- Semiconductor content skyrocketing
- Foundry — a much bigger percentage
- Intel extends dominance
- Embedded and ASIC/SLI the drivers
- Exploding pipeline

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Semiconductor Forecast

Dataquest
A Gartner Group Company

1996-1997 Revenue Forecast by Product

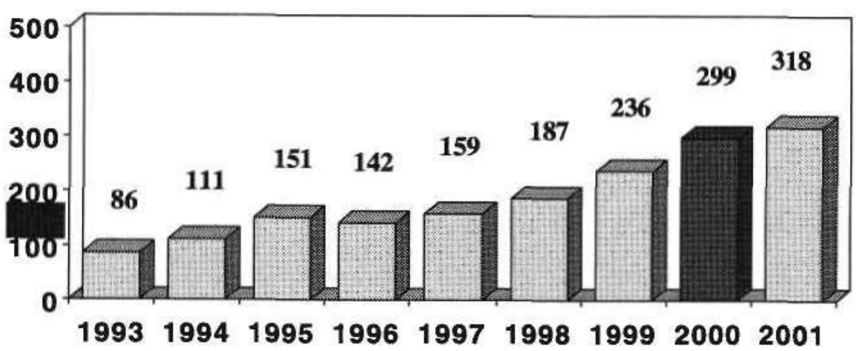
	1996		1997	
	$ Billions	*Percent*	*Billions of Dollars*	*Percent*
Memory ICs	37.8	-31.6	39.5	4.5
Microcomponent ICs	41.3	19.8	49.5	19.9
Logic/ASICs	21.6	4.5	24.7	14.4
Analog ICs	19.3	9.6	21.0	8.8
Discrete Devices	13.5	-5.9	15.5	14.8
Opto. Semiconductors	4.9	-2.1	5.7	16.3
Total (incl. Hybrids)	141.7	-6.3	158.8	12.1

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Semiconductor Forecast — Slow recovery

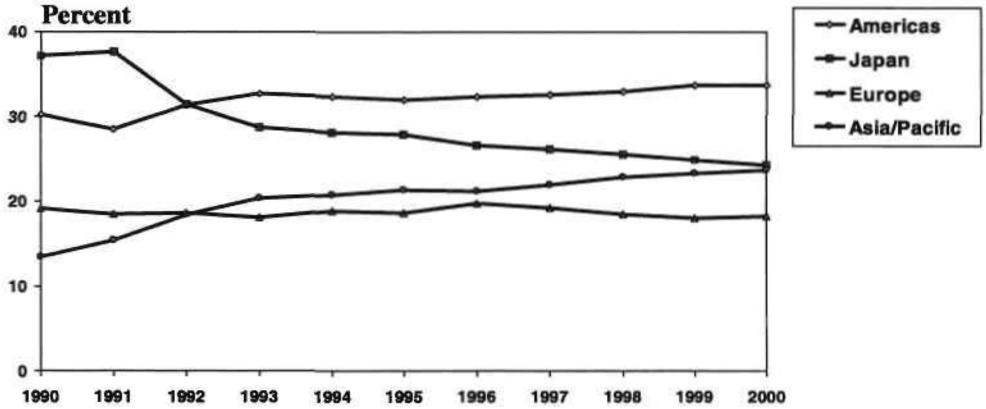
Billions of Dollars



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Regional Semiconductor Share: AP the big winner!



Source: Dataquest (May 1997 Estimates)
970845

Capital Spending Trends and Forecast

970935

Semiconductor Capital Spending

*Millions of U.S. Dollars**

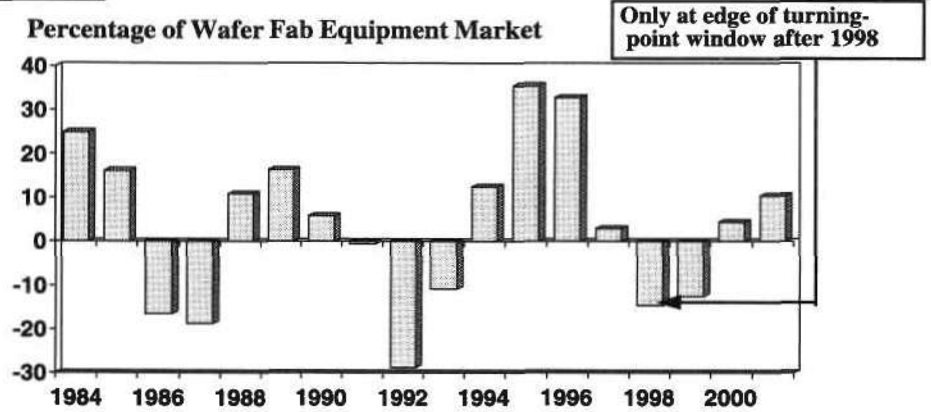
1996 Rank	1995 Rank		1995	1996	Percentage Change	1997 Prelim
1	1	Intel	3550	3400	-4.2	4450
2	3	LG Semicon	12258	2748	21.7	2250
3	12	TI	1079	2300	113	1150
4	5	Samsung	1946	2248	15.5	1875
5	9	Hyundai	1492	2124	42.3	1750
6	4	NEC	2010	1809	-10	*
7	10	IBM Micro	1150	1550	34.8	1400
8	16	Siemens AG	850	1450	70.6	1250
9	6	Toshiba	1624	1438	-11.5	*
10	14	Micron	960	1400	45.8	550

***We estimate the avarage Jpnese co. will spend 12-15% less in '97**

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

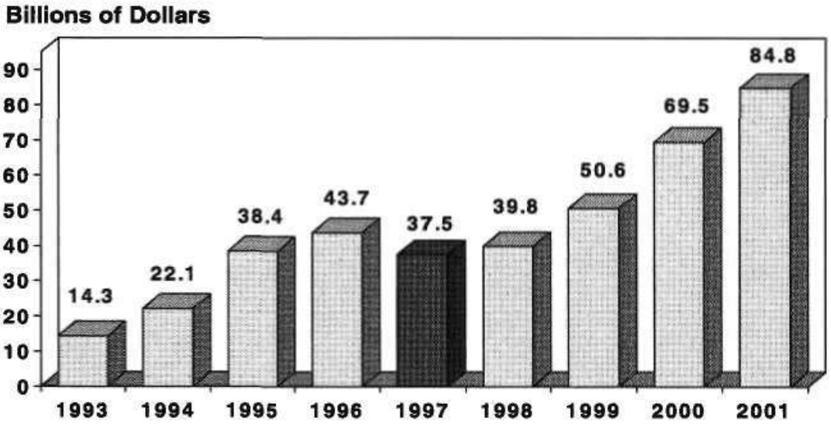
Net Cumulative Investment as a Percentage of Equipment Market



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Capital Spending Forecast



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Dataquest Predicts

- Electronic equipment growth of 8% to 9% in 1997
- Semiconductor growth of 9% to 14% in 1997
- Capital expenditures decline 12% to 18% in 1997
- Excess capacity until late 1998

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

European Applications Market Analysis

EUROPEAN APPLICATIONS MARKET ANALYSIS

David Moorhouse
Associate Director
European Semiconductor Group
Dataquest Europe

David Moorhouse is an Associate Director and Program Manager of Dataquest's Semiconductor Application Markets Europe program, based in Egham, UK, and has worked in the European electronics industry for the past 15 years. His expertise is in communications, military/aeronautical, industrial, and emerging applications. Before joining Dataquest, David was a Senior Consultant with the design house ID Devices, with responsibilities for product developments in fiber-optic communications and speech synthesis systems. His previous marketing experience was gained at STC (Standard Telephones and Cables) Hybrids Division as Product Marketing Manager and Applications Manager. Before STC, David worked for GEC Avionics as a designer in high-speed serial data bus systems used in military and civil aircraft. David is a graduate from Salford University with a degree in Electronics.

Robin Daines
Industry Analyst
European Semiconductor Group
Dataquest Europe

Robin is an Analyst for Dataquest's European Electronics Applications Group, where he is responsible for the Electronic Equipment Production Monitor program. His research covers non-PC EDP applications, including workstations, printers, storage devices, and EFTPOS equipment; captive and contract manufacture of electronic equipment, including manufacturing locations; system manufacturing costs, which includes system teardowns, bill of materials analysis, and component spend analysis. Recent work includes research about European manufacturing and equipment teardown and bill of materials analysis for: workstations, rigid disc drives, printers, digital cellular phones, modems, wide area pagers, PCs and telephone line cards, as well as research about the European contract electronics manufacturing (CEM) industry. Before joining Dataquest, Robin spent three years with ICL's manufacturing division (now called D2D) in a manufacturing engineering role. He is an associate member of the IEE and holds an Honours degree in Electronic Engineering from Southampton University.

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands

EUROPEAN APPLICATIONS MARKET ANALYSIS

Paul O'Donovan
Industry Analyst
European Semiconductor Group
Dataquest Europe

Paul O'Donovan is an Industry Analyst covering the Consumer Applications program within Dataquest's European Semiconductor Group. His main area of responsibility is the video and audio segments, although he covers all consumer applications. Paul is based at the European headquarters at Egham in the UK and has more than 11 years of experience in the semiconductor industry. Before joining Dataquest, he was with National Semiconductor at its European headquarters in Munich. There he had pan-European responsibility for managing National's Logic families through its distribution network. His tasks were primarily the gathering and analysis of trends for his product responsibilities and the setting of tactics and strategies. Before this role he was a marketing assistant in National's headquarters in the UK within the Digital Logic Group, and before this he was in Production Planning. Paul has studied Sales and Marketing with the Chartered Institute of Marketing.

Mike Williams
Senior Industry Analyst
European Semiconductor Group
Dataquest Europe

Mike is a Senior Industry Analyst for Dataquest's Semiconductor Application Markets Europe Service and is based in Egham, Surrey, UK. He has 9 years' experience in research and analysis into the semiconductor industry. His main expertise is in automotive application markets research, but he also covers specific areas of research in the computer and consumer segments. Prior to joining Dataquest, he was with Aidcom International, a consumer marketing research company based in London. Mike studied Computer Management at the Institute of Data Processing Management in London.

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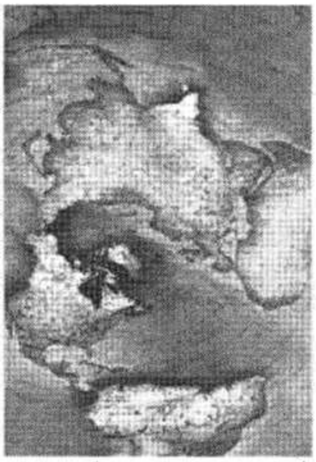

Dataquest

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Semiconductor Industry Conference

Applications Overview

David Moorhouse

Associate Director

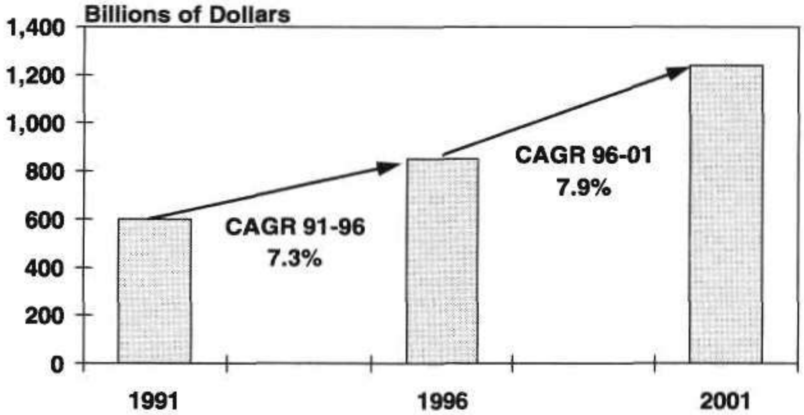
Dataquest Europe

Applications Agenda and Speakers

- **Applications Overview** — ***David Moorhouse***
- **Communications** — ***David Moorhouse***
- **Electronic Data Processing** — ***Robin Daines***
- **Consumer** — ***Paul O'Donovan***
- **Automotive** — ***Mike Williams***
- **Industrial and Mil/Aero** — ***David Moorhouse***
- **Summary** — ***David Moorhouse***

Source: Dataquest (May 1997)

Worldwide Equipment Production Ex-Factory Revenue



Source: Dataquest (May 1997 Estimates)

Dataquest
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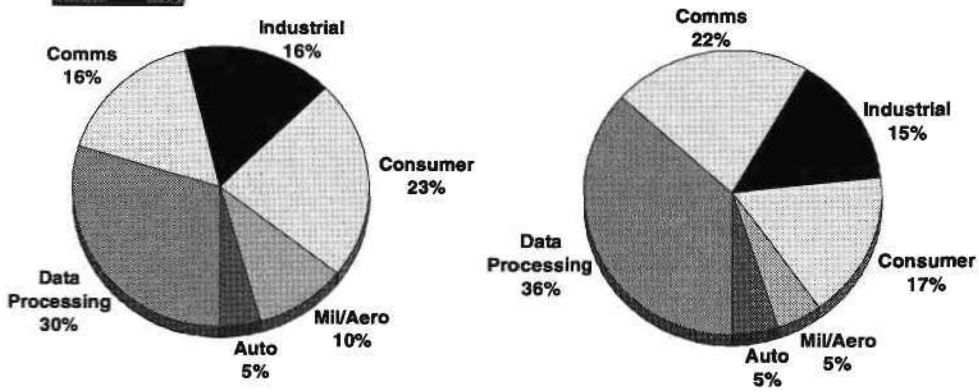
Worldwide Equipment Production Ex-Factory Revenue



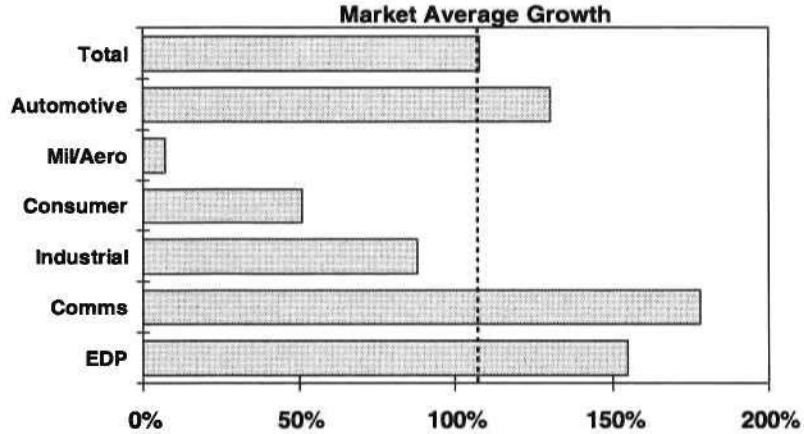
1991 World Electronics Production
Total = $599 Billion

2001 World Electronics Production
Total = $1,240 Billion

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Worldwide Equipment Production Percentage Growth 1991-2001



Source: Dataquest (May 1997 Estimates)

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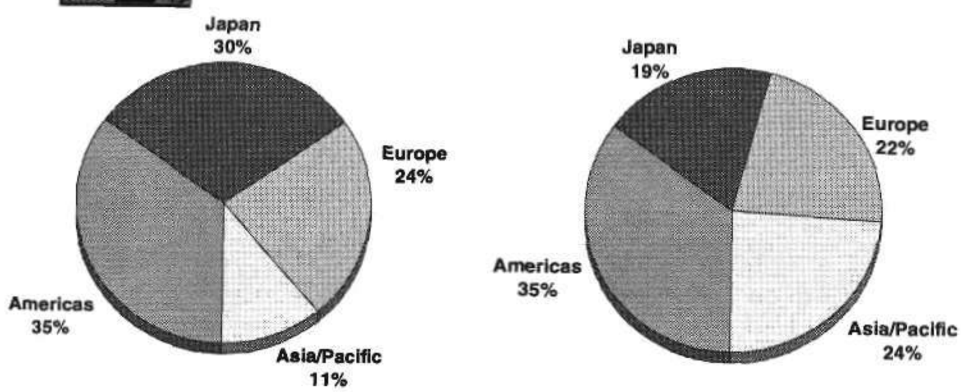
What Trends Are Driving This Growth in Production?

- Increasing Individual Productivity
- Increasing Value of Information
- User Choice/Convenience
- Mobility/Portability
- Data Everywhere
- Connectivity
- Safety and Security

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Worldwide Equipment Production by Region



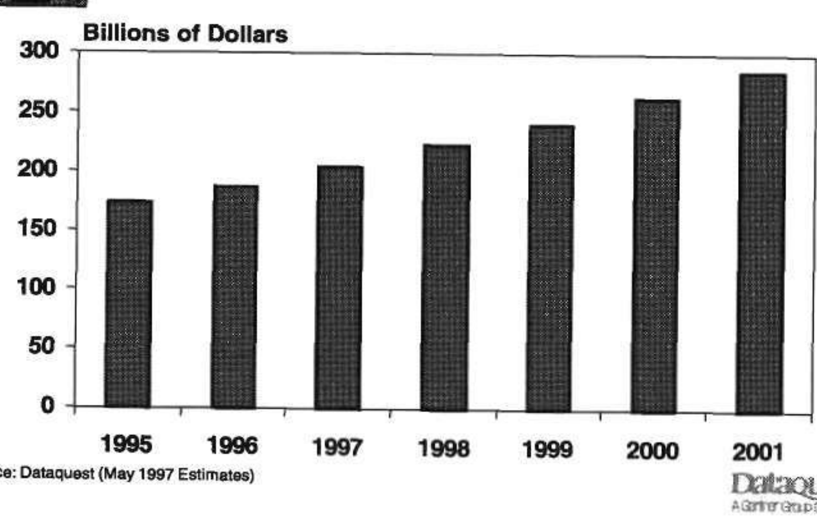
1991 Ex-Factory Revenue
Total = $599 Billion

2001 Ex-Factory Revenue
Total = $1,240 Billion

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

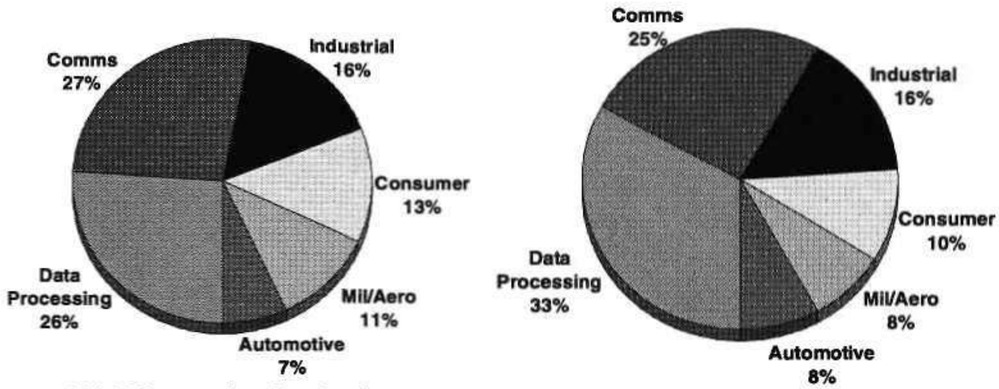
Total European Ex-Factory Revenue



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

European Equipment Production Ex-Factory Revenue by Application



1996 Electronics Production
Total = $185.3 Billion

Source: Dataquest (May 1997 Estimates)

2001 Electronics Production
Total = $275.2 Billion

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A Gartner Group Company

What Products Are Being Driven By These Trends?

- **Increasing individual productivity → PC, mobile phone**
- **Increasing value of information → Smart cards, digital wireless comms**
- **User choice/convenience → Digital STB, telecoms liberalisation**
- **Mobility/portability → Mobile phone/wireless LAN**
- **Data everywhere → LAN, WAN, remote access, ATM/xDSL**
- **Connectivity → Internet/Intranet, TCP/IP**
- **Safety and security → Automotive airbag and ABS**

Source: Dataquest (May 1997)

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How Do These Growth Products Impact The Semiconductor Market?

- PC
- Mobile Communications
- Data Networking
- Digital STB
- Smart Cards
- Automotive Airbag

Source: Dataquest (May 1997)

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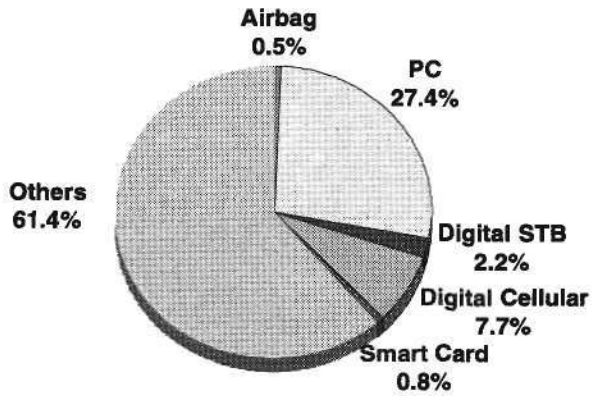
Key Applications Influencing The European Semiconductor Market



1996 Semiconductor Market
Total $28.5 Billion

Source: Dataquest (May 1997 Estimates)

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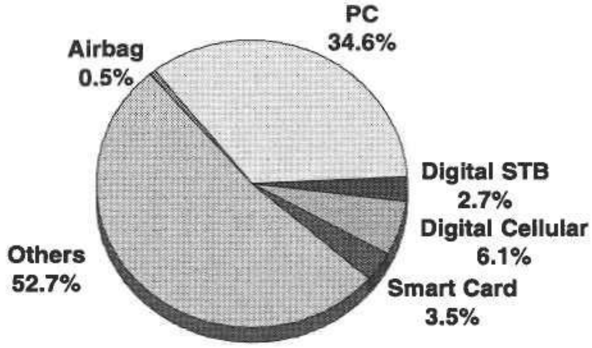
A Gartner Group Company

Key Drivers Influencing The European Semiconductor Market



2001 Semiconductor Market
Total $62.1 Billion

Source: Dataquest (May 1997 Estimates)

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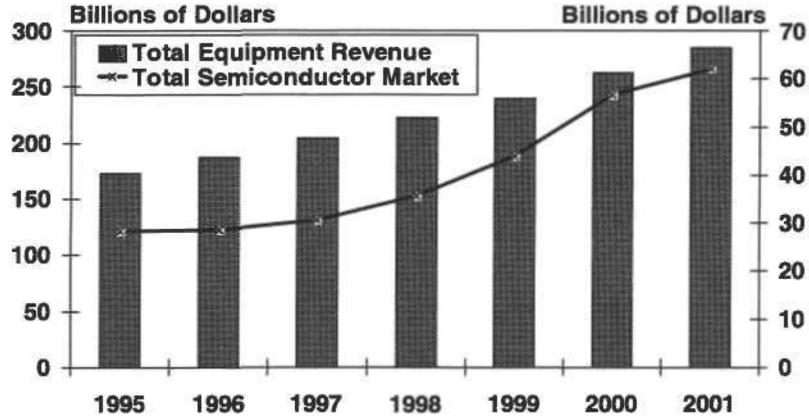
A Gartner Group Company

European Equipment Production and Semiconductor Forecast



Source: Dataquest (May 1997 Estimates)

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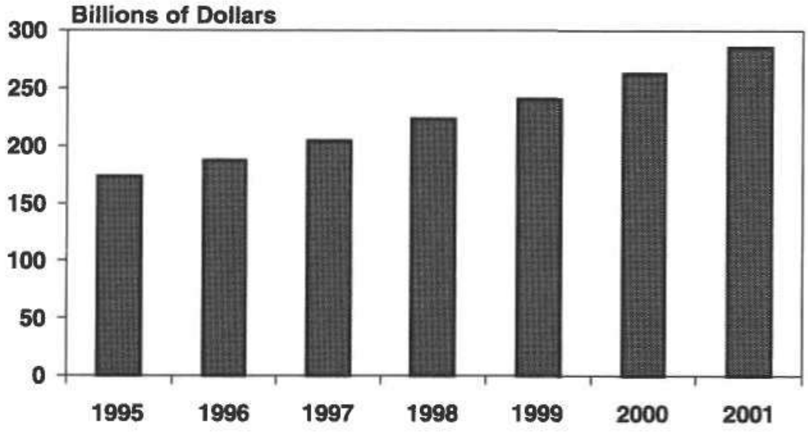
Electronic Equipment Production European Total Ex-Factory Revenue



Source: Dataquest (May 1997 Estimates)

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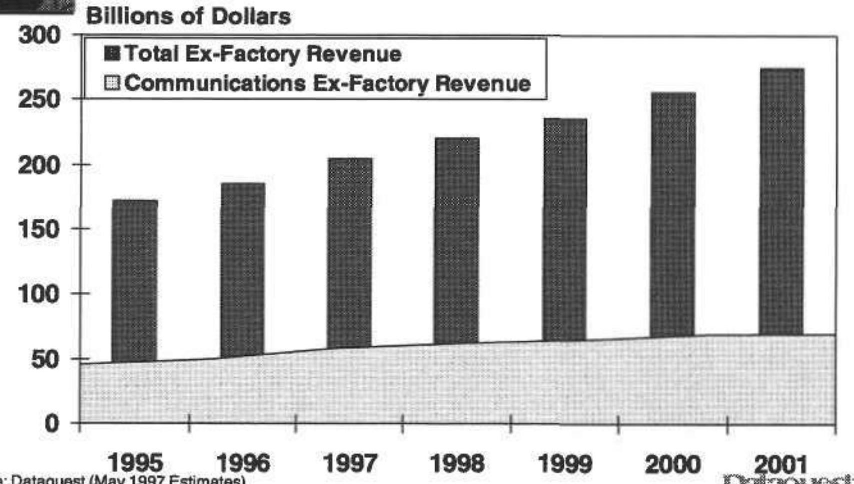
European Electronic Equipment Production: Communications



Source: Dataquest (May 1997 Estimates)

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Electronic Equipment Market Drivers: Communications

- Premise Telecoms:
  - * Digital Cordless
  - * Data Communications
- Mobile Communications:
  - * Digital Cellular
  - * Mobile Comms Infrastructure
- Public Telecoms:
  - * ISDN Line Cards

* Key Applications

Source: Dataquest (May 1997)

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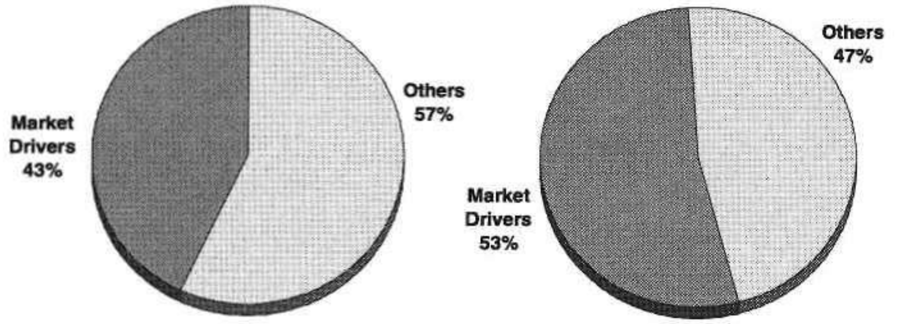
European Communications Electronic Equipment Production



1996 Comms Ex-Factory Revenue
Total = $50.3 Billion

2001 Comms Ex-Factory Revenue
Total = $69.8 Billion

Source: Dataquest (May 1997 Estimates)

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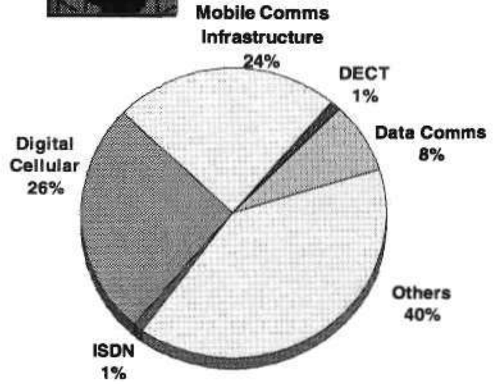
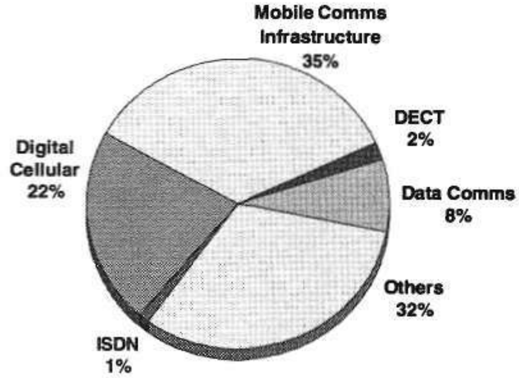
European Comms Semiconductor Market: Key Applications



1996 Comms Semiconductor Market
Total = $8.3 Billion



2001 Comms Semiconductor Market
Total = $17.3 Billion

Source: Dataquest (May 1997 Estimates)

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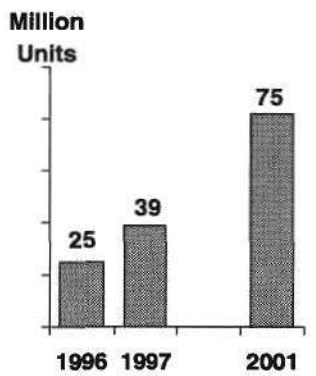
Mobile Communications Digital Cellular Production



1996 Leading Manufacturers

- Nokia
- Ericsson
- Motorola

Market & Technology Drivers

- 1997 introduction of dual-band handsets
- Data-intensive, even Internet access
- Semiconductor content:
  - 1996: $87
  - 2001: $51

Source: Dataquest (May 1997 Estimates)

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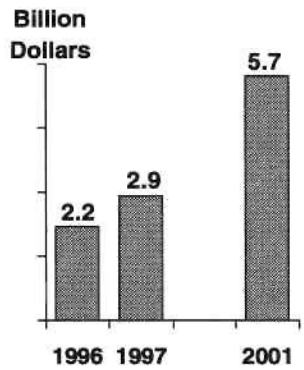
A Gartner Group Company

Mobile Comms Infrastructure Semiconductor Market

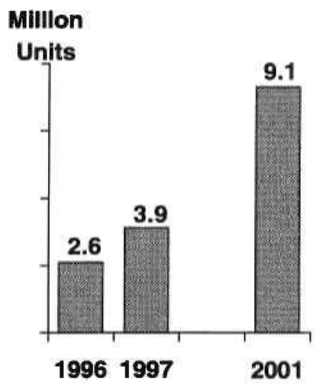


1996 Leading Manufacturers
- Ericsson
- Motorola
- Nokia

Market & Technology Drivers
- Massive exports
- Multi-band and multi-mode
- In building pico cellular
- UMTS rollout starting at end of forecast period

Source: Dataquest (May 1997 Estimates)

Premise Telecoms Digital Cordless Handset Production

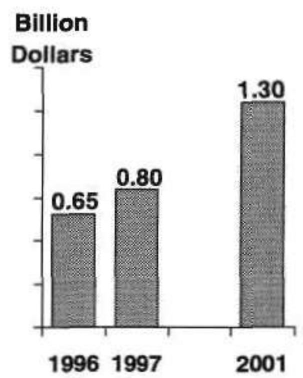


1996 Leading Manufacturers
- Siemens
- Ericsson
- Philips

Market & Technology Drivers
- Driven by consumer market
- More integration to come in RF semiconductors
- Semiconductor content:
  - 1996: $44
  - 2001: $35

Source: Dataquest (May 1997 Estimates)

Data Communications Semiconductor Market



Source: Dataquest (May 1997 Estimates)

1996 Leading Manufacturers

- 3Com
- Cabletron
- Madge

Market & Technology Drivers

- Internet, remote access more and more bandwidth
- High-speed modems 56.6Kb
- ISDN
- xDSL (HDSL, ADSL, VDSL)
- Hubs/switches, bridges/routers
- 100Mb/Gigabit Ethernet
- ATM

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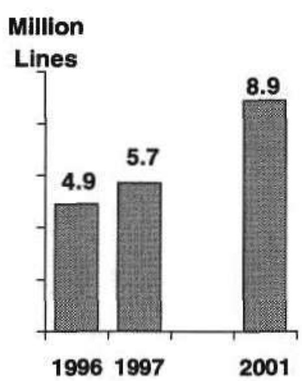
Public Telecoms ISDN Line Card Production



Source: Dataquest (May 1997 Estimates)

1996 Leading Manufacturers

- Siemens
- Alcatel
- Ericsson

Market & Technology Drivers

- ISDN becoming important, driven by remote access and Internet access
- Siemens major semiconductor vendor
- Price reduction in liberalizing markets

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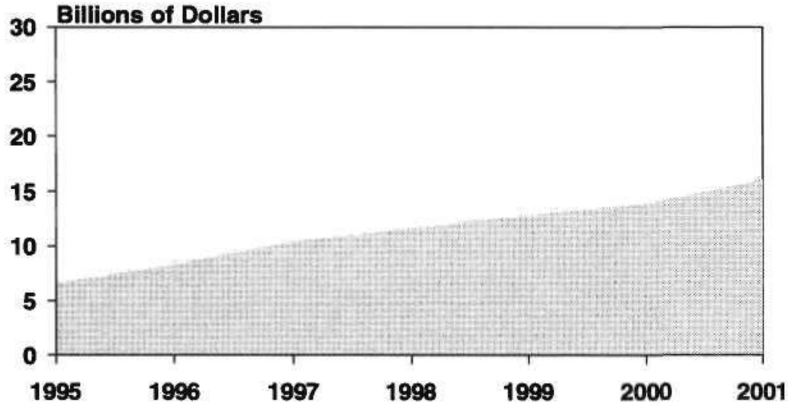
European Semiconductor Market: Communications



Source: Dataquest (May 1997 Estimates)

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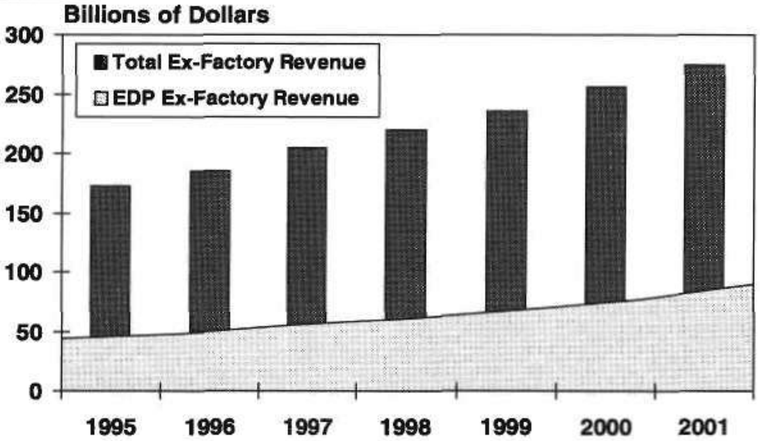
European Electronic Equipment Production: EDP



Source: Dataquest (May 1997 Estimates)

Dataquest
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Electronic Equipment Market Drivers: EDP

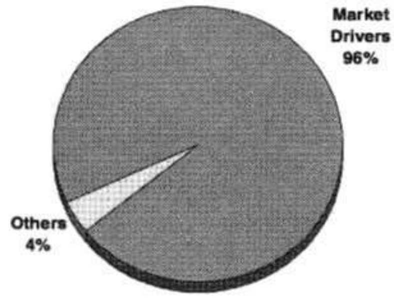
- **Computer:**
  - **PC & Motherboard***
  - **Workstation**
  - **Midrange***
  - **Mainframe**
- **Dedicated:**
  - **Smart Card***
- **Storage:**
  - **Rigid Disk Drive (RDD)***
  - **Optical Disk Drive (ODD)**
  - **Removable Magnetic Storage (Tape)**
- **I/O Devices:**
  - **Page Printer**
  - **Serial Printer (Ink Jet & Dot Matrix)**
  - **Monitors**
  - **Other Output (Plotter)**

* Key Applications

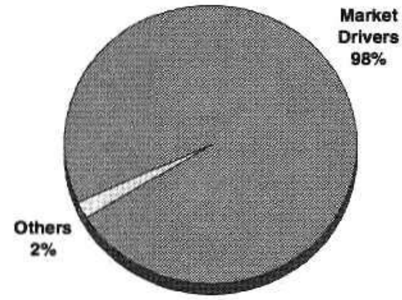
Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

European EDP Electronic Equipment Production



1996 EDP Ex-Factory Revenue
Total = $48.2 Billion

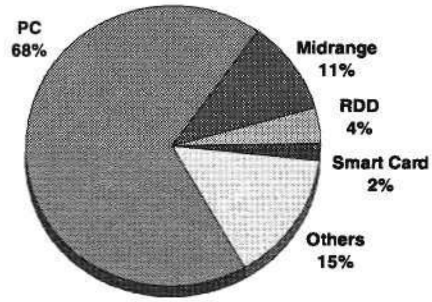


2001 EDP Ex-Factory Revenue
Total = $89.8 Billion

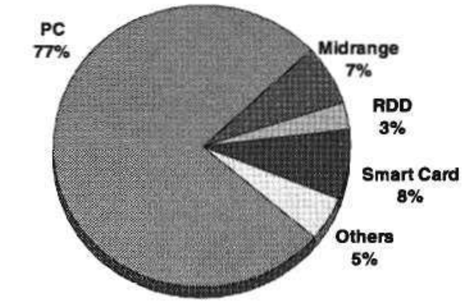
Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

European EDP Semiconductor Market: Key Applications



1996 EDP Semiconductor Market
Total = $11.5 Billion

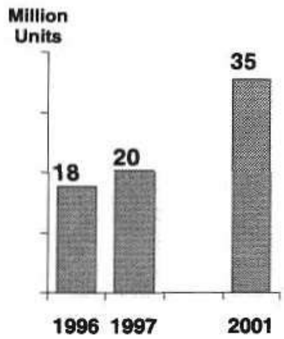


2001 EDP Semiconductor Market
Total = $27.9 Billion

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

PC Production



Market & Technology Drivers

- 1997 more active than 1996
- Processor and memory transition
- Increasing multimedia functionality
- Ex-factory ASP
  - 1996: $1,320
  - 2001: $1,480
- Semiconductor content:
  - 1996: $483
  - 2001: $615

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

European PC Production Rankings

Rank 1996	Rank 1995	Manufacturer	Unit Production (K) 1995	1996	1997	Growth 1996/1995	1997/1996
1	1	Compaq	1,900	1,900	2,200	0%	16%
2	2	IBM	1,600	1,880	2,050	18%	9%
3	4	Hewlett-Packard	750	950	1,100	27%	16%
4	10	Dell	500	780	1,000	56%	28%
=5	5	Packard Bell NEC	730	750	920	3%	23%
=5	8	SNI	630	750	900	19%	20%
=5	3	Apple	880	750	800	-15%	7%
8	6	Olivetti	707	660	800	-7%	21%
9	7	Vobis Group	650	650	725	0%	12%
10	11	Fujitsu	465	625	700	34%	12%
		All Others	7,116	8,035	9,229	13%	15%
		Total Production	**15,928**	**17,730**	**20,424**	**11%**	**15%**

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

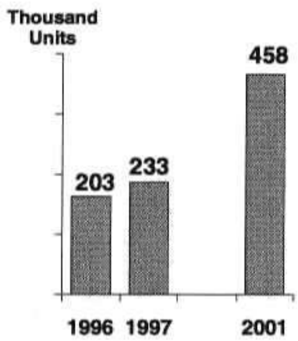
Structural Changes in European PC Production

- Increased production in Central and Eastern Europe, Middle East & Africa
- More OEM & channel assembly:
  - Acer/IBM
  - Mitac
  - Olivetti & Digital ?
- Local motherboard production declining to 45% in 2001
- The Japanese influence:
  - Fujitsu (ICL)
  - NEC Packard Bell
  - Sony

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Midrange Computer Production



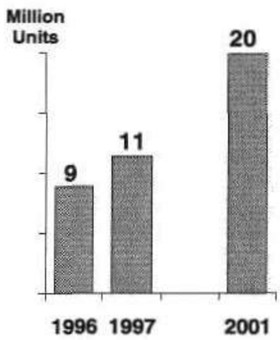
1996 Leading Manufacturers
- Compaq
- IBM
- Hewlett-Packard

Market & Technology Drivers
- Internet/intranet
- Price/performance of IA
- Semiconductor content:
  - 1996: $7,183
  - 2001: $4,374

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Rigid Disk Drive (RDD) Production

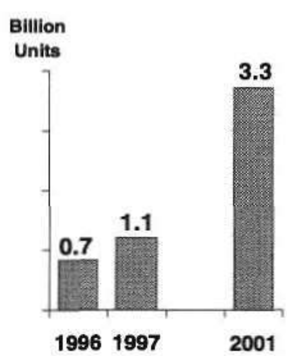


1996 Leading Manufacturers
- IBM
- Seagate
- Xyratex

Market & Technology Drivers
- Storage capacity increase
- Interface evolution
- Semiconductor content:
  - 1996: $55
  - 2001: $42

Source: Dataquest (May 1997 Estimates)

Smart Card/Chip Card Production

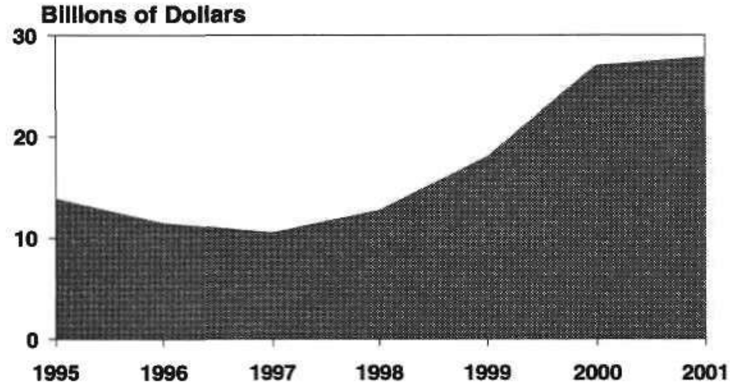


1996 Leading Manufacturers
- Gemplus
- Giesecke & Devrient
- Schlumberger

Market & Technology Drivers
- Diverse application base
- MCU-based cards gain share:
  - 1996: 22% of total
  - 2001: 41 % of total
- Semiconductor content:
  - 1996: $0.59
  - 2001: $0.80

Source: Dataquest (May 1997 Estimates)

European Semiconductor Market: EDP



Source: Dataquest (May 1997 Estimates)

Dataquest
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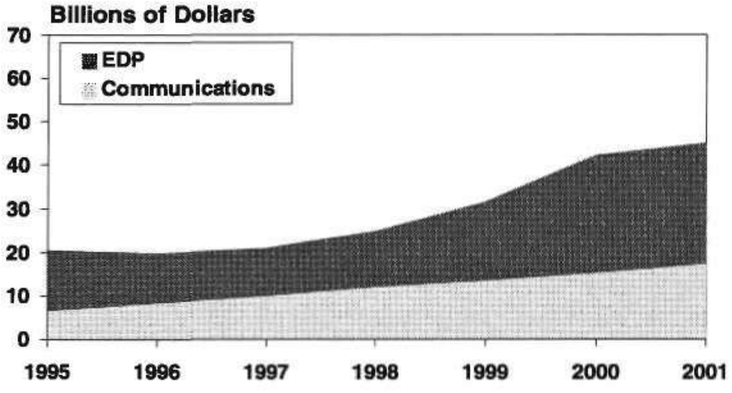
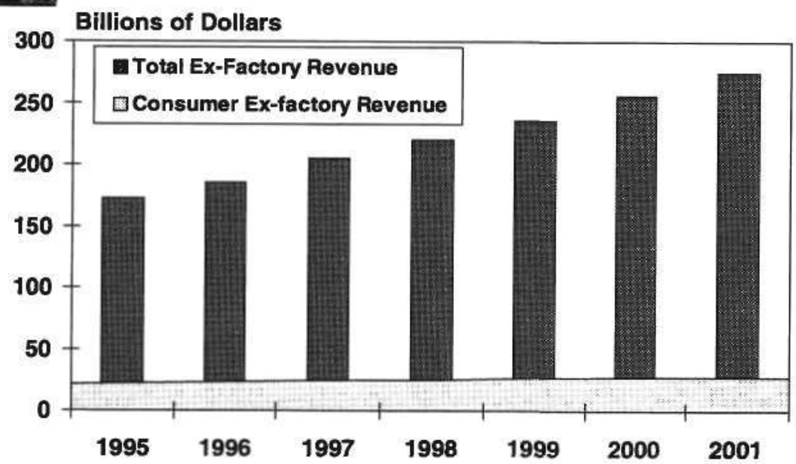
European Semiconductor Market: Comms, EDP



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Electronic Equipment Production European Ex-Factory Revenue: Consumer



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Electronic Equipment Market Drivers: Consumer

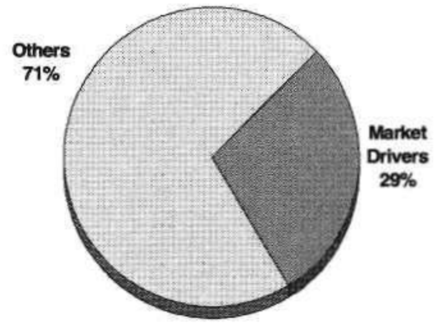
- Video:
  - Set-Top Boxes*
  - Televisions*
  - DVD†
  - Camcorders
  - VCRs
- Personal Electronics:
  - Digital Still Cameras†

* Key Applications
† Not significant in forecast period

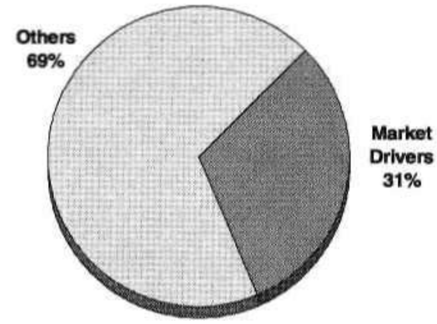
Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Electronic Equipment Production European Market Drivers: Consumer



1996 Consumer Ex-Factory Revenue
Total = $23.1 Billion

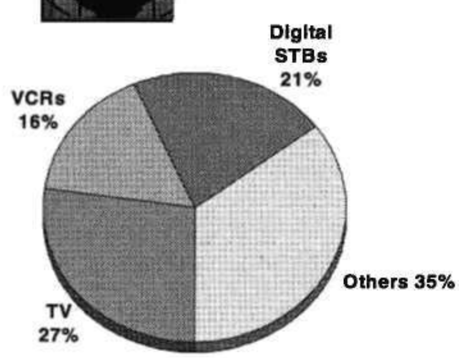


2001 Consumer Ex-Factory Revenue
Total = $28.2 Billion

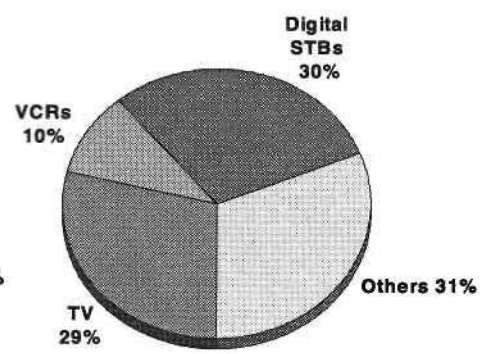
Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Semiconductor Market by Application. European Market Drivers: Consumer



1996 Consumer Semiconductor Market
Total = $3.0 Billion

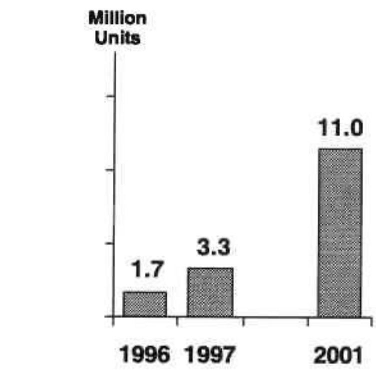


2001 Consumer Semiconductor Market
Total = $5.9 Billion

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Digital Set-Top Box Production



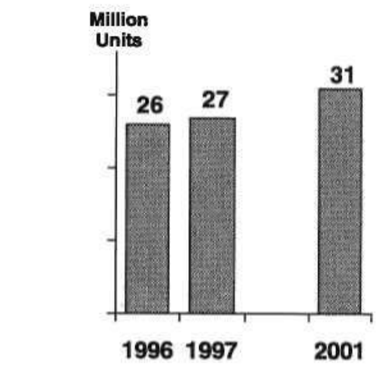
Source: Dataquest (May 1997 Estimates)

1996 Leading Manufacturers
- Pace
- Philips
- Nokia

Market & Technology Drivers
- Digital broadcasting via satellite/cable/terrestrial
- More bandwidth, more services
- Interactive two-way communication
- Semiconductor content:
  - 1996: $199
  - 2001: $96

Dataquest
A Gartner Group Company

Color Television Production



Source: Dataquest (May 1997 Estimates)

1996 Leading Manufacturers
- Philips
- Sony
- Grundig
- Thomson

Market & Technology Drivers
- Digital video broadcasting
- 16:9 widescreen
- Home cinema
- Semiconductor content:
  - 1996: $40
  - 2001: $50

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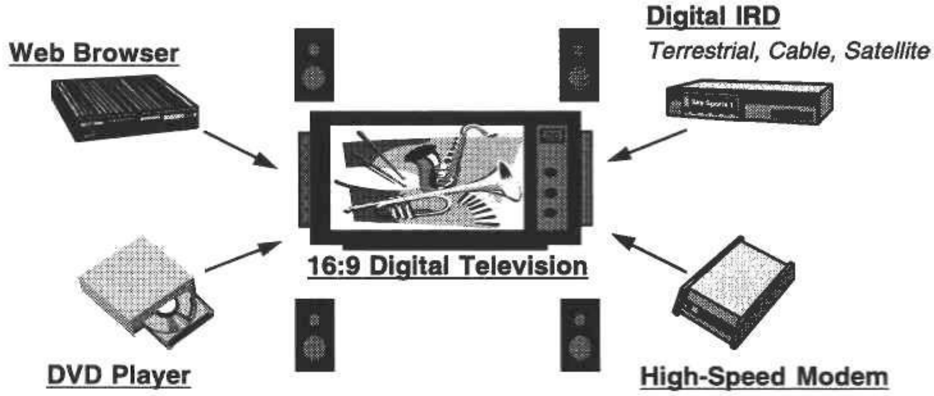
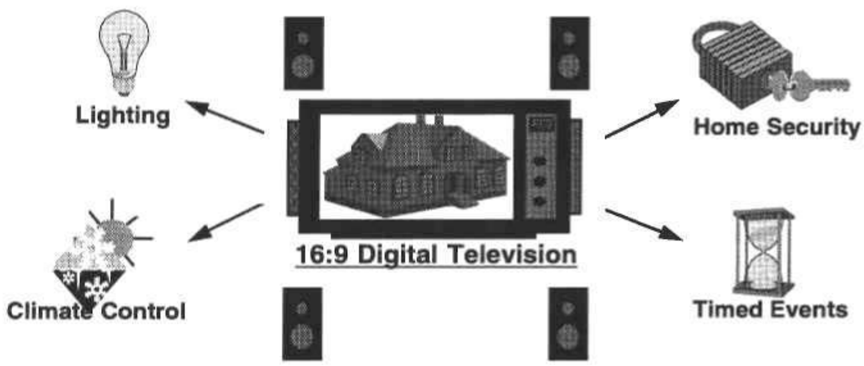
The Arrival of the Digital Television



Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

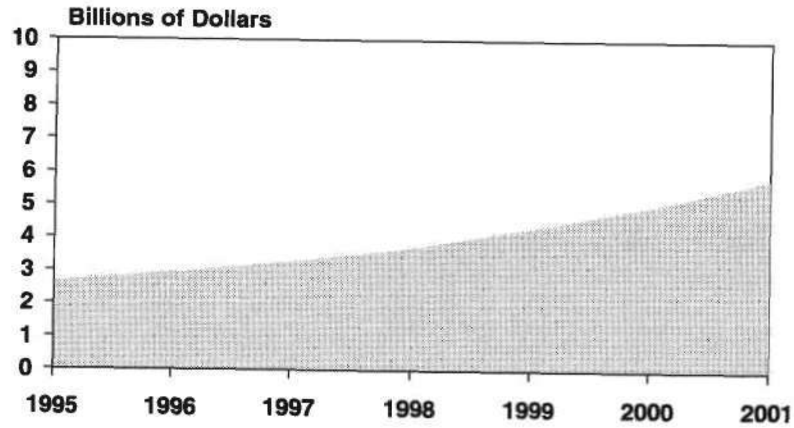
The Future of the Digital Television



Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

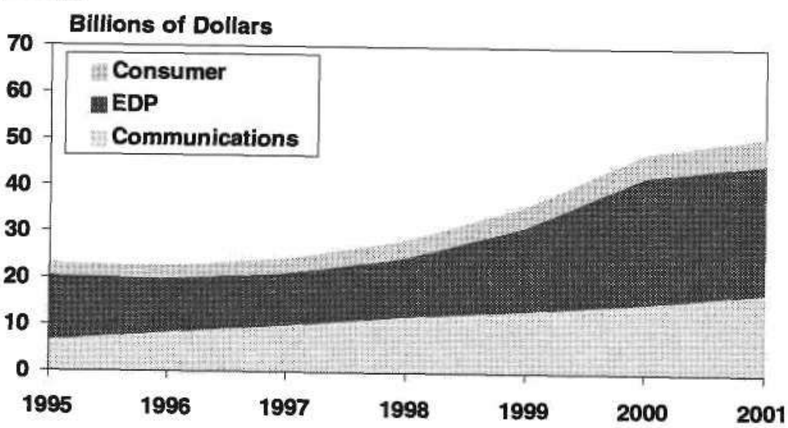
European Semiconductor Market: Consumer



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

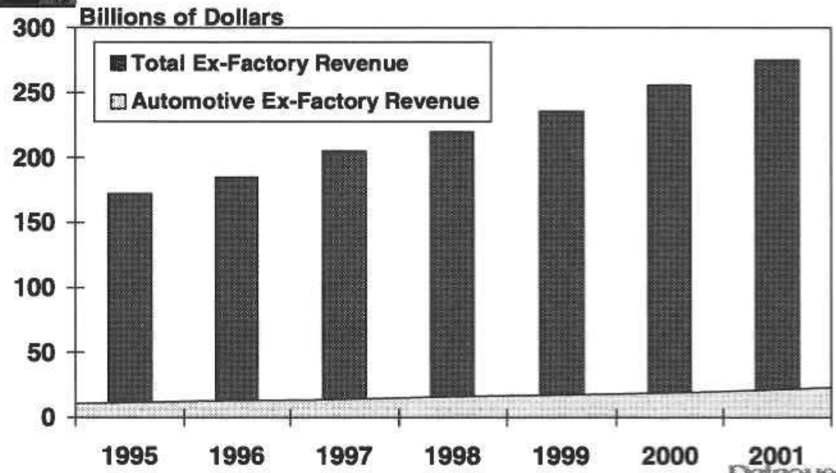
European Semiconductor Market: Comms, EDP, Consumer



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

European Electronic Equipment Production: Automotive



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Electronic Equipment Market Drivers: Automotive

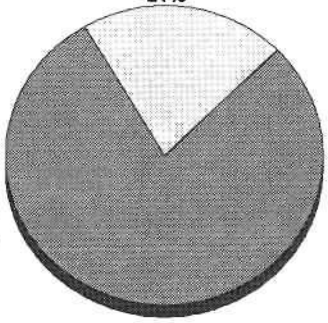
- **Body Control**
  - **Multiplex Systems**
  - **Body Computer**
- **Powertrain**
  - **Engine Control Units***
  - **Transmission Control Systems**
- **Driver Information**
  - **Auto GPS Navigation Systems***
  - **Dashboard Electronics**
- **Safety and Convenience**
  - **Airbag System Diagnostic Modules***
  - **Antilock Braking Systems (ABS)***
  - **Keyless Entry**
  - **Security Systems**

* Key Applications

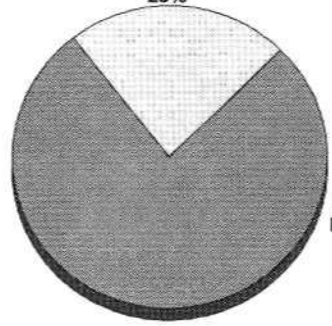
Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

European Automotive Electronic Equipment Production



1996 Automotive Ex-Factory Revenue
Total = $13.0 Billion

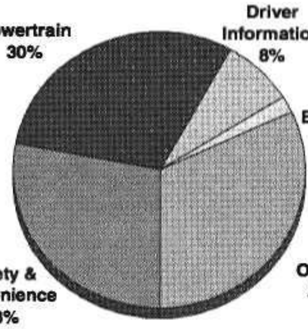


2001 Automotive Ex-Factory Revenue
Total = $22.7 Billion

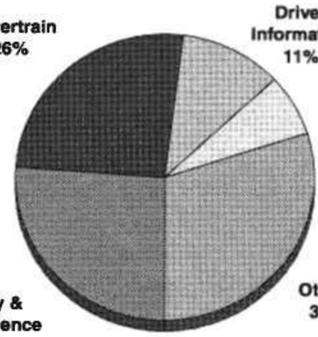
Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

European Automotive Semiconductor Market: Key Applications



1996 Automotive Semiconductor
Market Total = $2.4 Billion

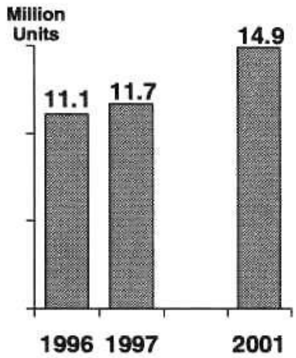


2001 Automotive Semiconductor
Market Total = $5.9 Billion

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Engine Control Unit Production



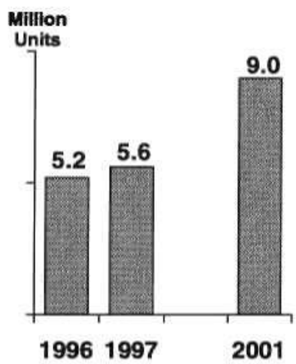
Source: Dataquest (May 1997 Estimates)

1996 Leading Manufacturers
- Robert Bosch
- Magneti Marelli
- Siemens Automotive

Market & Technology Drivers
- Known good die
- Increasing functionality
- Multi-valve engines
- Semiconductor content:
  - 1996: $36
  - 2001: $37

Dataquest
A Gartner Group Company

ABS Production



Source: Dataquest (May 1997 Estimates)

1996 Leading Manufacturers
- Robert Bosch
- ITT Automotive (Teves)
- LucasVarity

Market & Technology Drivers
- Legislation
- Traction & engine control
- Dynamic vehicle control
- Brake boosters
- Semiconductor content:
  - 1996: $36
  - 2001: $31

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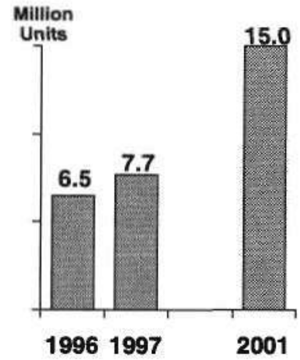
Airbag (SDM) Production*



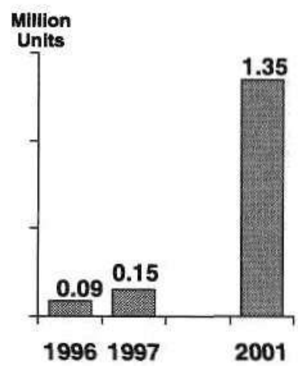
* System Diagnostic Module

Source: Dataquest (May 1997 Estimates)

1996 Leading Manufacturers
- TRW
- Autoliv (Morton)
- Siemens Automotive

Market & Technology Drivers
- US Legislation
- Seat sensors
- Chip level system integration
- Semiconductor content:
  - 1996: $21
  - 2001: $23

GPS Navigation System Production



Source: Dataquest (May 1997 Estimates)

1996 Leading Manufacturers
- Philips
- Blaupunkt (Robert Bosch)
- TECmobility (Magneti Marelli)

Market & Technology Drivers
- Digital maps & content
- GSM/GPS integration
- GPS chip sets vs GPS engines
- Semiconductor content:
  - 1996: $315
  - 2001: $180

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The In-Car GPS Navigation System: Evolving Multimedia Platforms

- **GPS Engine**
  - **GPS Receiver (Input) — RF ASIC**
  - **Signal Processor — Digital ASIC**
  - **Position Processor (Output) — MPU, SRAM, ROM**
- **CD-ROM/DVD (Digital Map)**
- **Navigation Processor Unit**
- **LCD (I/O system)**
- **Dead-reckoning (I/O system)**
- **Trip Computer (I/O system)**
- **In-Car Entertainment (Audio, TV, Games, Karaoke, Internet, ...)**
- **Cellular Phone (I/O system)**

Example: Philips CARiN System

Graphics Courtesy of Philips

Source: Dataquest (May 1997)

Dataquest
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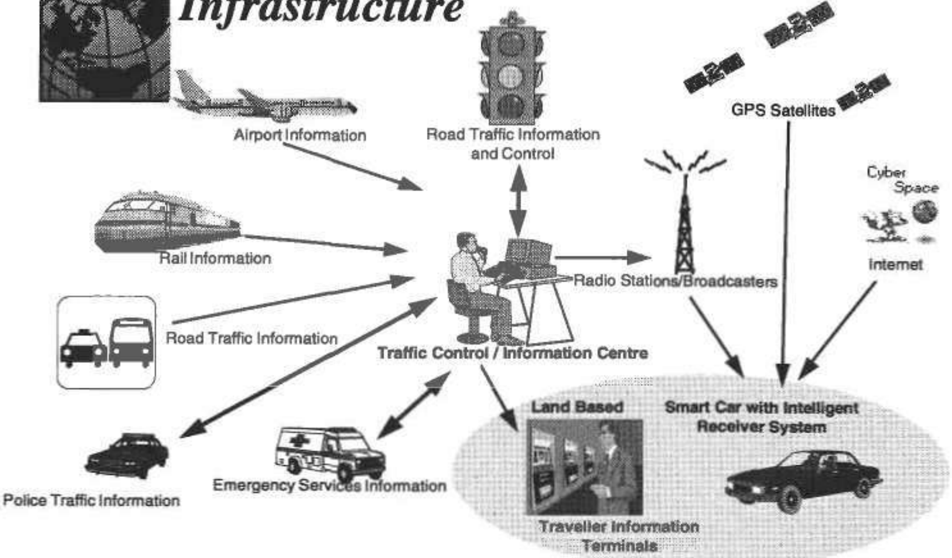
Intelligent Transport Systems Infrastructure



Source: Dataquest (May 1997)

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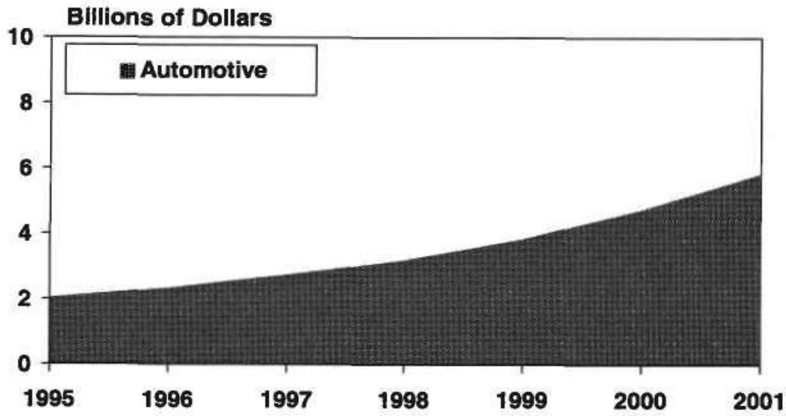
European Semiconductor Market: Automotive



Source: Dataquest (May 1997 Estimates)

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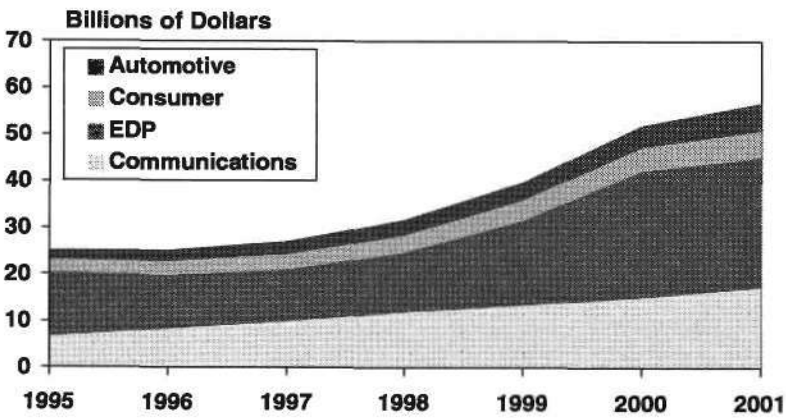
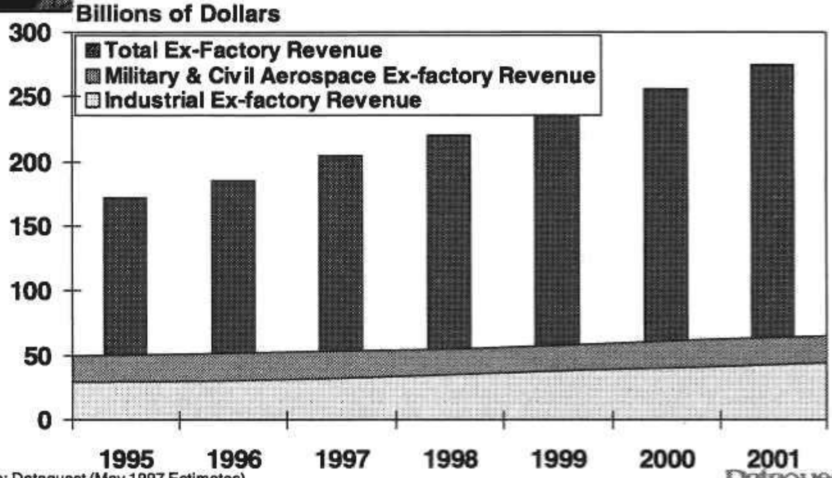
Semiconductor Market: Comms, EDP, Consumer, Automotive



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Electronic Equipment Production European Ex-Factory Revenue: Industrial & Military/Aerospace



Source: Dataquest (May 1997 Estimates)

Dataquest
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Electronic Equipment Market Drivers Industrial & Mil/Aero

- **Industrial:**
  - * **Motor Drives**
  - * **Metering**
  - * **PLCs**
- **Mil/Aero:**
  - * **Civil Avionics**

Source: Dataquest (May 1997)

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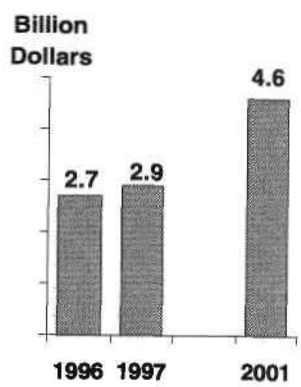
Industrial Electronics Semiconductor Market



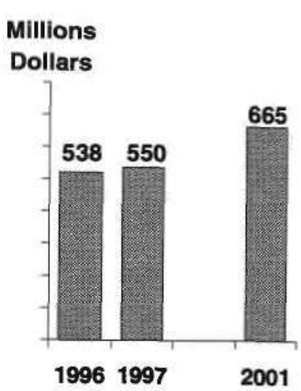
Leading Manufacturers
- Siemens
- ABB
- GEC

Market & Technology Drivers
- Motor Drives
- Security and Energy Management
- Metering

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Mil/Aero Electronics Semiconductor Market



Leading Manufacturers
- Matra
- GEC
- Alenia

Market & Technology Drivers
- Euro Fighter entering production
- Defense electronics company mergers improving competitiveness
- Revival in world Civil Aerospace
- Airbus Industries exceeding market growth

Source: Dataquest (May 1997 Estimates)

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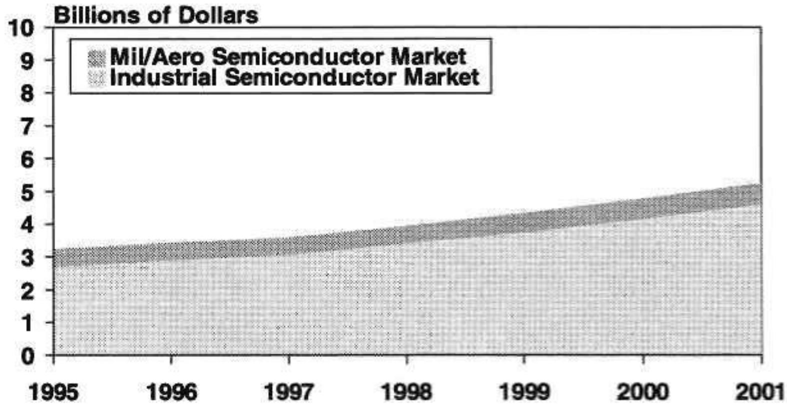
European Semiconductor Market: Industrial & Military/Aerospace



Source: Dataquest (May 1997 Estimates)

Dataquest
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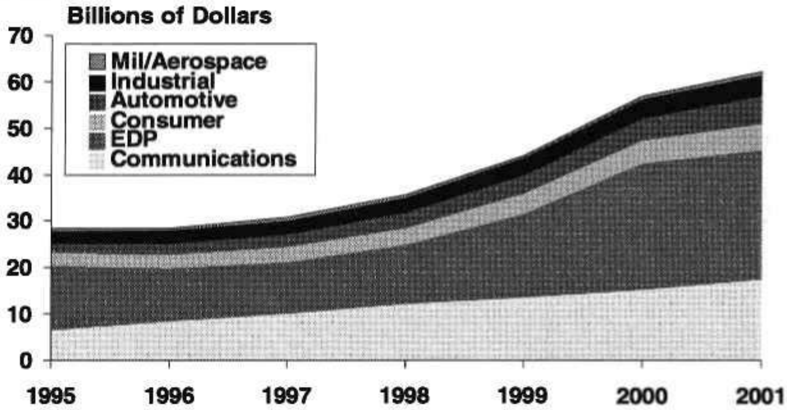
Semiconductor Market: All Applications



Source: Dataquest (May 1997 Estimates)

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European Semiconductor Market and Electronic Equipment Production

	1996 Semiconductor Market *$28.5 Billion*	1997 Semiconductor Market *$30.7 Billion*	2001 Semiconductor Market *$62.1 Billion*	CAGR 1996-2001
Data Processing	$48B	$56B	$90B	13.3%
Communications	$50B	$58B	$70B	6.8%
Consumer	$23B	$24B	$28B	4.0%
Industrial	$30B	$32B	$44B	8.0%
Transportation	$13B	$14B	$23B	11.7%
Military/Aerospace	$21B	$21B	$20B	-0.1%
Total Electronic Equipment	*$185B*	*$205B*	*$275B*	8.2%

Source: Dataquest (May 1997 Estimates)

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European Semiconductor Market

	1996 Semiconductor Market *Dollars Billion*	1997 Semiconductor Market *Dollars Billion*	2001 Semiconductor Market *Dollars Billion*	CAGR 1995-2000
Data Processing	$11.5B	$11.0B	$27.9B	19.4%
Communications	$8.3B	$10.0B	$17.3B	15.8%
Consumer	$2.9B	$3.3B	$5.8B	14.7%
Industrial	$2.9B	$3.1B	$4.6B	9.6%
Transportation	$2.4B	$2.8B	$5.8B	20.0%
Military/Aerospace	$0.5B	$0.5B	$0.7B	4.3%
Total Semiconductor Market	*$28.5B*	*$30.7B*	*$62.1B*	16.8%

Source: Dataquest (May 1997 Estimates)

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European Semiconductor Market Applications Conclusions

- Underlying electronic equipment production growth stronger next 5 years
- Unit production volumes of high volume equipment continiues to grow
- New products moving into volume production, boosting European semiconductor market
- Semiconductor market continues to grow faster than electronics production

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

European Device Market Analysis

EUROPEAN DEVICE MARKET ANALYSIS

Richard Gordon
Industry Analyst
European Semiconductor Group
Dataquest Europe

Richard is an Industry Analyst responsible for the European Memories program. As a member of the European Semiconductor Group, he is based at Egham, Surrey, UK. Richard has nine years of experience in the electronics and semiconductor industries. Before joining Dataquest he was at Advanced Micro Devices where he was Senior Product Engineer supporting non-volatile memory product customers across Europe. Before this, he was Transputer Device Engineer at the INMOS wafer Fab in South Wales, and before that spent two years with A.B. Electronics in the subcontract electronics assembly industry. Richard received a Bachelor of Science (Honours) degree in Electronics from the University of Glasgow, Scotland, and has a Postgraduate Diploma in Marketing from the Chartered Institute of Marketing.

Joe D'Elia
Senior Industry Analyst
European Semiconductor Group
Dataquest Europe

Joe D'Elia is a Senior Industry Analyst covering the European Memories Service and PC Watch. He is based at the European headquarters at Egham and has 27 years' experience in the semiconductor industry. Before joining Dataquest, he was at LSI Logic in Munich, where he managed the European Customer Marketing Group responsible for providing tactical marketing support on ASICs and Standard Products. Prior to this, he spent two years at LSI Logic's Californian headquarters in International Marketing. Previous to this, Joe was at Intel Corporation for 4 years in Major Accounts Management and EPLD Marketing, 8 years at National Semiconductor as an FAE and FSE and 10 years at Texas Instruments in Manufacturing and Consumer Applications. Joe is a member of the IEEIE.

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands

EUROPEAN DEVICE MARKET ANALYSIS

Jim Tully
Principal Analyst
European Semiconductor Group
Dataquest Europe

Jim is the Principal Analyst in Dataquest's European Semiconductor Group, based at Egham, UK. He is responsible for Dataquest's Electronic Design Automation (EDA) and Application-Specific Integrated Circuit (ASIC) programs in Europe. He is also responsible for Dataquest's semiconductor user and buyer research in Europe. Before joining Dataquest in 1990, Jim spent seven years with the EDA company, Racal Redac Limited, where he held worldwide strategic and product marketing responsibility. In this role, he was responsible for systems integration, product development, and hardware platform portation. Before this, he held various design, design management, and production management roles within the Armstrong Organization, Ferranti Limited, UK Atomic Energy Authority, and Rediffusion Cable TV. In these roles, he designed, specified, and purchased a wide range of electronic components and systems. Jim is a Chartered Engineer and he holds a Master of Science degree and a Ph.D. in Electrical and Electronic Engineering from the University of Bradford, UK, and an M.B.A. from the University of Warwick, UK.

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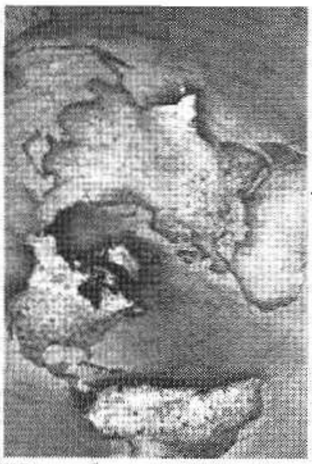
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands



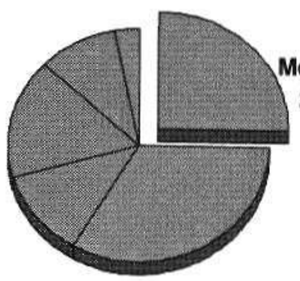
European Semiconductor Conference '97

European Device Market Analysis

Richard Gordon
Joe D'Elia
Jim Tully
Jim Eastlake

Dataquest
A Gartner Group Company

The European Memory Market



Total 1996 Revenue
$28.55 Billion

- **Memory**
  - **Richard Gordon**
- **Microcomponent**
  - **Joe D'Elia**
- **ASIC**
  - **Jim Tully**
- **Total Forecast**
  - **Jim Eastlake**

Source: Dataquest (May 1997 Estimates)

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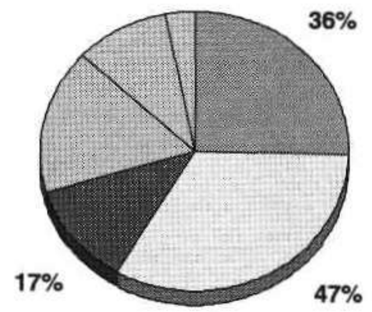
Memory Share of MOS Digital TAM



Total 1996 Revenue
$28.55 Billion

Source: Dataquest (May 1997 Estimates)

In 1996:

- **MOS Digital accounted for 69% of the total semiconductor market**
- **Of MOS Digital:**
  - **Memory 36%**
  - **Micro 47%**
  - **Logic 17%**

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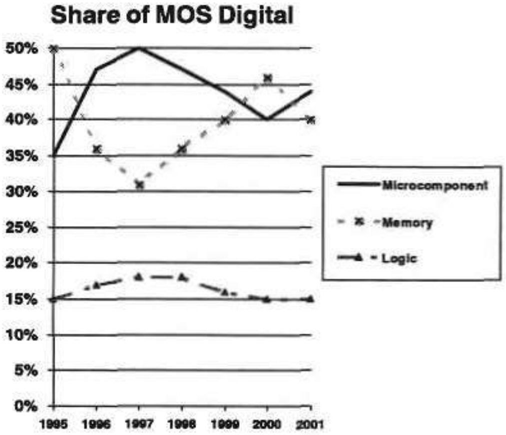
Relationship between MOS Memory and MOS Microcomponent

Share of MOS Digital



Source: Dataquest (May 1997 Estimates)

- **In 1996, MOS Memory revenues dropped below MOS Micro**
- **MOS Memory proportion of MOS Digital will recover during forecast period**
- **In 2000, MOS Memory will once more be the largest portion of MOS Digital**

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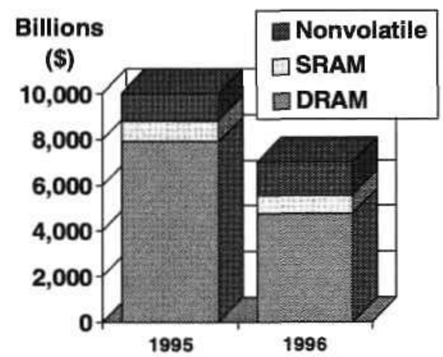
What Happened to the European MOS Memory Market in 1996?



- MOS Memory revenues declined by 30%

  DRAM crashed by 40%

  SRAM fell by 13%

  Nonvolatile grew by 20%

- $10b in 1995 to $7b in 1996

Source: Dataquest (May 1997Estimates)

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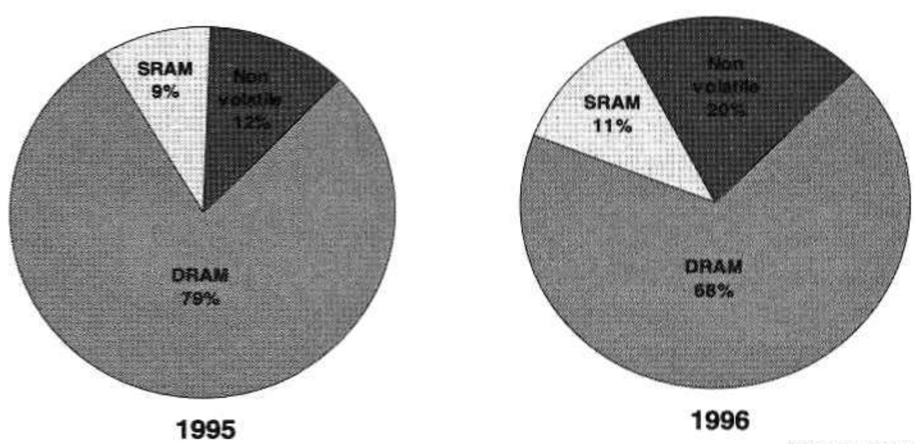
The Shifting MOS Memory Market: 1995 vs 1996



Source: Dataquest (May 1997 Estimates)

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1996 MOS Memory Market Share Ranking

1996 Rank	1995 Rank		Revenue 1995 ($m)	Revenue 1996 ($m)	Percentage Change	1996 Market Share (%)
1	1	Samsung	1,470	1,090	(26)	15
2	2	NEC	849	540	(36)	8
3	3	Siemens	790	494	(38)	7
4	8	Hitachi	618	469	(24)	7
5	7	Fujitsu	643	433	(33)	6
6	6	Texas Instruments	646	409	(37)	6
7	4	Hyundai	781	395	(49)	6
8	13	SGS-Thomson	275	391	42	6
9	10	LG Semicon	452	376	(17)	5
10	9	Toshiba	579	342	(41)	5
		All Others	2,971	2,119	(29)	30
		Total Market	10,074	7,058	(30)	100

Source: Dataquest (May 1997 Estimates)

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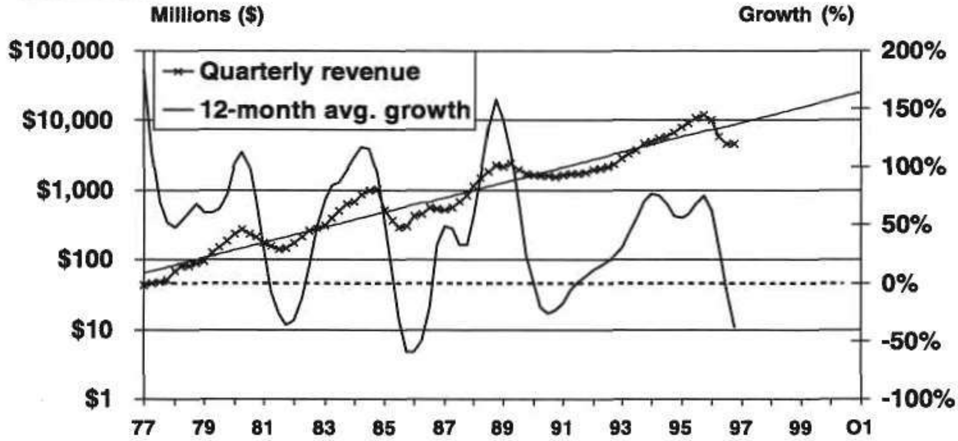
The DRAM Cycle



Source: WSTS/Dataquest (May 1997 Estimates)

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DRAM Capacity Outlook

	Q2 '97	Q4 '97	Q4 '98	Q4 '99	Q4 '00	Q4 '01
Overcapacity	20-25%	10-15%	0%		0%	10-15%
Undercapacity			0%	5-10%	0%	

- Overcapacity will remain in place throughout 1997 and most of 1998
- A period of tight supply is expected during 1999 and most of 2000
- Before the return of overcapacity in 2001

Source: Dataquest (May 1997 Estimates)

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European DRAM Market Forecast Spring 97—Part 1

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
Dynamic RAM	$4,759	$4,158	-13%	$12,515	21%

Market Conditions: Short Term (1997)

- European PC production forecast to grow by 15% to 20.3 million
- Average main memory fit expected to increase to 28MB
- Historic DRAM bit growth maintained at about 70% per annum
- Overcapacity remains in place
- Reference pricing will act to provide an ASP floor level

Source: Dataquest (May 1997 Estimates)

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European DRAM Market Forecast Spring '97—Part 2

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
Dynamic RAM	$4,759	$4,158	-13%	$12,515	21%

Market Conditions: Longer Term (2001)

- European PC production forecast to grow by CAGR of 15% to 35 million
- Average main memory fit expected to increase to 120MB
- Historic DRAM bit growth maintained at about 70% per annum
- DRAM market will recover throughout 1998, 1999 and 2000:
  - Synchronous DRAM will replace EDO
  - 64Mb density will dominate the market

Source: Dataquest (May 1997 Estimates)

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European SRAM Market Forecast Spring '97

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
Static RAM	$800	$890	11%	$2,042	21%

Market Conditions

- Fragmented marketplace:
  - Many vendors
  - Many and varied applications
- Fast SRAM price declines of 1996 stabilise
- All PC's fitted with at least 256Kb cache, moving to 512Kb
- Slow SRAM market driven by communications applications

Source: Dataquest (May 1997 Estimates)

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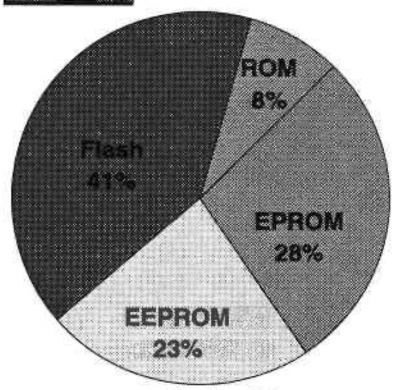
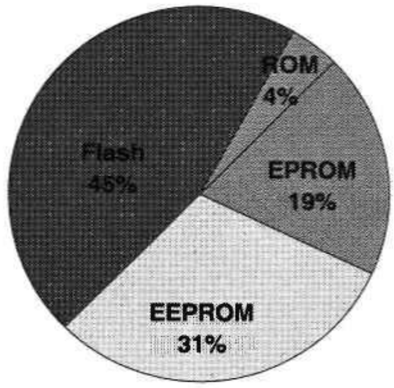
The Shifting Nonvolatile Memory Market 1995 vs 1996



1995 Market Size
$1,180 Millions



1996 Market Size
$1,414 Millions

Source: Dataquest (May 1997 Estimates)

Dataquest
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Nonvolatile Memory Market Forecast Spring '97—Total

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
Nonvolatile Memory	$1,414	$1,441	2%	$3,797	22%

Comprising:
- **EPROM, EEPROM, Flash and Mask ROM**

Market Conditions
- **Growth driven by Flash and EEPROM**
- **Death of EPROM accelerating**
- **Mask ROM market remains insignificant**

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Nonvolatile MOS Memory Forecast Spring '97—EPROM

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
EPROM	$282	$230	-18%	$163	-10%

Market Conditions

- Market decline driven by:
  - Flexibility of Flash
  - Cost effectiveness of Mask ROM
- Exacerbated by:
  - Increasing cost competitiveness of Flash EPROM

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Nonvolatile MOS Memory Forecast Spring '97—EEPROM

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
EEPROM	$431	$459	7%	$1,525	29%

Market Conditions

- Continued pervasion of devices in all application areas:
  - Communications - mobile handsets
  - Consumer - Television, VCR
  - Automotive - ABS, Airbag
- Market growth driven by Smart Cards:
  - Pre-paid telephone cards
  - True Smart Cards

Source: Dataquest (May 1997 Estimates)

Dataquest
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Nonvolatile MOS Memory Forecast Spring '97—Flash

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
Flash	$641	$705	10%	$2,056	26%

Market Conditions

- ASPs fell by 50% during 1996 as competitive pressures increased
- 1Mb and 2Mb densities in demand in Automotive:
  - Engine Control Units
- 4Mb and 8Mb densities in demand in Communications:
  - European GSM handset production forecast 39 million in '97
- Slow adoption of 16Mb in Europe

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Nonvolatile MOS Memory Forecast Spring 1997—Mask ROM

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
Mask ROM	$60	$47	-20%	$53	-2%

Market Conditions

- Stagnant market dominated by Printer application
- Europe accounts for only 4% of the global market

Source: Dataquest (May 1997Estimates)

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MOS Memory Forecast Spring 1997

(Millions of Dollars)	1996	1997	AGR	2001	CAGR
MOS Memory	$7,058	$6,587	-7%	$18,504	21%
Dynamic RAM	4,759	4,158	-13%	12,515	21%
Static RAM	800	890	11%	2,042	21%
Nonvolatile Memory	1,414	1,441	2%	3,797	22%
Other MOS Memory	85	98	15%	150	12%

Source: Dataquest (May 1997 Estimates)

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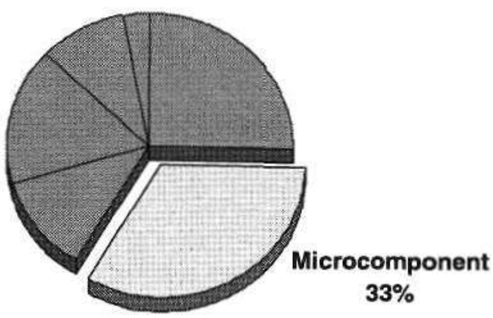
Microcomponent Explosion



Total 1996 Revenue
$28.55 Billion

- Memory
  - Richard Gordon
- Microcomponent
  - Joe D'Elia
- ASIC
  - Jim Tully
- Total Forecast
  - Jim Eastlake

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Microcomponent—1996 in Review

(Millions of Dollars)	1995	1996	AGR	% of TAM
MOS Microcomponent	7000	9371	40%	33%
Microprocessor	3196	5088	59%	18%
Microcontroller	2030	2083	3%	7%
Microperipheral	1226	1542	26%	5%
Digital Signal Processor	548	658	20%	2%

- MOS Microcomponent largest growth segment in 1996
- Different growth drivers among subcategories
- Becomes biggest portion of European Semi TAM

Source: Dataquest (May 1997 Estimates)

Dataquest
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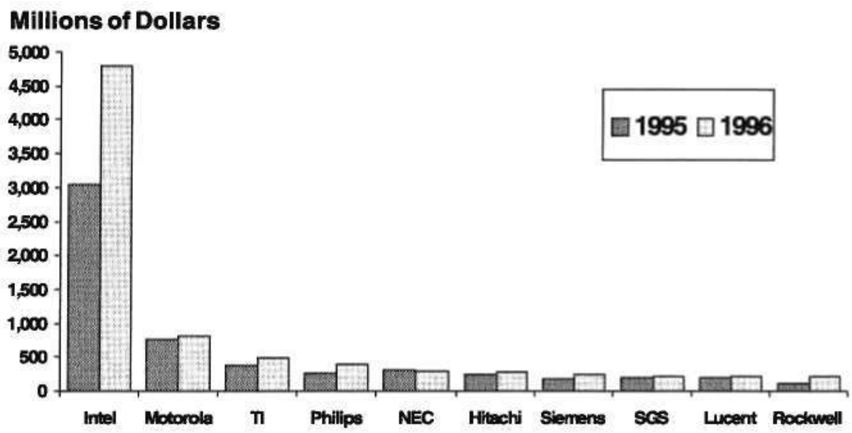
Top 10 Microcomponent Companies 1996



Source: Dataquest (May 1997 Estimates)

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1996 Growth Drivers—Part 1

- PC continued to be prime driver for Microprocessor:
  - Low rate of technology advancement
  - Intel dominated with 67% growth, 85% share:
    - Portion of growth is result of redistribution of revenues
  - AMD/Cyrix had 5% of total Microprocessor TAM
- Microcontroller revenue flat:
  - 8 bit unit growth continued, 2% revenue decrease
  - 16 bit highest growth 33%:
    - Automotive, Cellular Radio, Digital Consumer

Source: Dataquest (May 1997 Estimates)

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1996 Growth Drivers—Part 2

- Microperipherals fueled by PC and Comms growth:
  - Intel main participant with PC chipsets with 25% share
  - Rockwell dominates Comms sector with 13% share
  - Philips rising force in Video/Imaging with 9% share
- DSP fuelled by Mobile Comms growth:
  - 4 players dominate segment with 96% share
    - TI = 42%, Lucent = 31%, ADI = 12%, Motorola = 9%

Source: Dataquest (May 1997 Estimates)

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Microprocessor Forecast—Part 1

(Million of Dollars)	1996	1997	AGR	2001	CAGR 96/01
Microprocessor	$5,088	$5,790	14%	$10,500	16%

Assumptions:

- PC market continues to grow at 15% CAGR to 2001
- Intel continues to drive technology adoption rate:
  - Intel releases four major new processor families in 1997:
    - MMX, Pentium II, Tillamook, Deschutes
    - New modular packaging for desktops/mobiles
  - AMD releases K6
  - Cyrix releases MediaGX, M2

Source: Dataquest (May 1997 Estimates)

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Microprocessor Forecast—Part 2

- AMD/Cyrix and others continue to provide competition to Intel
- Power PC in compute applications continues at low single-digit share
- Other RISC volumes continue to be driven by embedded applications
- x86 architecture continues migration into embedded space

Source: Dataquest (May 1997)

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Microcontroller Forecast

(Millions of Dollars)	1996	1997	AGR	2001	CAGR 96/01
Microcontroller	$2,083	$2,250	8%	$4,240	15%

Assumptions:

- Digital Handset unit growth continues at 25% CAGR to 2001
- Automotive swing to 16/32 bit continues to ramp as application complexity grows
- True Smart Card adoption accelerates as secure multifunction capabilities proliferate
- Digital Consumer applications continue to grow

Source: Dataquest (May 1997 Estimates)

Dataquest
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Microperipheral Forecast

(Millions of Dollars)	1996	1997	AGR	2001	CAGR 96/01
Microperipheral	$1,542	$1,770	15%	$3,610	19%

Assumptions:

- PC growth maintained at 15% through 2001
- +45% of PC Motherboards remain manufactured in Europe
- Second-Tier Cellular Handset manufacturers use off-the-shelf chipsets
- Consumer digital products utilise merchant market ASSPs

Source: Dataquest (May 1997 Estimates)

Dataquest
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Digital Signal Processor Forecast

(Millions of Dollars)	1996	1997	AGR	2001	CAGR 96/01
Digital Signal Processor	$658	$790	20%	$2,130	27%

Assumptions:

- DSP continues to expand into volume Consumer applications
- Mobile Base Stations deployment increases in step with Celullar Handset growth
- Motor Control becomes volume application

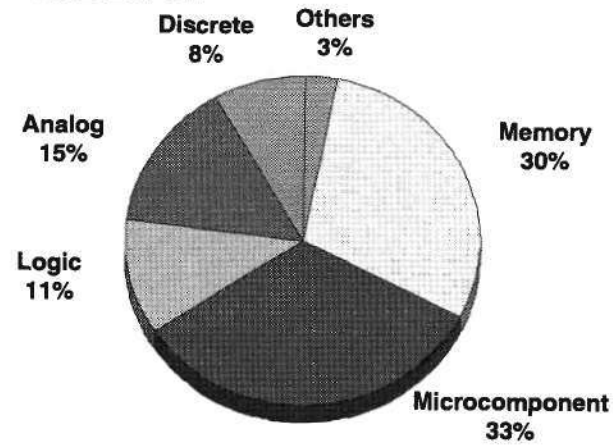
Source: Dataquest (May 1997 Estimates)

Microcomponent—Total Forecast

(Millions of Dollars)	1996	1997	AGR	2001	CAGR 96/01
MOS Microcomponent	$9,371	$10,600	13%	$20,480	17%
Microprocessor	$5,088	$5,790	14%	$10,500	16%
Microcontroller	$2,083	$2,250	8%	$4,240	15%
Microperipheral	$1,542	$1,770	15%	$3,610	19%
Digital Signal Processor	$658	$790	20%	$2,130	27%

Source: Dataquest (May 1997 Estimates)

Microcomponent as Share of Total TAM 2001



Total 2001 Revenue
$62.12 Billion

Source: Dataquest (May 1997 Estimates)

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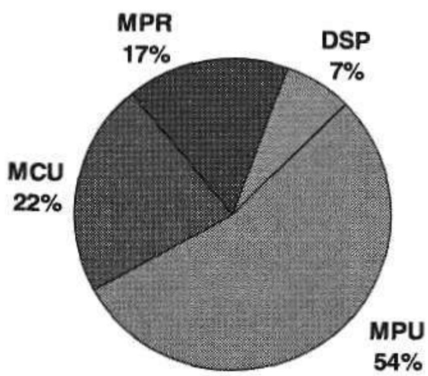
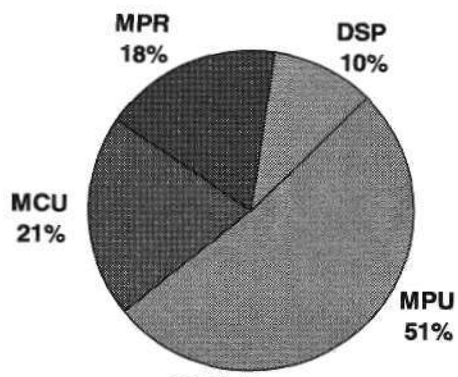
Microcomponent Segment Split 1996/2001



1996 Revenue
$9.4 Billion



2001 Revenue
$20.5 Billion

Source: Dataquest (May 1997 Estimates)

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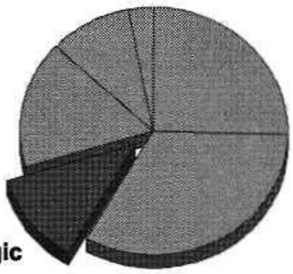
ASICs: Which Way Now?



Total 1996 Revenue
$28.55 Billion

- **Memory**
  - **Richard Gordon**
- **Microcomponent**
  - **Joe D'Elia**
- **ASIC**
  - **Jim Tully**
- **Total Forecast**
  - **Jim Eastlake**

Source: Dataquest (May 1997 Estimates)

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ASICs: Key Features

- **Have to be designed-in**
- **Interface is primarily with designers**
- **Needs different sales approach from that of commodity products**
- **Needs close integration with design tools**
- **Harder to switch; customers are 'locked-in' to a greater degree**

Source: Dataquest (May 1997)

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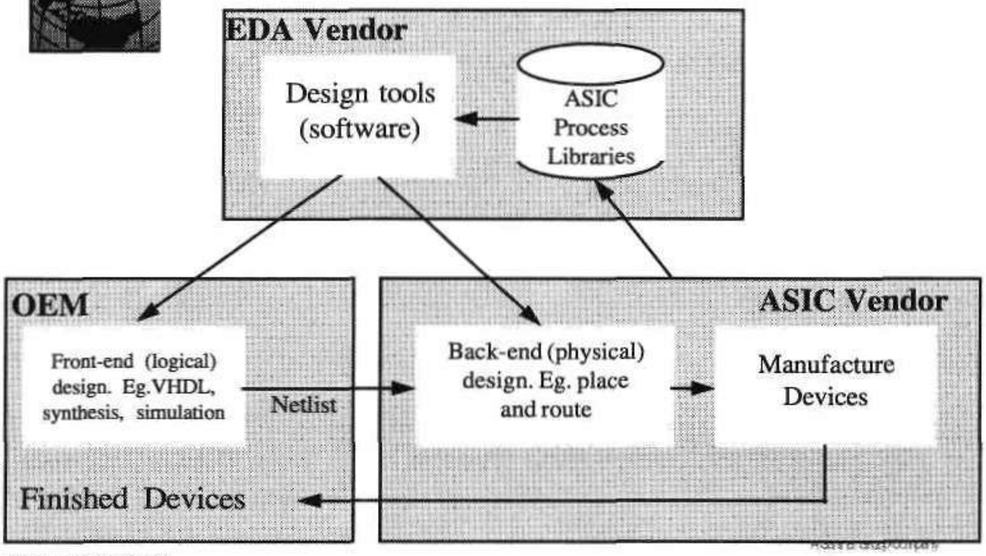
A Gartner Group Company

A Three-Way Partnership



Source: Dataquest (May 1997)

European ASIC Market Share

1996 Rank	Company	Revenue ($M)	AGR (%)
1	Lucent Technologies	280	164
2	Texas Instruments	208	42
3	LSI Logic	188	4
4	VLSI Technology	179	33
5	Mietec	173	7
6	SGS-Thomson	167	67
7	NEC	158	-4
8	Xilinx	125	15
9	Motorola	112	1
10	Austrian Mikro Systems	106	1
	Total All Companies	2,951	24

Source: Dataquest (May 1997 Estimates)

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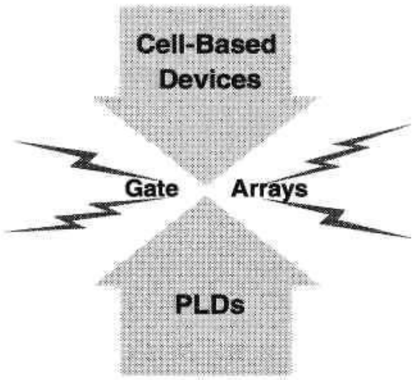
Forecast Assumptions (Short/Medium Term)

- Cell-based ICs will continue to gain share
- Gate Array market will flatten, squeezed between CBICs and PLDs
- PLDs will capture a significant portion of the 'less than 20K gate' market
- Availability of 'soft' processor and other cores will boost PLD market



Source: Dataquest (May 1997)

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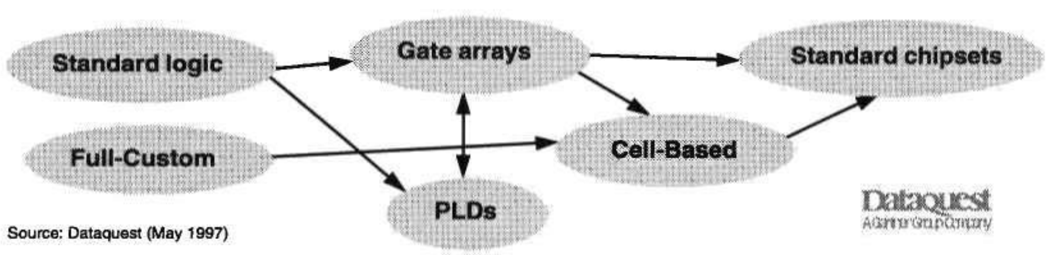
Forecast Assumptions (Short/Medium Term)

- Telecoms will continue as major driver, with networking and consumer showing strong growth
- BiCMOS technology will continue its decline
- Full-Custom ASICs will continue to decline
- Cannibalisation process will continue



Source: Dataquest (May 1997)

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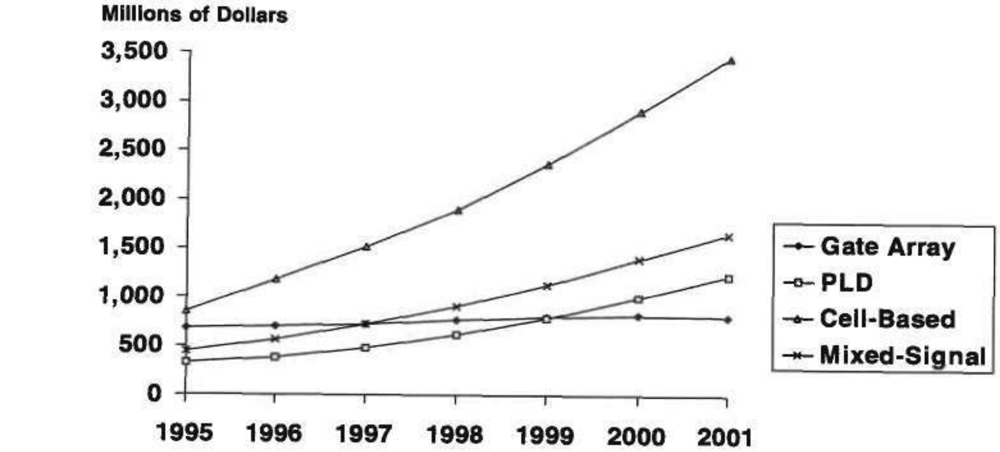
ASIC Forecast—Europe



Source: Dataquest (May 1997 Estimates)

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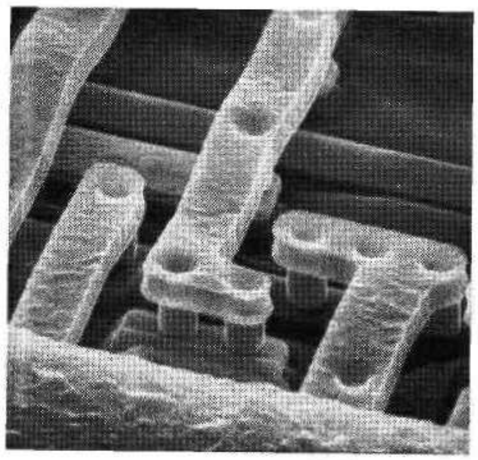
Forces For Change: Manufacturing Races Ahead

- Manufacturing technology progressing at incredible rate
- 12M transistors; 3M gates on a device. NOW!
- Silicon capacity for system-on-chip: compute engine, memory and logic (SLI)



Source: Dataquest/SGS-Thomson

Source: Dataquest (May 1997)

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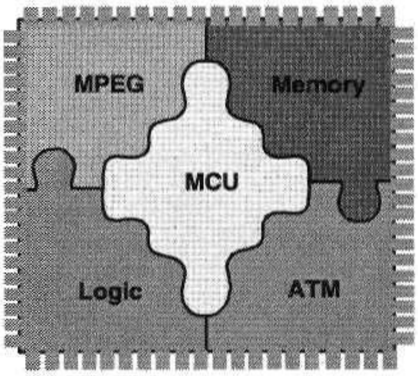
Forces For Change: Intellectual Property (IP) Market

- Re-use of large functional blocks/cores/macros is the only solution
- New market in intellectual property about to explode ...
  - 1996: $60 million worldwide
  - CAGR 65% to 2004



Forces For Change: Design Technology

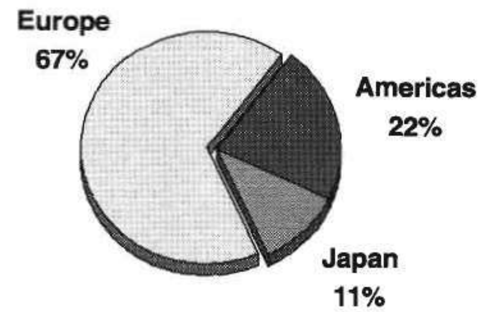
- Third-party design tools proliferate:
  - Wide range of cores
  - Ability to manufacture anywhere
- Language-based design becoming mainstream
- Hardware/software co-design solutions emerging
- SLI/ASIC design methodology widely used outside of pure ASIC market:
  - MPU, DSP, ASSP, ...
  - Key driver of semiconductor market

Source: Dataquest (May 1997)

Design Houses Proliferate

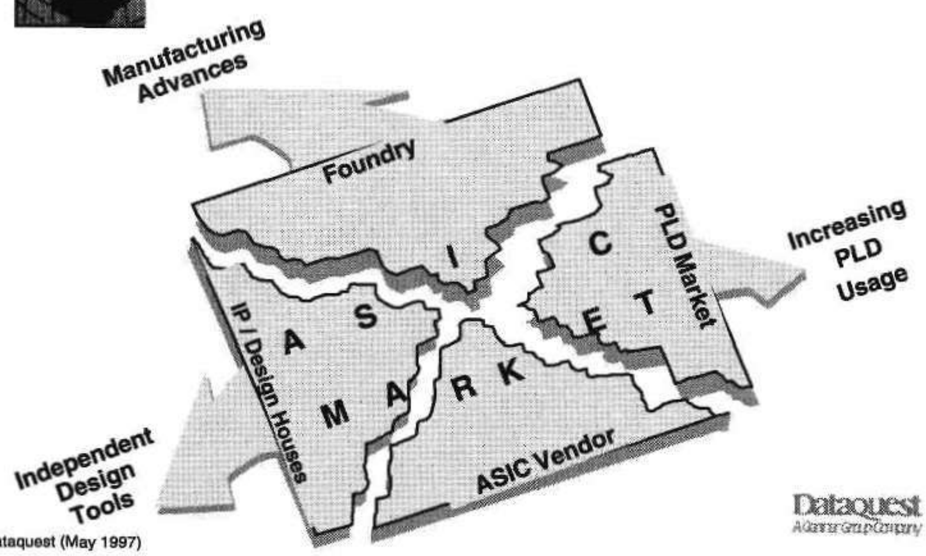
- Increasing number of design houses
- Greater quantity and more stable in Europe because:
  - Redundancies
  - Fewer start-ups to steal staff
  - Mobility barriers

Independent Design Houses (Worldwide)



Source: Dataquest (May 1997 Estimates)

A Market Torn Apart



Source: Dataquest (May 1997)

Which Way for ASIC Vendors?

Foundry

- Core strength in manufacturing
- Logistics expertise
- Flexibility

IP Provider

- Core strength in design
- Distribution channels
- Support / consultancy

Source: Dataquest (May 1997)

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Conclusion

- Strong growth over forecast period
- Fragmentation/cannibalisation will continue
- Big changes are afoot in the longer term
- Impending structural changes in response to SLI requirements
- SLI is creating and driving the IP market; key driver of wider semis market
- ASIC vendors must re-examine their businesses

Source: Dataquest (May 1997)

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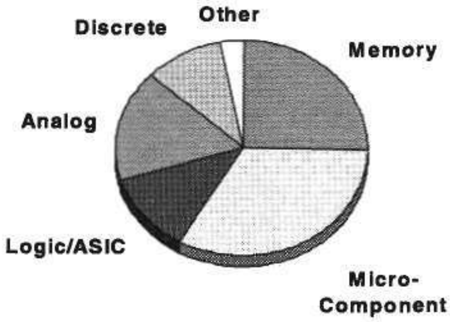
A Gartner Group Company

Total Forecast



- Memory
  - Richard Gordon
- Microcomponent
  - Joe D'Elia
- ASIC
  - Jim Tully
- **Total Forecast**
  - **Jim Eastlake**

Total 1996 Revenue
$28.55 Billion

Source: Dataquest (May 1997 Estimates)

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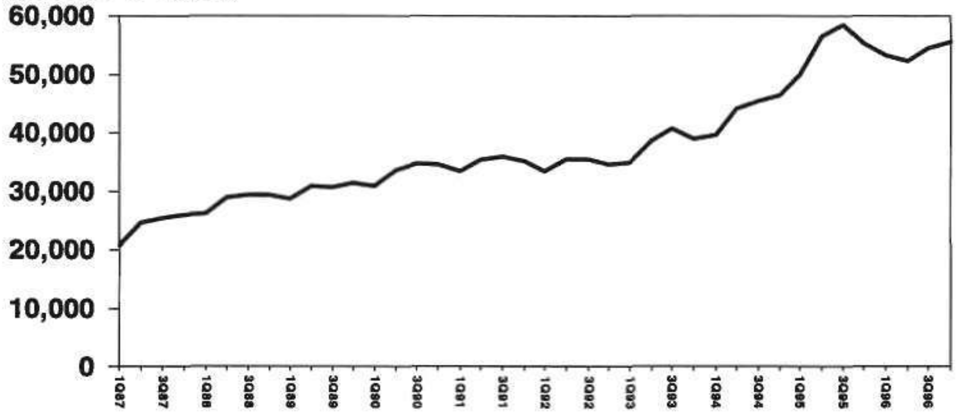
Worldwide Quarterly Unit Shipments of Semiconductors

(Millions of Units)



Source: WSTS/Dataquest (May 1997 Estimates)

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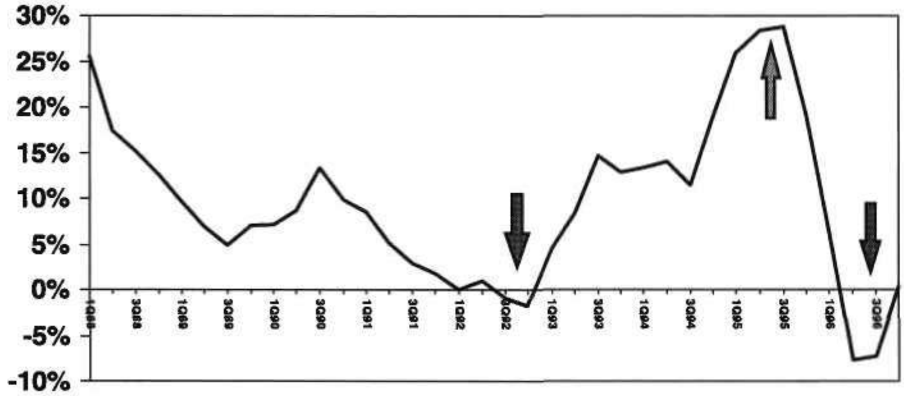
Worldwide Unit Shipments—
Year-on-Year Quarterly Growth Rate



Source: WSTS/Dataquest (May 1997 Estimates)

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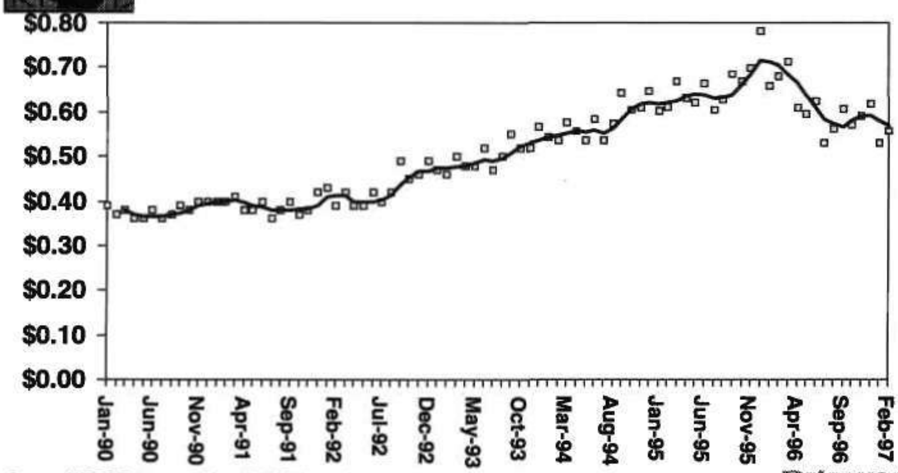
World Semiconductor Market
Quarterly ASP Trend 1990-97



Source: WSTS/Dataquest (May 1997 Estimates)

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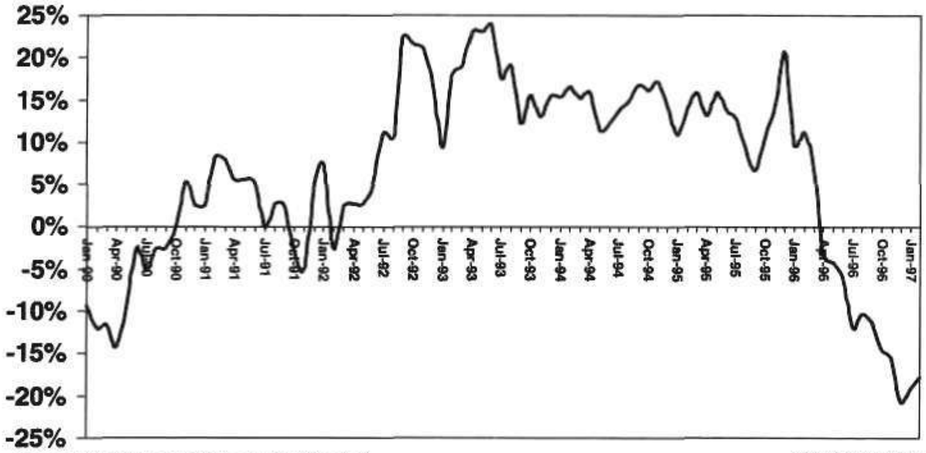
World Semiconductor Market— 12/12 ASP Growth Rate



Source: WSTS/Dataquest (May 1997 Estimates)

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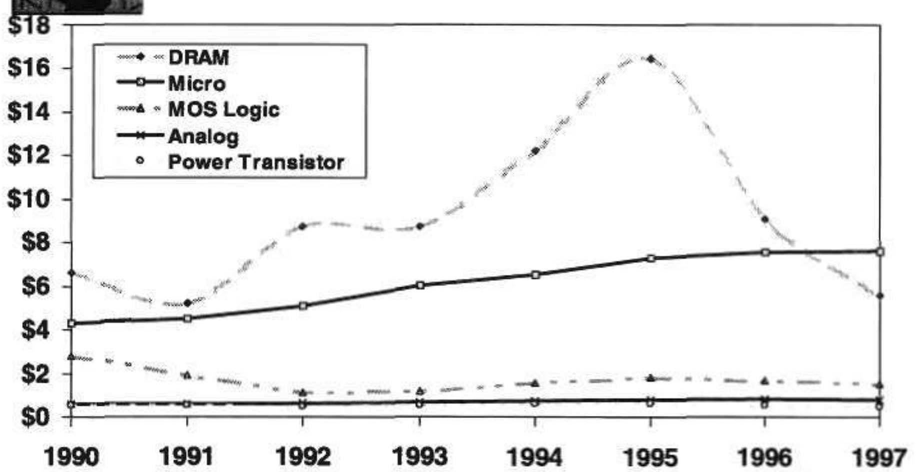
Annual ASP Trend of Leading Device Markets-1990 to 97



Source: WSTS/Dataquest (May 1997 Estimates)

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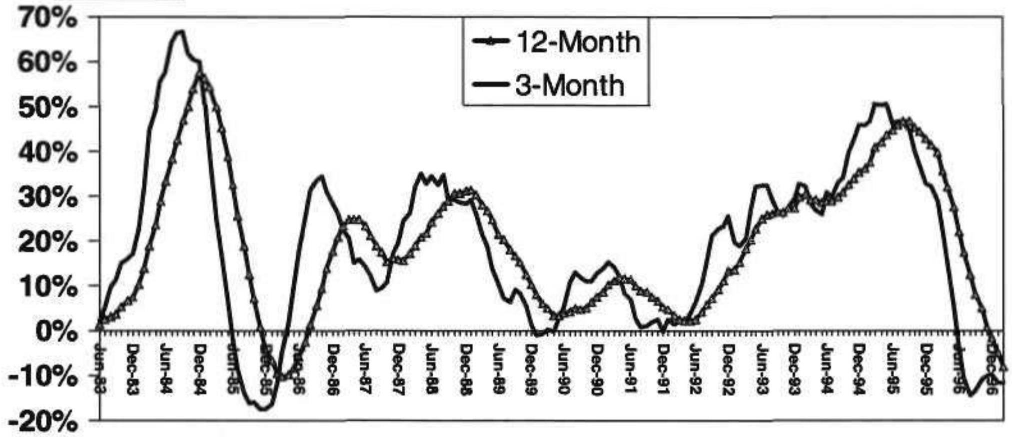
Total Market 3-Month & 12-Month Moving Average Billings Growth



Source:WSTS/Dataquest (May 1997 Estimates)

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European Semiconductor Market Consumption Forecast

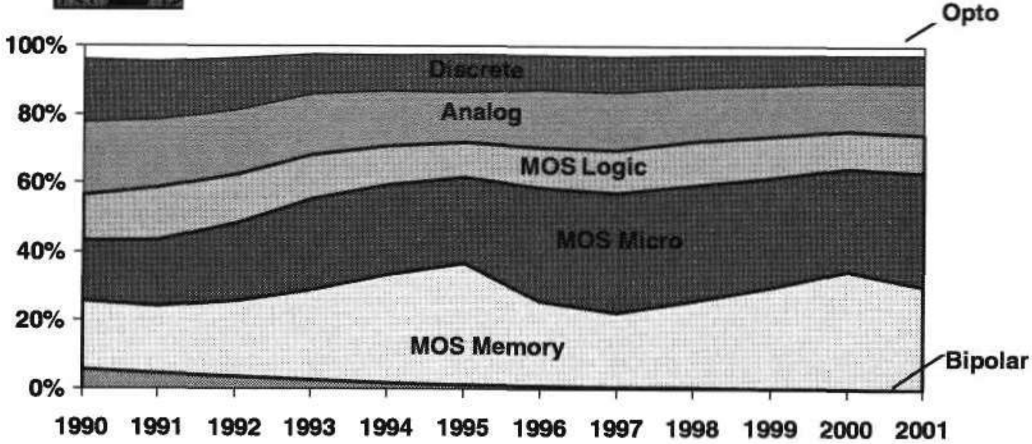
(Millions of Dollars)

	1996	1997	AGR	2001	CAGR 2001/96
Total Semiconductor	28,548	30,650	7%	62,116	17%
Total IC	24,901	26,534	7%	55,387	17%
Bipolar Digital	246	202	-20%	92	-18%
MOS Digital	19,814	21,081	6%	46,055	18%
Memory	7,058	6,587	-7%	18,504	21%
Microcomponent	9,371	10,600	13%	20,480	17%
Logic	3,385	3,894	15%	7,071	16%
Analog	4,841	5,250	8%	9,240	14%
Discrete	2,848	3,211	13%	5,220	13%
Optocomponents	799	906	13%	1,508	14%

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Major Product Markets— Share of the European Market



Source: Dataquest (May 1997 Estimates)

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A Gartner Group Company

Summary of Forecast Assumptions

- PC has become a long-term driving force
- Cultural shift toward electronics
- Electronics market elasticity
- Communications, consumer and automotive markets are alive and driving
- Capacity/demand imbalance corrected end 1998
- DRAM market next peak in 2000
- x86 MPU dominance
- Structure of the industry is changing

Source: Dataquest (May 1997)

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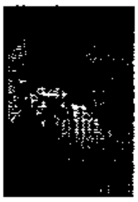

European Market Share

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European Ranking-1996

(Millions of Dollars)

Rank	Company	1995	1996	Growth
1	Intel	3,240	5,044	56%
2	Siemens	2,058	2,068	0%
3	Motorola	1,955	1,844	-6%
4	SGS-Thomson	1,533	1,814	18%
5	Philips	1,789	1,747	-2%
6	Texas Instruments	1,560	1,502	-4%
7	Samsung	1,505	1,156	-23%
8	NEC	1,429	1,095	-23%
9	Hitachi	947	872	-8%
10	Toshiba	1,095	810	-26%
	Total Europe	*28,341*	*28,547*	*1%*

Source: Dataquest (May 1997 Estimates)

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*Europe Ranking-Without PC**
(Millions of Dollars)

Overall	Rank*	Company	1995	1996	Growth
4	1	SGS-Thomson	1,515	1,800	19%
2	2	Siemens	1,543	1,768	15%
5	3	Philips	1,787	1,747	-2%
3	4	Motorola	1,783	1,734	-3%
6	5	TI	1,151	1,266	10%
8	6	NEC	870	755	-13%
1	7	Intel	685	750	9%
10	8	Toshiba	766	652	-15%
12	9	National Semi.	612	605	-1%
9	10	Hitachi	543	568	5%
		Total Market	***19,691***	***20,865***	***6%***

Source: Dataquest (May 1997 Estimates)

* Minus PC DRAM and MPU

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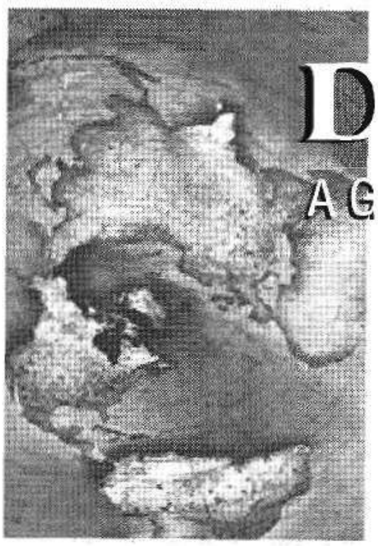

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Connecting For Growth—
'Internetivity' And The Semiconductor Industry

- *Dataquest European Semiconductor Procurement Survey: 1997*

- *Dataquest European Vendor Of The Year Awards*

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Dataquest European Semiconductor Procurement Survey Results

Jim Tully
Principal Analyst
European Semiconductor Group
Dataquest Europe

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands

Dataquest European Semiconductor Procurement Survey: 1997

Jim Tully
Principal Analyst

Dataquest
A Gartner Group Company

Procurement Survey Overview

- **Survey major European buyers of semiconductors**
- **Target significant portion of market**
- **Key survey dimensions ...**
  - **Amount purchased**
  - **Purchase outlook**
  - **Purchase criteria**
  - **Vendor assessment**
- **Method: Telephone / fax**
- **Survey date: March - May 1997**

Source: Dataquest (May 1997)

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Participants--1

Mitel
Alcatel
Valeo Electronics
Hewlett-Packard
SCI Europe
3Com Access
Philips Business Communications
Motorola ECSD Ltd
Sony Broadcast & Professional
Research Machine
3Com Technologies
Ericsson OMC
Jabil Circuit

Dassault Automatismes et Telecommunications
Apple Computer
Siemens AG
Motorola ECID
MET Commutation
Alcatel Telecom
Alcatel Telecom Antwerp
Matra Communication
Valeo
Bull
Alcatel SEL
Racal Mobilcal Ltd
Loewe OPTA GmbH

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Participants--2

Electrolux Zanussi Electrodomestici
Bruel & Kjaer
Semi-Tech
Cabletron Systems
Seleco Spa
Psion Computers plc
Ericsson Business Networks AB
Ascom Business Systems AG
Brother Industries (UK) Ltd
Samsung Electronics Research Inst.
Altec SA
Grundig
Blaupunkt-Werke GmbH
Calluna Technology

British Aerospace (Systems & Equipment) Ltd
Valeo Borg Instruments GmbH
Apricot Computers Ltd
AST Ireland Ltd
Welwyn Systems Ltd
SEW Eurodrove GmbH & Co
Memorex Unirepair BV
Bull
Rohde & Schwarz
E.G.O Elektro-Geratebau Gmbh
DeTeWe
Becker Automotive Systems
Acer Computer BV

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Participants--3

Panasonic C.T.V
Hitachi Home Electronics Europe Ltd
Ericsson Diax A/S
Mitac Europe Ltd
Tefal SA
Siemens Automotive SA
GPT Ltd
Osterreichische Philips
Industrie GmbH
Siemens plc
IBM - ECP Europe
Bang & Olufsen A/S
SNI AG
Sony
Siemens ATEA

Siemens AG
Danfoss A/S
Alcatel CIT
Avex Electronics
Nortel
Hewlett-Packard
Oki-UK Ltd
NUM SA (Schneider Group)
Syntaq
Delta Electronica Spa
Dassault Electronique
Siemens Med Mek
3Com Ltd
Nortel

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Participants--4

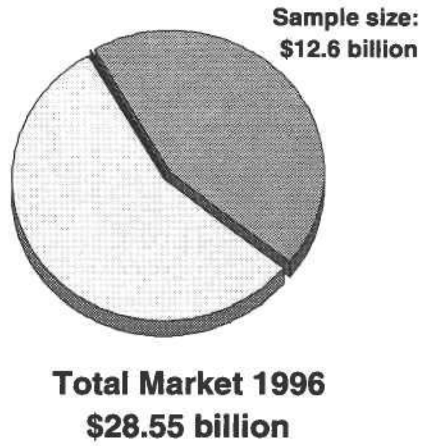
Ericsson AB
ICL - Fijitsu
Audioline
Maxon Communications
Radiometer Medical
Hughes Microelectronics
Nokia Telecoms
Brother Industry
Solotron

Source: Dataquest (May 1997)

Dataquest
A Gartner Group Company

Significant Sample Size

- $12.6 billion semiconductors purchased by sample
- 44.4 percent of total market
- Wide range of company sizes (<$1m to >$2.5b)
- Significant basis for decision-making



Source: Dataquest (May 1997 Estimates)

Dataquest
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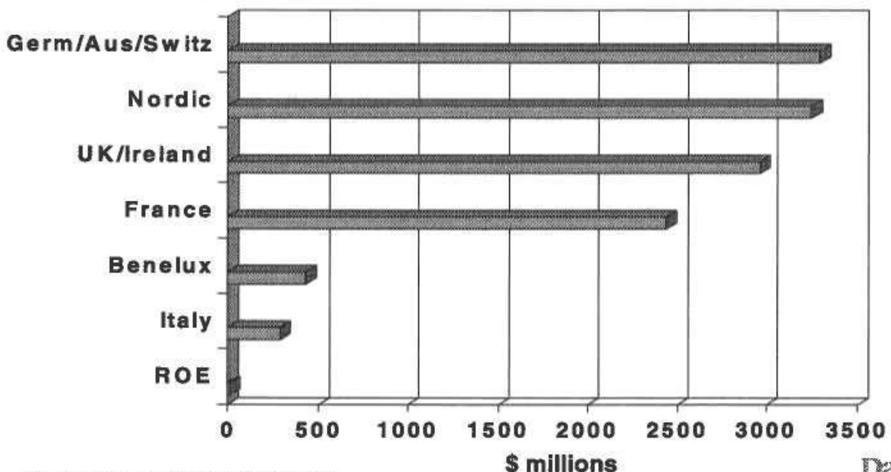
Semis Spend by Country/Region



Source: Dataquest (May 1997 Estimates)

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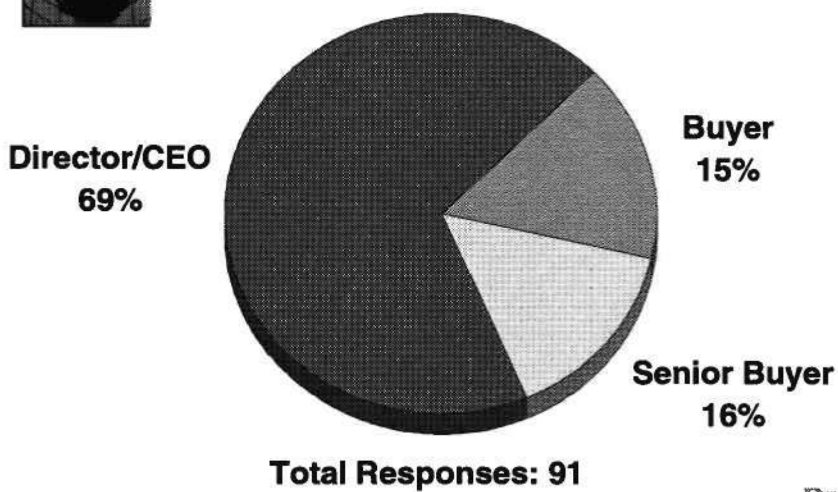
Respondents by Title



Source: Dataquest (May 1997 Estimates)

Dataquest
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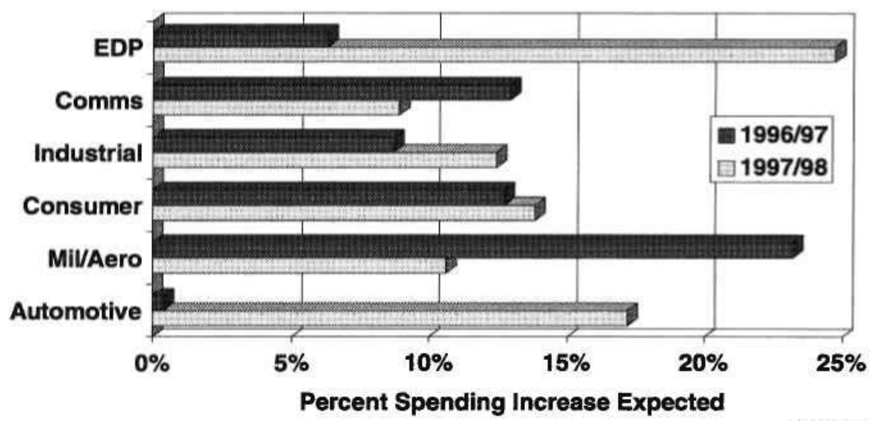
Projected Growth by Sector



Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Largest Users by Category

DRAM	**$1.8 billion**	**Computers (especially PCs and workstations)**
SRAM	**$446 million**	**Central office, car radio & navigation, PCs, mobile infrastructure**
EEPROM	**$359 million**	**As SRAM, plus aircraft guidance, defence systems**
Micros *	**$2 billion**	**PCs and peripherals, VCRs, car security and navigation, TV and satellite receivers**

* MPU, MCU and DSP

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Largest Users by Category

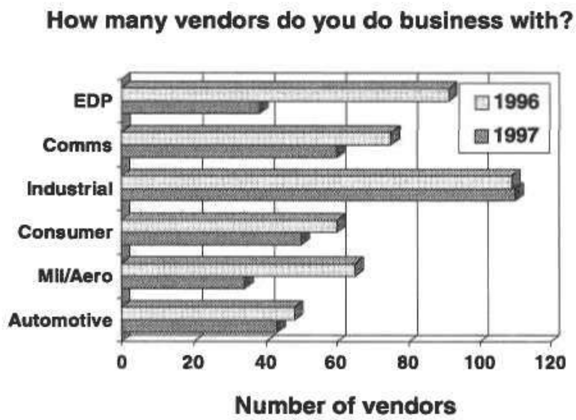
Gate Array	**$622 million**	**Network adapters, car radio / navigation, PCs, central office**
Cell-Based ICs	**$457 million**	**Central office, car navigation, network adapters, PCs**
PLDs	**$181 million**	**Mobile base stations, network adapters, PCs, aerospace, defence**

Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

Number of Vendors, by Sector

- Average number of vendors: 56 (98 in 1996)
- Highest figures in industrial sector
- High in 'dissimilar products' companies
- Low in 'one product' companies (especially PCs)



Source: Dataquest (May 1997 Estimates)

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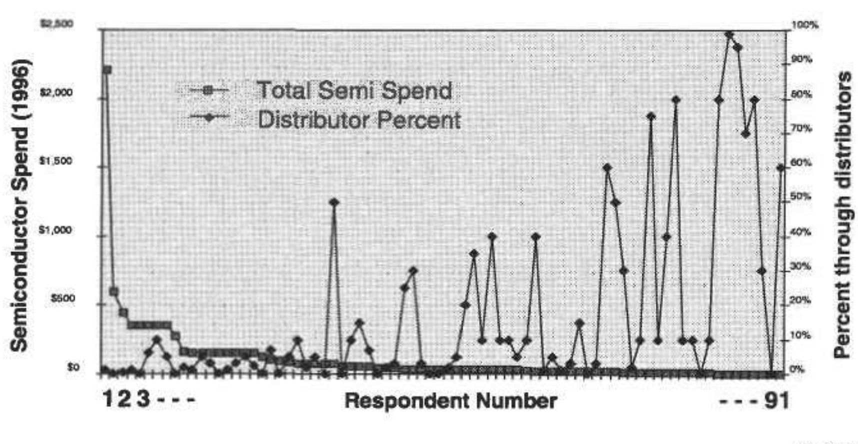
A Gartner Group Company

Direct vs Distributors

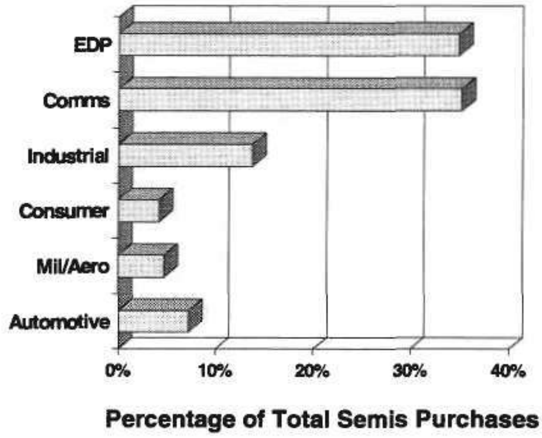


Source: Dataquest (May 1997 Estimates)

Dataquest
A Gartner Group Company

The Distributor Channel

- Semis revenue through distributors: $348 million
  - 3.9% of total
- Mostly to comms and EDP sectors



Source: Dataquest (May 1997 Estimates)

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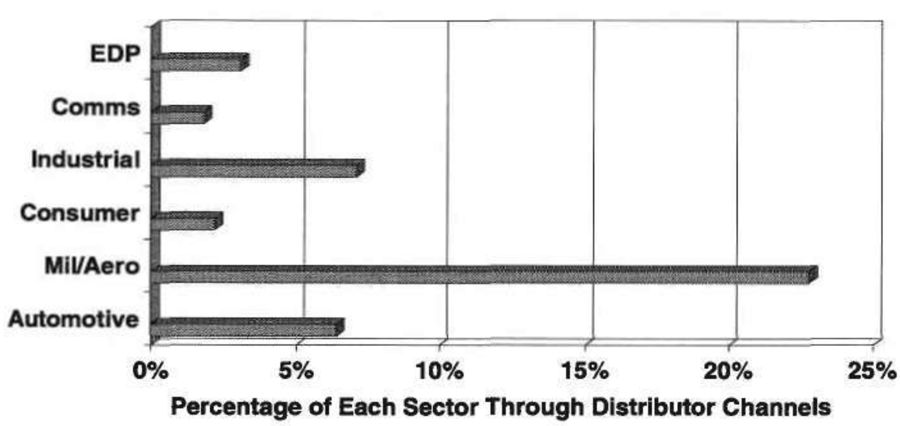
Distributors: Mil/Aero Dominates



Source: Dataquest (May 1997 Estimates)

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Advantages/Disadvantages of Distributors

Advantages

	No of Mentions
Flexibility	25
Stocking	18
Service	10
Delivery	6

Disadvantages

	No of Mentions
Pricing	42
Technical support	15
Non-availability	6
Service	5

Source: Dataquest (May 1997 Estimates)

Dataquest
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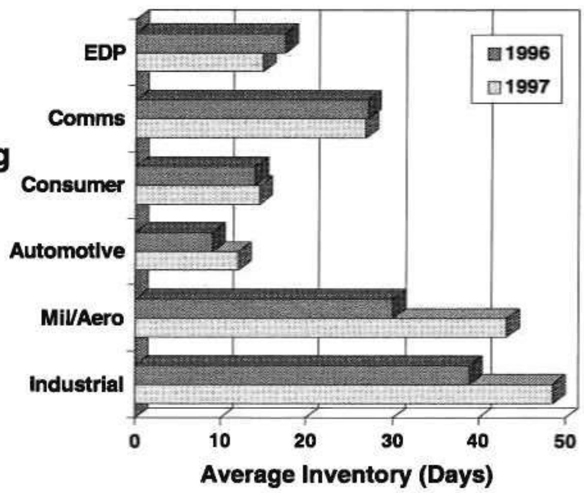
Inventory

- Reduced in EDP
  - Continued easing of supply
- Flat or rising in other sectors
- Expected reduction (1997/98): 33%



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Source: Dataquest (May 1997 Estimates)

Top Five Issues--Overall

Ratings (1 - 10 scale)

Rank	1996		1997	
1	Quality/Reliability	8.1	Pricing	8.5
2	On-Time Delivery	7.9	On-Time Delivery	8.3
3	Pricing	7.3	Avail. of Products	8.2
4	Cost of Ownership	7.1	Flexibility	8.1
5	Flexibility	6.9	Lead Times	8.0

Source: Dataquest (May 1997 Estimates)

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Top Five Issues--EDP

	1996		1997	
1	Quality/Reliability	7.9	Pricing	8.4
2	On-Time Delivery	7.7	L-Term Agreements	8.0
3	Pricing	6.4	Flexibility	7.9
4	Inventory Control	6.1	On-Time Delivery	7.3
5	Cost of Ownership	5.8	Avail. of Products	7.1

Source: Dataquest (May 1997 Estimates)

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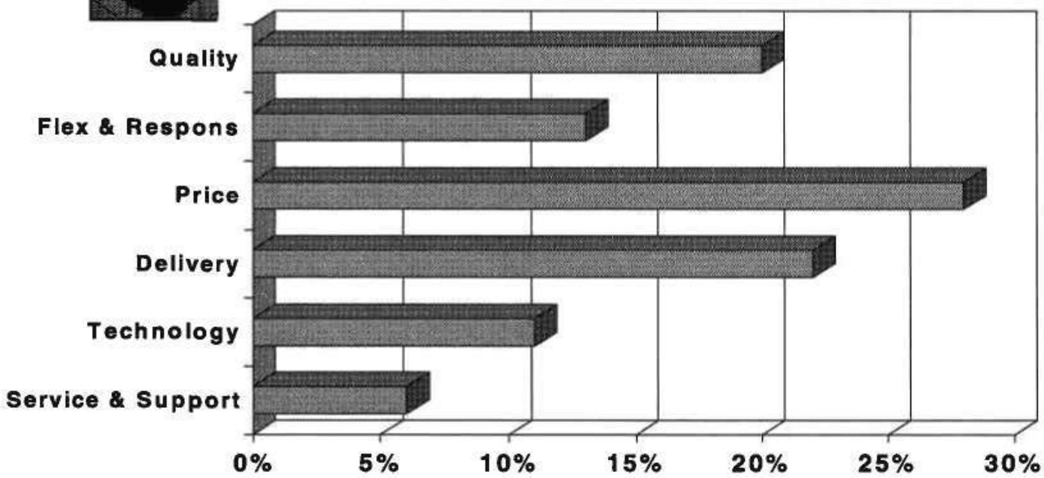
Factors Causing Vendors to Lose Business--EDP



Source: Dataquest (May 1997 Estimates)

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Top Five Issues--Communications

	1996		1997	
1	Flexibility	8.3	On-Time Delivery	8.8
2	Cost of Ownership	8.2	Pricing	8.8
3	Quality/Reliability	7.9	Avail. of Products	8.7
4	On-Time Delivery	7.7	Lead Times	8.6
5	Pricing	7.7	Flexibility	8.5

Source: Dataquest (May 1997 Estimates)

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A Gartner Group Company

Top Five Issues--Consumer

	1996		1997	
1	Avail. of Products	8.7	Avail. of Products	8.3
2	Pricing	8.3	On-Time Delivery	8.1
3	On-Time Delivery	8.2	Pricing	8.0
4	Lead Times	7.9	Lead Times	7.8
5	Flexibility	7.4	Flexibility	7.0

Source: Dataquest (May 1997 Estimates)

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Top Five Issues--Automotive

	1996		1997	
1	Pricing	9.8	Pricing	9.8
2	Cost of Ownership	9.5	Quality/Reliability	9.7
3	On-Time Delivery	9.5	Cost of Ownership	9.2
4	Responsiveness	9.3	Flexibility	9.1
5	Avail. of Products	9.0	Avail. of Products	8.9

Source: Dataquest (May 1997 Estimates)

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Conclusion

- Record number of responses; 69% from Director/CEO. Strategic shift/change of policy?
- Vendor reduction continues. Increasing competition in EDP
- Distributor channels viewed as flexible but expensive. Technical support challenge.
- Desire for inventory reductions continue, but seem difficult to achieve
- Price returns to top concern overall

Source: Dataquest (May 1997)

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Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Dataquest European 'Vendor of the Year' Awards 1997

Presented by:

Jim Eastlake
Vice President and Director
European Semiconductor Group
Dataquest Europe

Gene Norrett
Vice President and Director
Semiconductor Group
Dataquest

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands

Connecting For Growth—'Internetivity' And The Semiconductor Industry

Seamless Connectivity: The Role Of Wireless

The Autonet

Connecting The Interactive Consumer Via Multimedia

Processor Solutions For Connectivity

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

SEAMLESS CONNECTIVITY: THE ROLE OF WIRELESS

Chairman: David Moorhouse

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Dataquest European Semiconductor Industry Conference
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Connecting For Growth—'Internetivity' And The Semiconductor Industry

Integrated Cellular And Cordless—The Next Generation

Jeremy Hendy
IC Technology Business Manager
Symbionics Ltd

Jeremy Hendy is responsible for the IC Technology business area at Symbionics, based in Cambridge, England. Symbionics provides design services and technology licensing to OEMs and semiconductor companies in the wireless communications and multimedia markets. Jeremy has been with Symbionics for 5 years, developing IC technology for DECT, PWT, PHS, GSM, radio local loop and multi-mode. Prior to joining Symbionics, Jeremy spent 4 years in the telecom systems marketing group of Texas Instruments' semiconductor division in the UK, working on IC designs and system solutions for CT2, DECT and GSM as well as spending some time as an ASIC Field Applications Engineer. Jeremy graduated from the University of Liverpool with a first class Honours degree in Electronic Engineering.

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Integrated Cordless and Cellular
The Next Generation

Jeremy Hendy

Business Manager - IC Technology, Symbionics Ltd

jph@symbionics.co.uk

Symbionics

engineering new business

- Design services & technology licensing
- Cellular, Cordless, RLL, Digital TV
- Designs end-products and ICs for equipment manufacturers and IC vendors
- Global view of markets, players and technologies

Integrated Cordless & Cellular

- Multi-mode/multi-band background
  - Sorting the sheep from the goats !
- Market drivers for Cordless+Cellular
  - Understanding the market forces
- GSM/DCS/DECT Market size
  - Does anyone want it ?
- IC Technology requirements

Which mode combinations ?

- Analogue Cellular + Digital Cellular
  - Stopgap solution for the US market
  - AMPS with everything ? (CDMA, D-AMPS,...)
  - Difficult to pick a single winner for the US
- Satellite + Digital Cellular
  - Low volume, high value market
  - Addressed by NRE-funded ASIC technology

Which mode combinations ?

- Multi-band Digital Cellular
  - Intercontinental combinations (GSM/DCS/PCS)
    - Low volume, high value end-use market
    - Major drive from GSM operators for WorldPhone
  - Single continent combinations (GSM/DCS)
    - Becoming a mainstream product for Europe
    - "No brainer" for new IC developments
- Digital Cordless + Digital Cellular
  - New consumer market opportunity

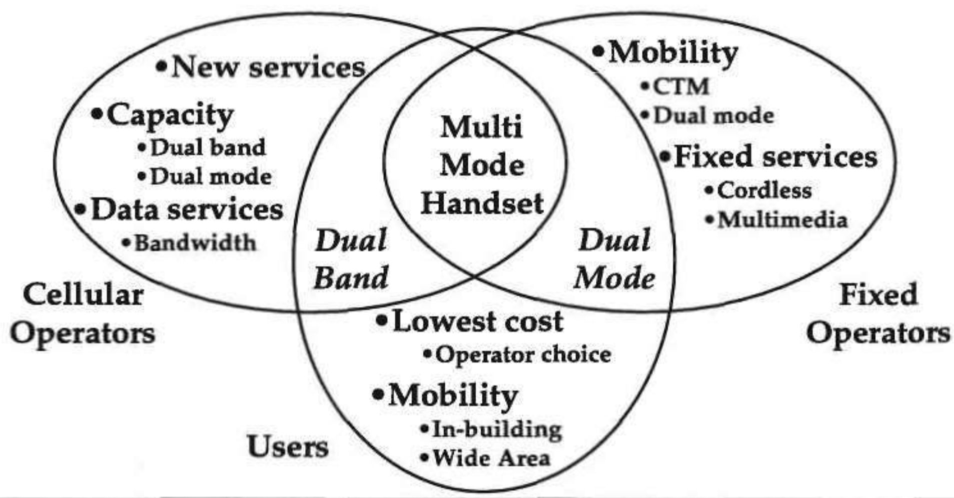
Which standards ?

	Digital Cordless	Digital Cellular	Analogue Cellular
Europe	DECT	GSM DCS1800	(E)TACS NMT
US	PWT PACS Proprietary	IS-136 TDMA IS-95 CDMA PCS1900	AMPS
Japan	PHS	PDC	JTACS
Asia	PHS	GSM/DCS	

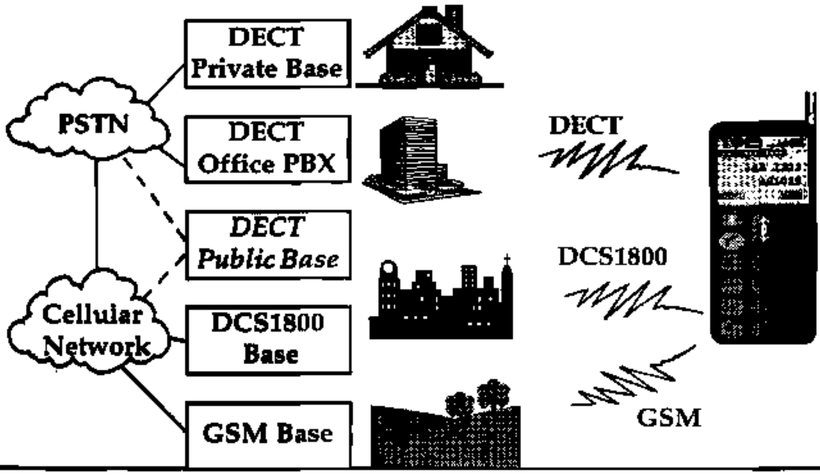
Integrated cordless and cellular

- Europe : DECT/GSM/DCS1800
  - Significant harmony between standards
- Japan : PHS/PDC ?
  - Operator competition issues
- Asia : PHS/GSM
  - Different modulation schemes add to cost
- US : fragmented (!)
  - PCS + Unlicensed PCS ? ISM cordless ?

Multimode market forces



DECT/GSM/DCS1800 Multimode Application Scenarios



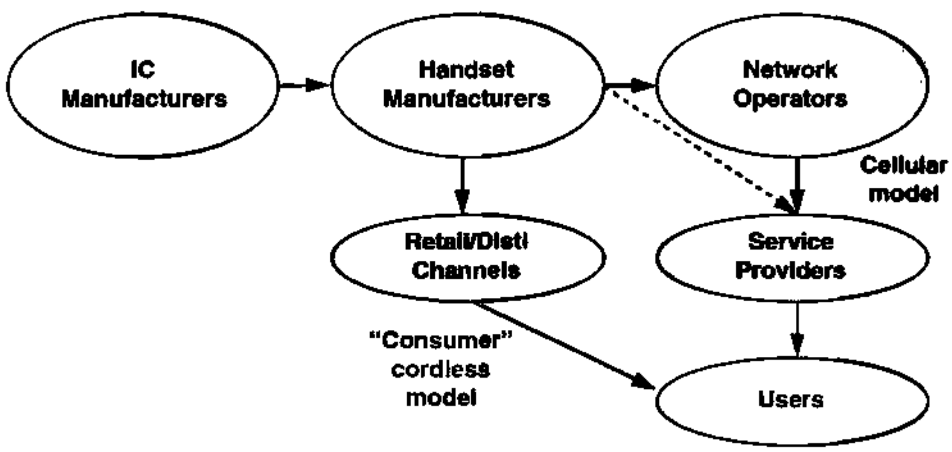
Why triple mode GSM/DCS/DECT ?

- Cellular operators want multi band
  - Will subsidise 1800 MHz RF component for DCS1800
  - Will not subsidise DECT
- Users want dual mode cordless+cellular
  - Consumer product choice
  - Delta cost for DECT is critical
- Triple mode meets both needs
  - Minimal cost overhead from Dual Band is achievable
  - Needs integrated chipsets and innovative RF architecture

Multimode handset + home base

- User buys cellular phone + home base
  - DECT/GSM/DCS1800 phone + DECT home base
  - Signs up normal GSM or DCS service agreement
  - Still attracts cellular handset subsidy from operators
- Indirect benefits to cellular operators
  - Phone becomes "personal" - increases cellular usage
  - Increased contactability, "one number" services, etc...
- Pragmatic - no infrastructure impact
  - Sell alongside regular cellular phones
  - *Market for consumer equipment manufacturers*

Supply chain discontinuities



Do the users want a multimode cordless/cellular phone ?

- Symbionics commissioned an independent telephone survey of 200 cellular users
- A simple product concept was presented
  - Buy the package of "multimode" phone + "home" base
  - No airtime charges for using the home/office base
  - Could buy additional domestic cordless handsets
- Questions were then asked to test interest
  - Would you be interested in buying this product ?
  - How much would you pay ?
  - Would you buy additional cordless handsets ?
  - What's important in a mobile phone ?

Symbionics multimode survey results

- 81% interested in buying the product
- £50 price tag acceptable to ≈ 90% of buyers
- 40% would like additional home cordless phones
- Most important factors in choosing a phone:
  - Monthly charges (cost of ownership)
  - Speech quality

GSM World Congress Survey

- Would you like to use GSM-based dual-mode/dual band ?
  - 96% said Yes
- What type of multi-mode ?
  - 33% said GSM/DECT
  - 47% said GSM/DCS1800
  - *GSM/DECT/DCS1800 meets needs of 80%*

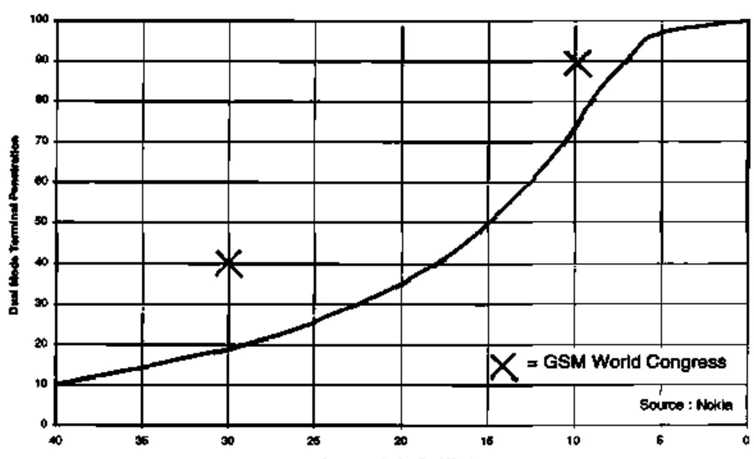
GSM World Congress Survey

- Would it bring benefit to your business ?
  - 85% said yes
    - Operators & equipment manufacturers
- What price penalty would you pay ?
  - 90% OK with GSM + 10%
  - 40% OK with GSM + 30%

British Telecom market research

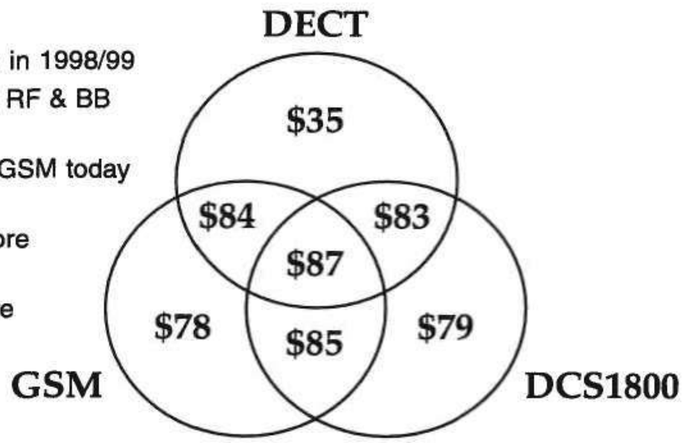
- BT's estimate of UK multimode market
  - 4.5 million small business/SOHO customers
  - 4 million residential customers
- Assume 3 year product life
  - 2.8 million units per year
- Extrapolate to European population
  - 70 million TAM
  - 23 million units per year

Dual Mode Terminal Price Elasticity

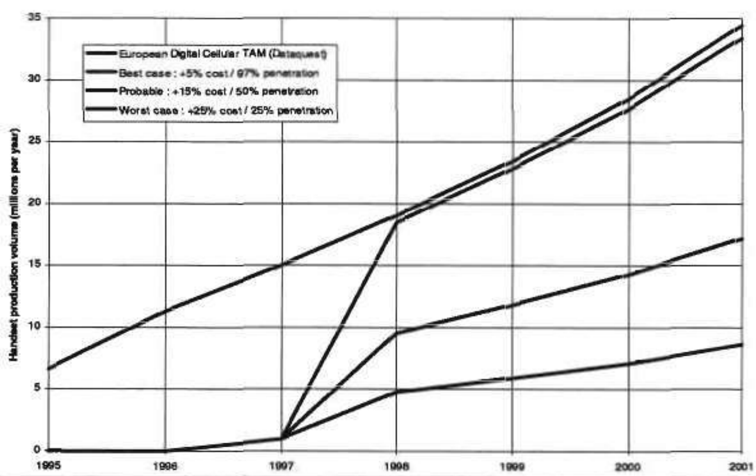


DECT/GSM/DCS1800 Handset Bill-Of-Materials estimates

- Assumes production in 1998/99
- Based on integrated RF & BB chipset availability
- Much cheaper than GSM today ($150 to $200)
- Triple mode 11% more than GSM-only
- Triple mode 3% more than GSM/DCS



Triple Mode DECT/GSM/DCS1800 Total Available Market forecast



What about UMTS ?

- UMTS/IMT-2000 likely to invent new air interface
  - Service based on GSM mobility platform
- Service launch unlikely before 2002
  - Specification work ongoing in ETSI
- Integrated cordless/cellular is a stopgap
  - 5 to 10 year market window

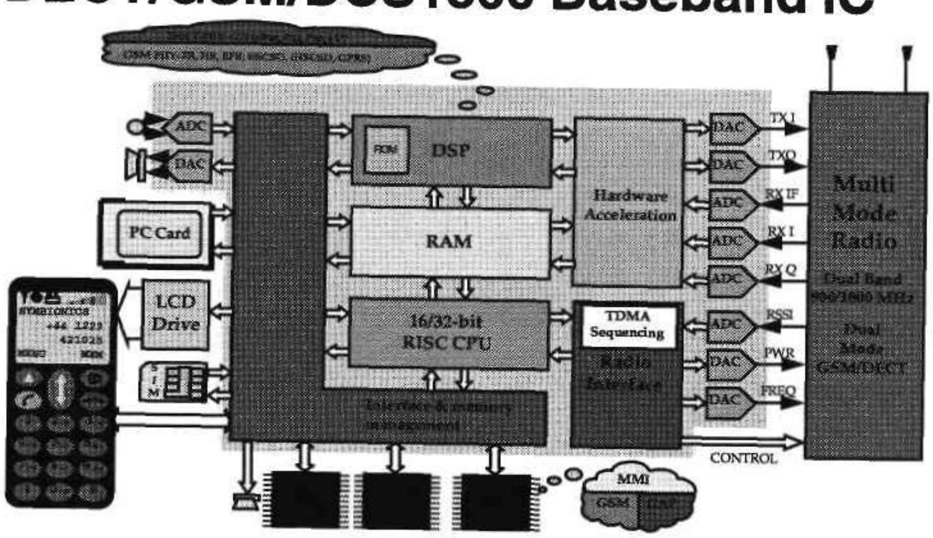
Baseband Technology issues - Physical Layer Processing

- GSM/DCS suited to DSP solution
  - Relaxed group delay allows "off line" receive processing
  - Flexibility is an advantage for performance optimisation
- DECT needs a hardware solution
  - Group delay constraints force "real time" receive processing
  - Cost constraints & high symbol rate drive optimised signal processing hardware
- Solution is a hybrid
  - DSP core + additional hardware accelerators

Baseband Technology issues - Voice Coding

- DECT uses 32 kbps ADPCM
  - Low complexity waveform coding
  - Traditionally implemented in Application Specific DSP for cost & power reasons, 4..8 MIPs
- GSM/DCS uses various voice coders
  - Full rate, Half rate, Enhanced Full Rate
  - Traditionally implemented in DSP, 3..30 MIPs
- Solution is programmable DSP

DECT/GSM/DCS1800 Baseband IC



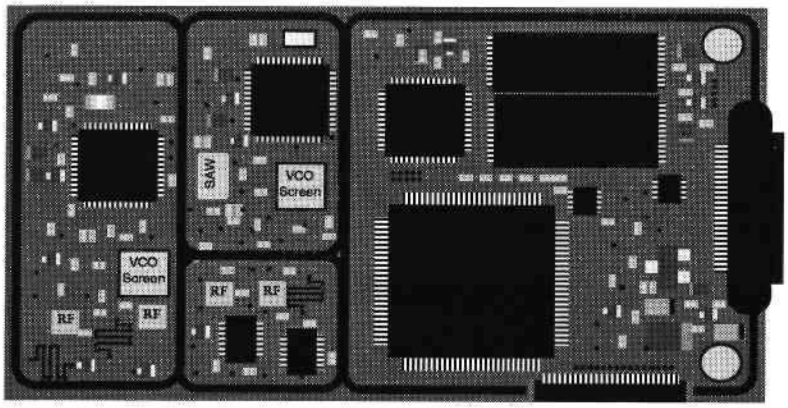
Baseband IC strategy for multimode

- Create multimode variant of multiband GSM/DCS baseband IC
  - Additional hardware accelerators
  - Additional ROM for voice coding
- Modify GSM/DCS mixed signal blocks
  - Dependent on architecture of radio

Radio technology issues

- DECT = 4 x GSM channel bandwidth
- Incompatible channel spacing
- Fast synthesizer settling requirement
  - Must scan for DECT in GSM standby
- GSM/DCS need linear RX (AGC)
  - DECT protocol not designed for AGC
- Avoid VCO and filter proliferation
- Avoid Duplication of PA and LNA

DECT/GSM/DCS1800 solution based on integrated ICs



RF IC strategy for multimode

- Apply additional thinking at design stage
- Produce competitive integrated multi-band RF chipset for today's market
- Support multi-mode operation with minimal additional silicon area
- Be the first with a multimode-capable chipset to secure key design-ins

Multimode - challenges for the semiconductor industry

- Investment decision
  - Need to "leapfrog" competitors increases risk
  - Offset by mainstream Dual Band opportunity
- Specification & design
  - Spec is more difficult than single mode DECT/GSM/DCS
  - Design effort can be similar to multi-band
- Time-to-volume
  - Significant hurdles to equipment manufacturers
  - Can address with software and reference designs

IC Technology trends for wireless

- Late 80's/Early 90's - ASIC
  - Early adopters building up IP themselves
- Mid/Late 90's - ASSP
  - Integration drives single chip solution
  - Maturing standards de-risk investment
- Late 90's/00's - Customer Specific SP
  - Differentiation can only be through silicon
  - Multimode is a good example
  - Tier 2/3 OEMs will stick with ASSP

Chipset differentiation

- Almost a "me-too" market by definition
- Cost is main driver for cellular market
  - Winners provide kit pricing for most of the BOM
- Power consumption is next
  - ...and can't be subsidised !
- Multiband/multimode are opportunities for function & feature differentiation

BB IC Technology Requirements

- Low cost, low power CMOS process
  - System voltage will be limited by RF PA
  - Low voltage core operation can reduce power
- Mixed signal is the key technology
  - 2 chip or 1 chip partitioning driven by cost and risk
  - Multimode may need tweaks to GSM mixed signal blocks
- On-chip Flash for code development
  - before going to mask ROM for production
  - MCM may be a good compromise

BB IC Technology Requirements

- Embedded DSP + Micro cores
  - Low power, low cost, memory efficient
  - Must address embedded code development issue
  - Need competent development tools (C compiler etc)
  - There's more to life than MIPs - need firmware as well !
- Support for Customer-Specific ICs
  - Variants of "Generic" ASSP solution
  - Must have IP blocks available for all key cordless & cellular standards

RF IC Technology requirements

- High performance, low cost processes
  - 25 GHz, low Ft, Bipolar/BiCMOS
  - Move to high performance CMOS for lower cost ?
- Libraries of well-characterised components
  - Characterised passives
  - Precharacterised circuit blocks
    - Fractional-N synthesizers, image-reject mixers etc
- Low cost packaging, characterised for RF
  - Broad range of low inductance packages

IC Methodology Requirements

- Customisability
  - May move away from “one size fits all”
  - Vendors with ASIC flow have an advantage
  - Infrastructure for customer-specific mask ROMs
- IP availability
  - DSP/MCU cores & third party IP for key wireless standards
- Need for complete solutions
  - Lower the barriers to reduce time-to-volume
  - Chipset, software & complete reference designs

“Software radios” - the future ?

- Significant interest in S/W radio concept
  - Mostly from the military !
  - Operators champion the downloadable air interface
- Significant technical challenges
  - Will push process technology to the limits
  - High linearity, wide bandwidth RF solutions
  - Several GIPs of DSP power
  - All for $50 and 10 mW...

Conclusions

- Convergence of cellular & cordless is the next big opportunity
- Likely to be addressed by “consumer” driven manufacturers looking for a niche
- Successful products need low cost, integrated RF and Baseband chipsets
- Customisation is the key !

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Integrated Digital Baseband Platform For Digital Wireless Communications

Gilles Delfassy
Vice President and General Manager
Wireless Communications Business Unit
Texas Instruments

Gilles Delfassy is in charge of the Worldwide Wireless Communications Business Unit at Texas Instruments. Since joining TI in 1978, Gilles has held a number of positions in sales, marketing and management. In 1984, he joined ASP, then named MMP, as European Product Marketing Manager for microcontrollers. In 1988, he was named Automotive Business Manager for Europe, and became European DSP Department Manager in September 1989. During these years, Euro-DSP is largely credited with defining, shaping and executing the strategy which eventually led TI to a leadership position in the wireless communications market - with such partners as Ericsson, Matra, Kyocera and Nokia, and such products definitions as BBIC and Lead Cores. In 1995, Gilles moved to Dallas to take worldwide responsibility for the Wireless Communications organization with the charter to make TI the dominant semiconductor supplier in this market. Gilles holds both an M.S.E. and an M.B.A..

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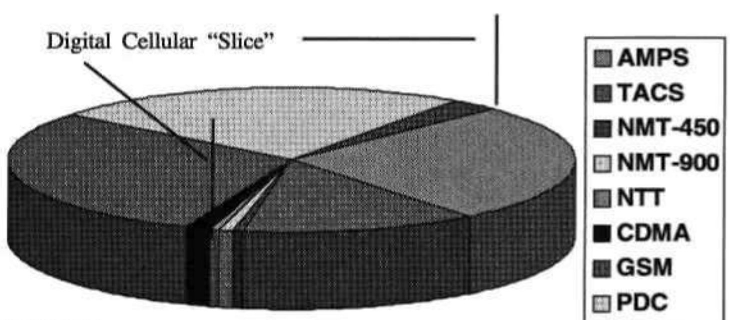
Amsterdam, The Netherlands

Integrated Digital Baseband Platform for Digital Wireless Communications

Gilles Delfassy
Vice President and General Mgr
Texas Instruments Wireless
Communications Business Unit

Digital Wireless Terminals- Major Opportunity



Year End 1996:

71 M total terminals: 41 M digital ; 30 M analog

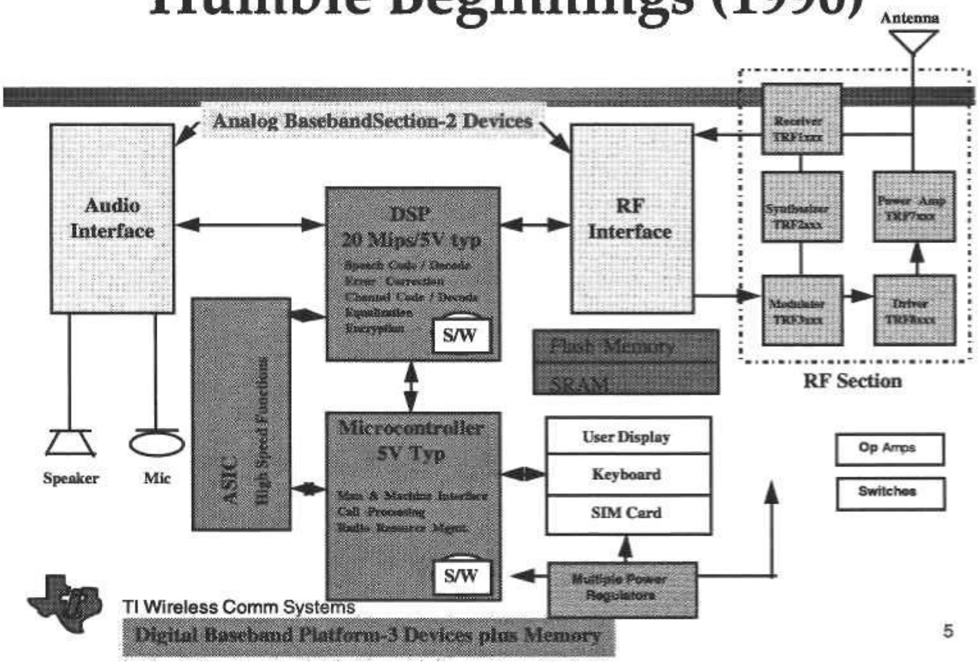
Digital Cellular Handsets- Extreme Challenges

- Size
- Power Consumption
- Cost
- Market Fragmentation due to multiple air interfaces
- Multimode Requirements

Initial Digital Cellular Architecture (1990)

- 5 chip Baseband/ 3Chip DBB
- 5 Volt Operation
- 500+ cc Volumes
- Standby times on the order of 8 hours
- Talk times in the 1-1.5 hour range

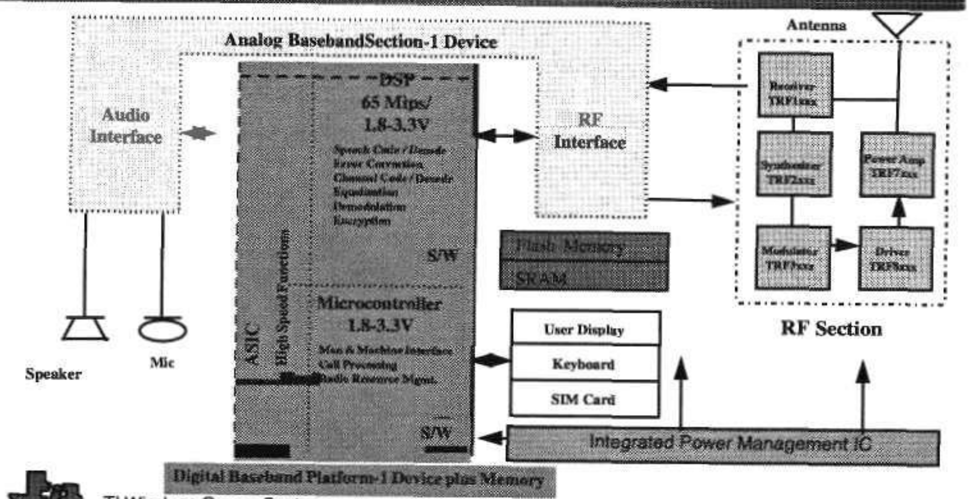
Humble Beginnings (1990)



Current Digital Cellular Architecture

- Single Chip Analog Baseband
- Single Chip Digital Baseband
- Sizes as small as 150 cc
- Standby times in the 200-400 hour range incent users to keep the units activated
- Talk times exceeding 5 hours

Current Situation (1996/7)



Unified Digital Baseband

- DSP and associated memory
- MCU Core
- ASIC logic exceeding 200K gates
- Integrated on chip peripherals

Single Chip Digital Baseband (DBB) Applications

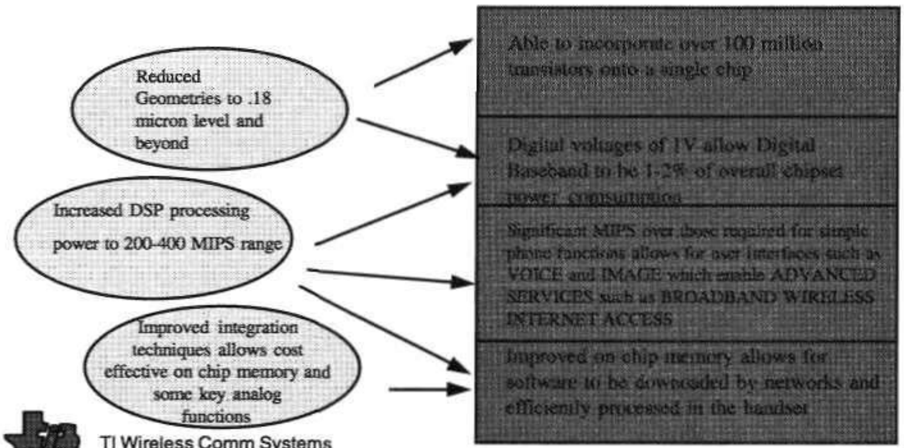
- GSM
- IS 95 CDMA (Digital plus AMPS)
- PDC
- IS 136 TDMA (Digital plus AMPS)

Applying the DBB- Same Platform, Different Configurations

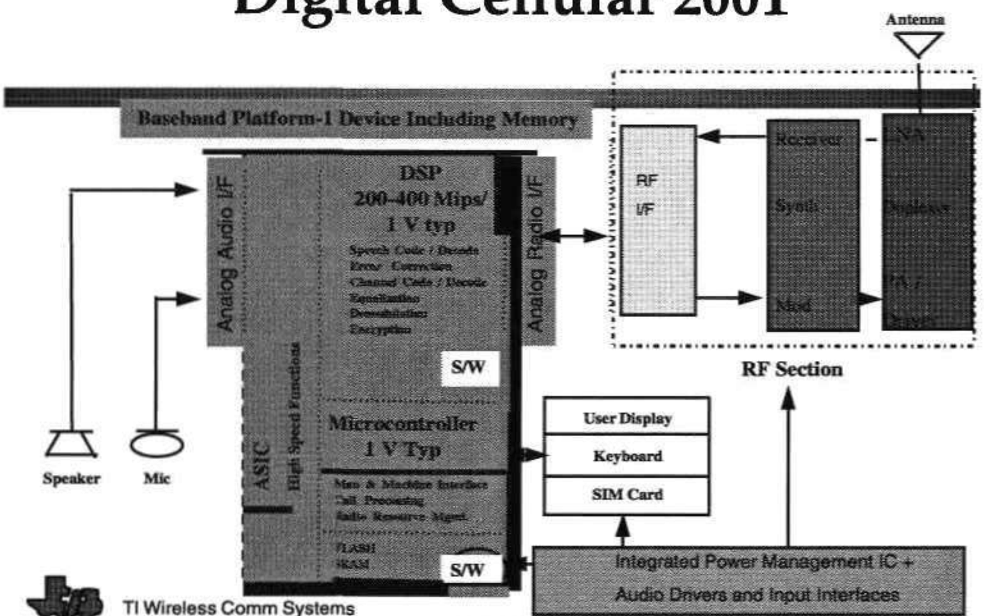
	GSM	IS95 CDMA	PDC	IS136 TDMA
DSP	Vocoders Chan Coding Demod 40-45 MIPS	Vocoders Chan Coding AMPS 20-30 MIPS	Vocoders Chan Coding Demod 40-50 MIPS	Vocoders Chan Coding Demod/AMPS 40-45 MIPS
MCU	Call Processing 200-300K Words	Call Processing Power Control Soft Handoff 250-350 K	Call Processing 200-300 K	Call Processing 250-300 K
ASIC	Accelerators 15-20 K Gates	Demod PN Gen Rake RX 150-200 K Gates	Accelerators 20-40 K Gates	Accelerators 15-30 K Gates

Evolving to the Next Step (2000)

Key Semiconductor Trends | **Impacts to Digital Wireless Baseband**



Digital Cellular 2001



Summary

- Digital wireless communicators represent a major opportunity with major challenges
- In response to these challenges, the single chip baseband platform has been developed
- This platform, fueled by technology trends, will evolve further to support the challenges of 2001 and beyond
  - » Broadband Wireless 3rd Generation Systems
  - » Wireless Internet Access
  - » Voice Driven Interfaces
  - » Image Based Services

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Problems With Future Baseband

Ronald Rosenzweig
President and CEO
Anadigics Inc.

Ronald Rosenzweig is President and Chief Executive Officer of Anadigics Inc., based in Warren, New Jersey, USA. He has held this position since co-founding the company in 1985. Anadigics is the leading resource for the design and manufacture of high speed, gallium arsenide (GaAs) analog integrated circuits (IC's) used in high volume commercial and consumer electronic applications such as cellular and PCS telephone handsets. In addition to directing the successful day-to-day operations of Anadigics, Ronald was also a co-founder of Microwave Semiconductor Corporation (MSC). He served as President of MSC for 15 years. MSC, a market leader in microwave silicon and GaAs transistors and amplifiers, was later sold to Siemens Corporation and, subsequently, to SGS Thomson. Ronald is a graduate of the City College of New York where he received his Bachelor of Science Degree in Chemical Engineering.

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Amsterdam, The Netherlands

ANADIGICS®

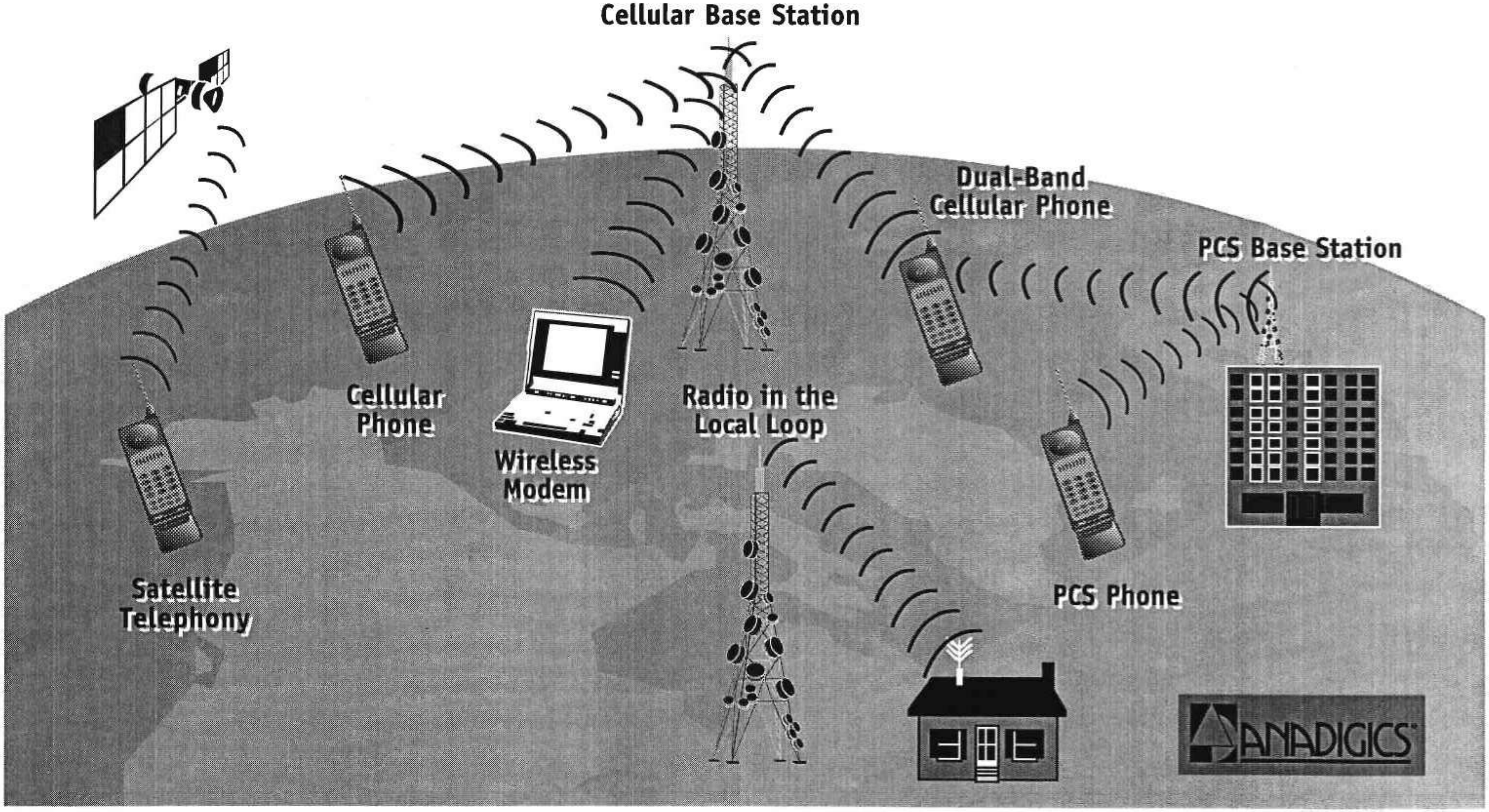
GaAs ICs

The Low Cost Solution For Multimode, Multiband RF Front Ends in Cellular PCS Handsets

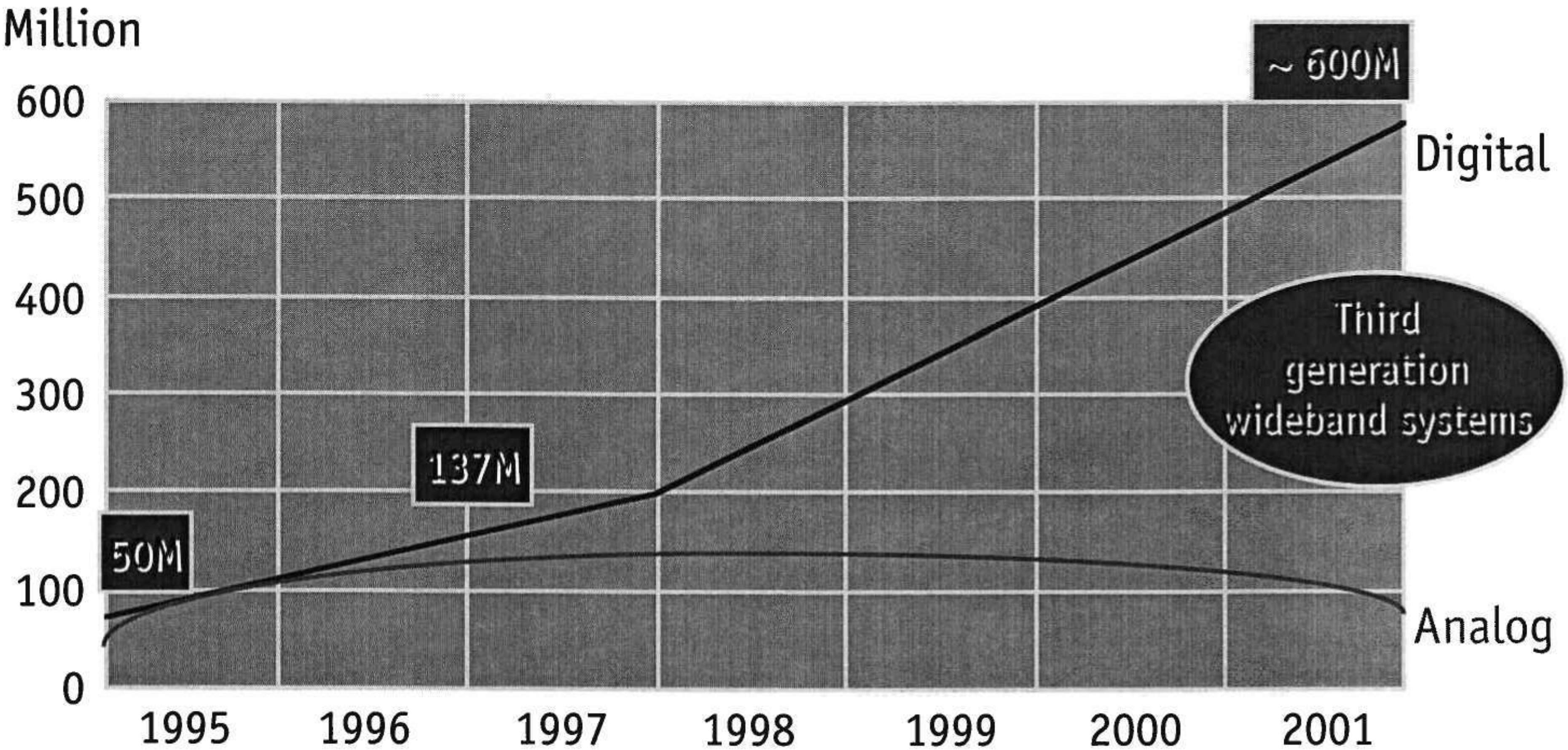
RONALD ROSENZWEIG
President and
Chief Executive Officer

DATAQUEST Conference, Amsterdam, May 20-21, 1997

Wireless Communications



Mobile Subscribers Worldwide



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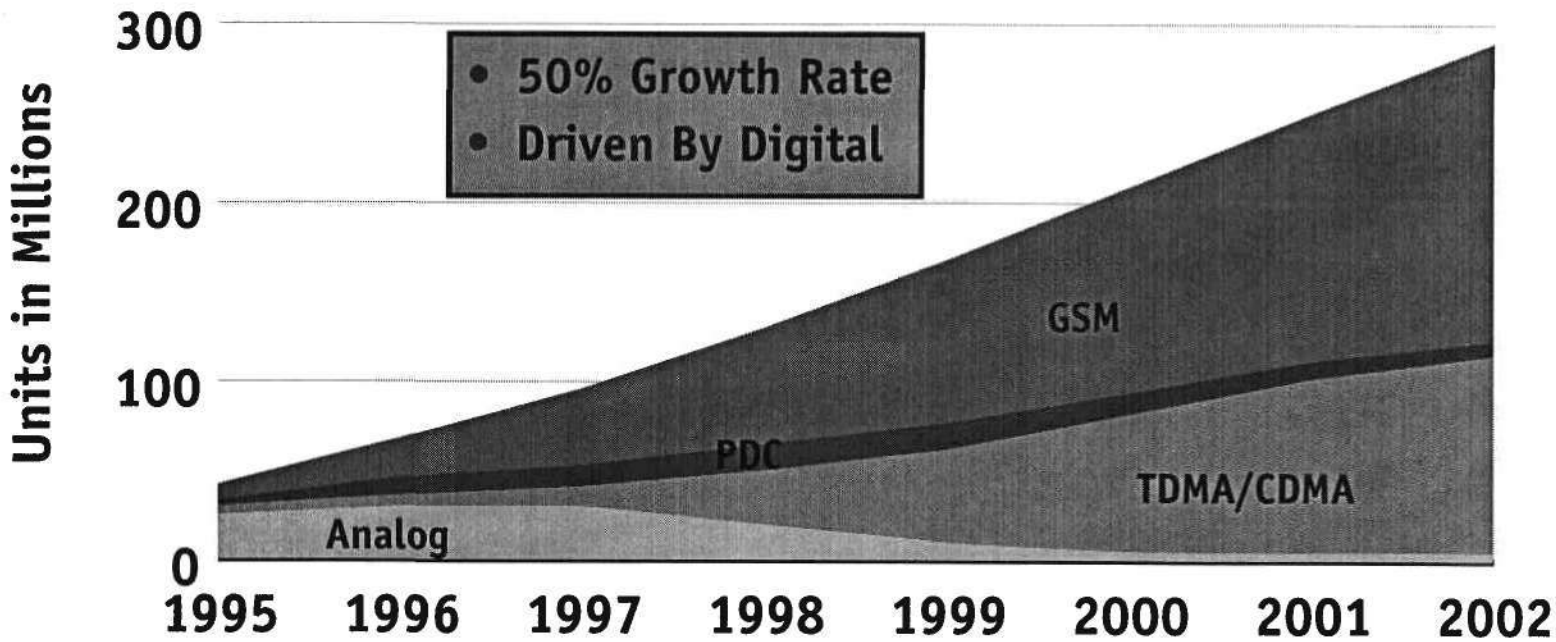
Source: Ericsson

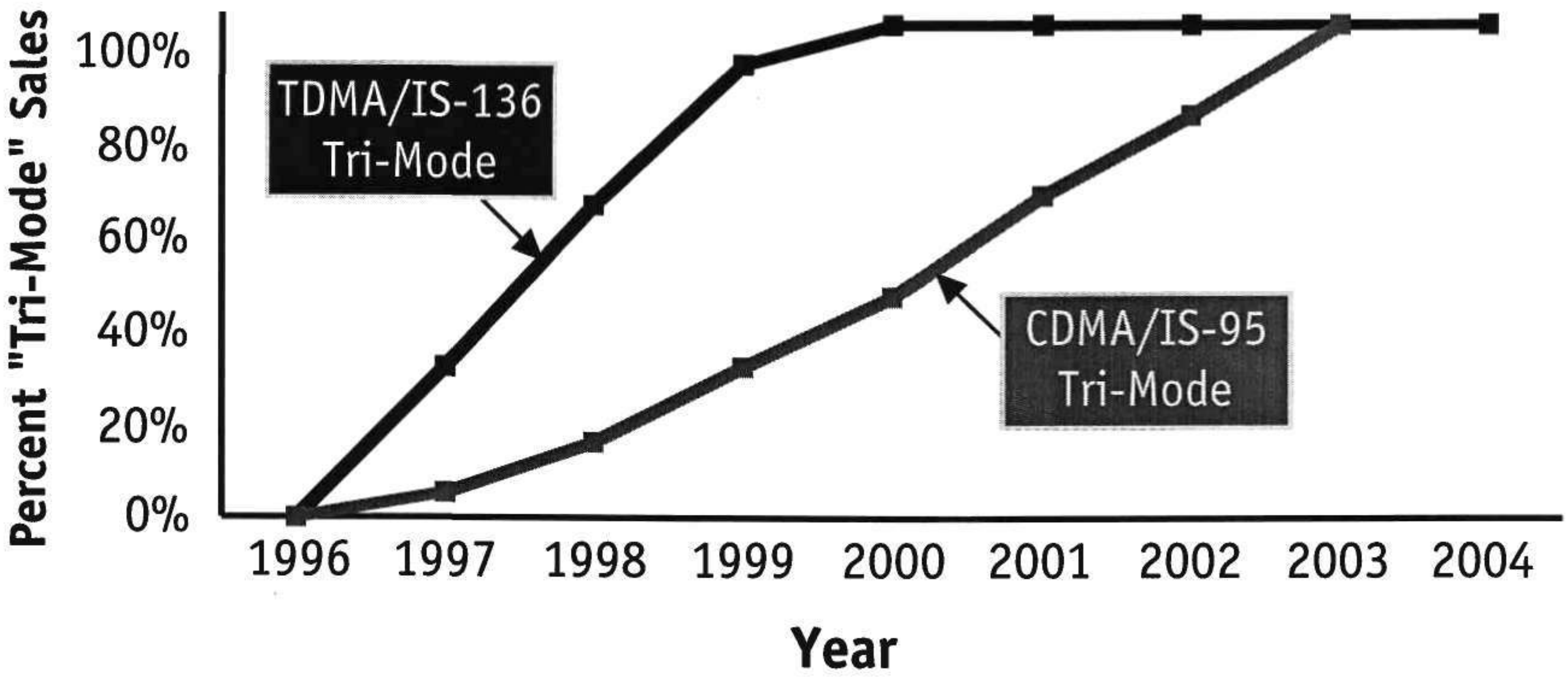
Cellular/PCS Handset Market: Large and Growing



Source: Ericsson, ANADIGICS

ANADIGICS

Transition to "Tri-Mode" 800/1900 MHz PCS Terminals, U.S. Market, 1996-2004



Source: Herschel Shosteck Associates, Ltd.

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World Digital Cellular Subscribers by Standard

December 1996

	Dec. 1996	Dec. 1995	YoY%
TDMA:			
– GSM	32.7	13.0	152%
– other TDMA	17.4	5.4	222%
CDMA:			
– IS-95	0.9	0.0	N/A
World Digital Total	51.0	18.4	177%

Source: Ericsson

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Market Condition & Demands

- Cellular and PCS have entered the consumer electronics market
- Price pressures on telephones are mounting
- Mobile terminals are getting smaller and lighter
- Product life cycle – 1-2 years

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The Telephone Handset Challenge

- Two operating frequencies: 900 MHz and 1900 MHz
- Three global digital standards: GSM, TDMA, CDMA
- Smaller, lighter, cheaper and more functions
- Anytime, anywhere service

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The GaAs IC Solution

- Single-chip RF solutions
- Transmitters and receivers
- Operate at 900 MHz and 1900 MHz
- Low power consumption
- Analog and digital standards

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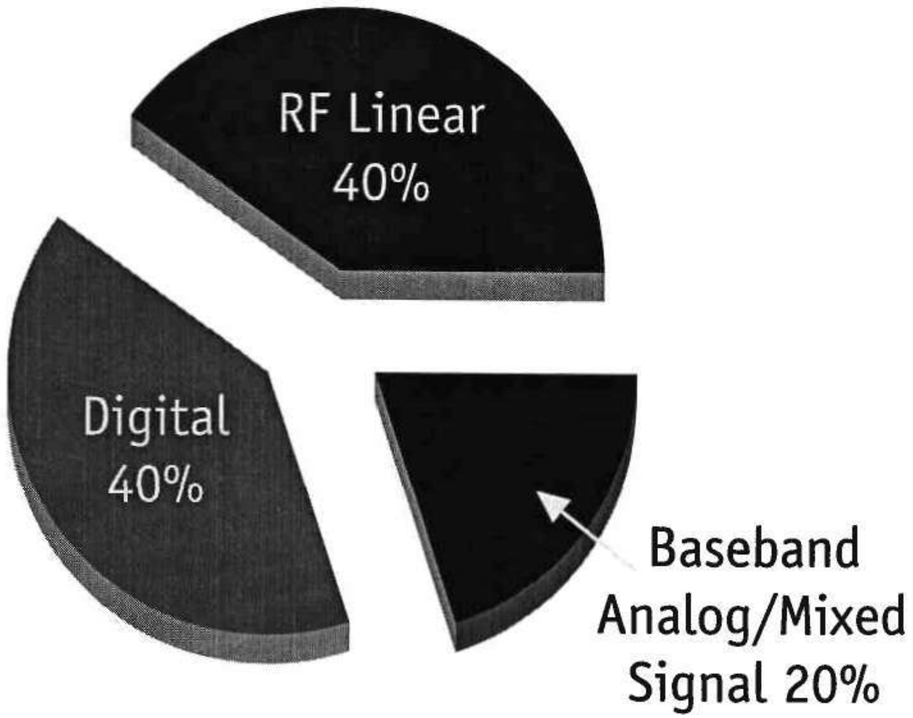
Bill-of-Materials for Chips in a GSM Handset

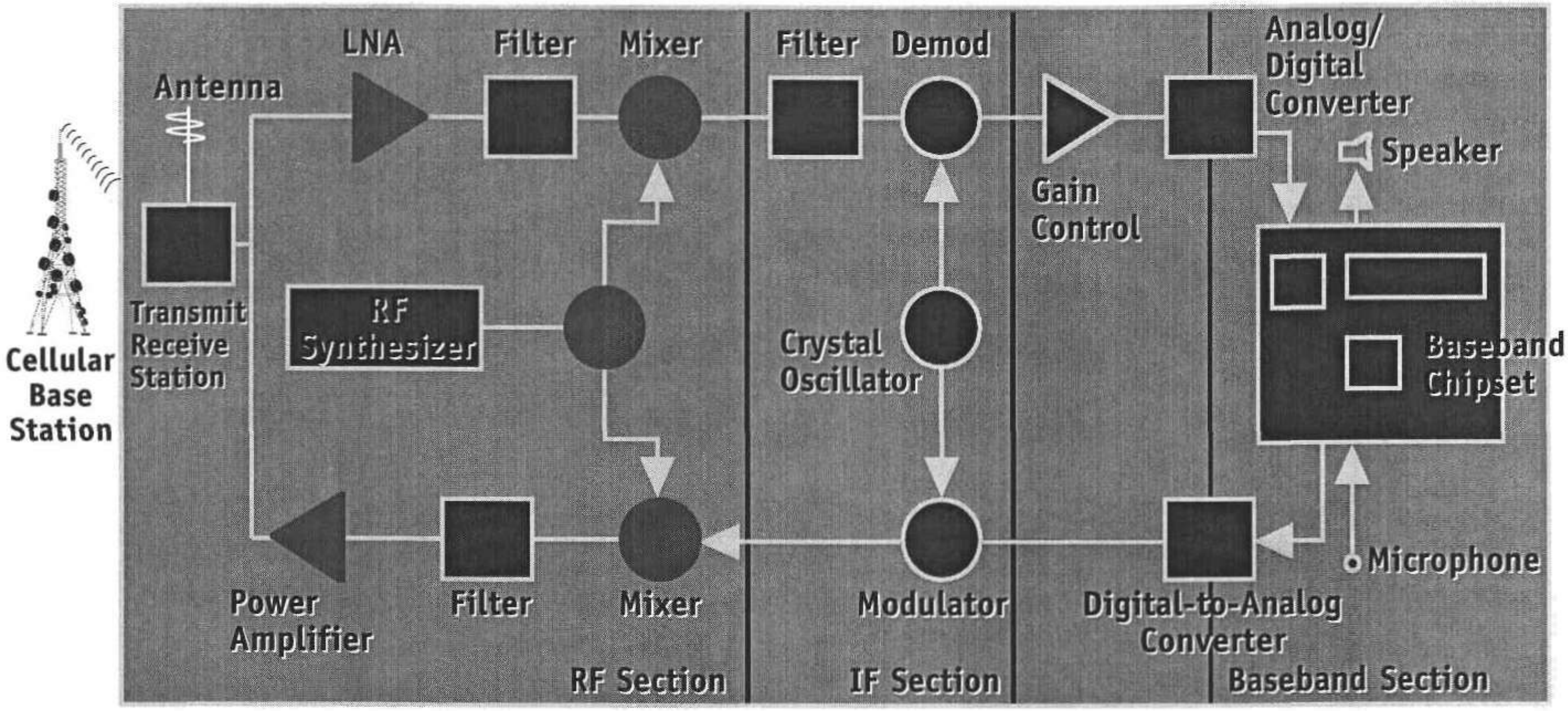


$100 Bill-of-Materials

Source: Dataquest

ANADIGICS

Wireless Handset Block Diagram



RF GaAs IC Opportunities

Source: Dataquest

ANADIGICS

Why Gallium Arsenide IC's?

	DISCRETE COMPONENT	SILICON IC's	GaAs IC's
Isolation	+		+
Bandwidth	+		+
Noise figure	+		+
Linearity	+		+
Efficiency	+		+
Size and weight		+	+
Reliability		+	+
Cost performance			+

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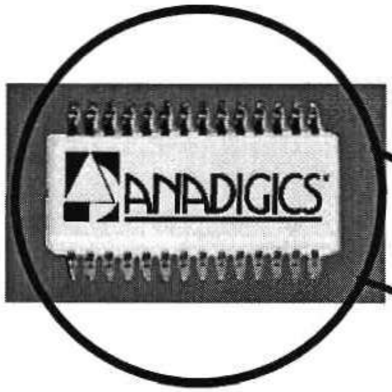
ANADIGICS IC's in Cellular/PCS Telephones



- Standards driven
- Lower operating voltages
- Dual-band multi-mode
- Smaller footprint
- Higher efficiency

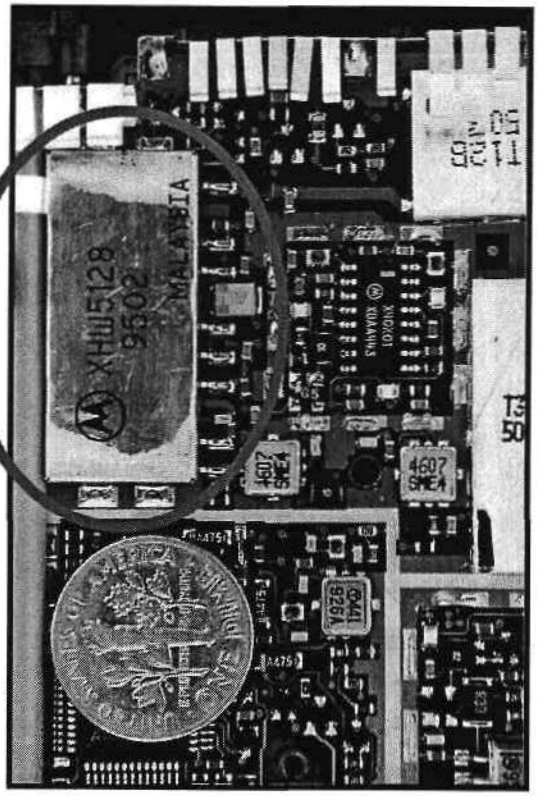
Radio

800 MHz/2000 MHz

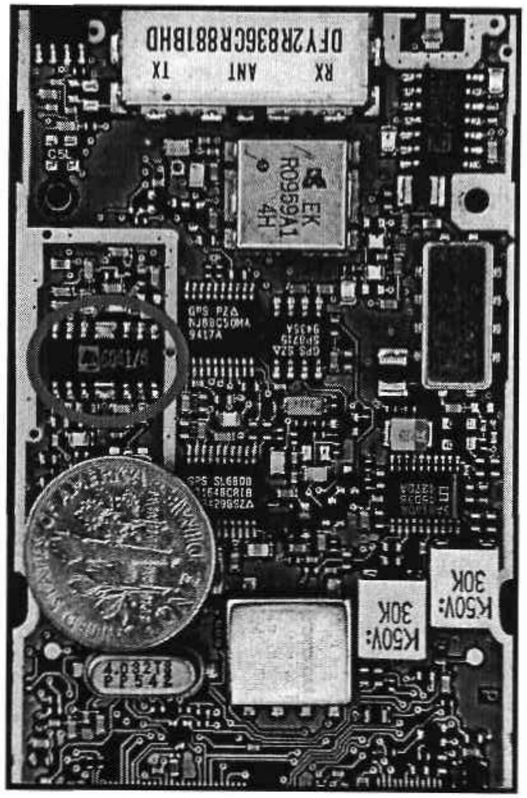
1–100 MHz

Signal Processor
& Controller

ANADIGICS Results in Less Components and Smaller Size

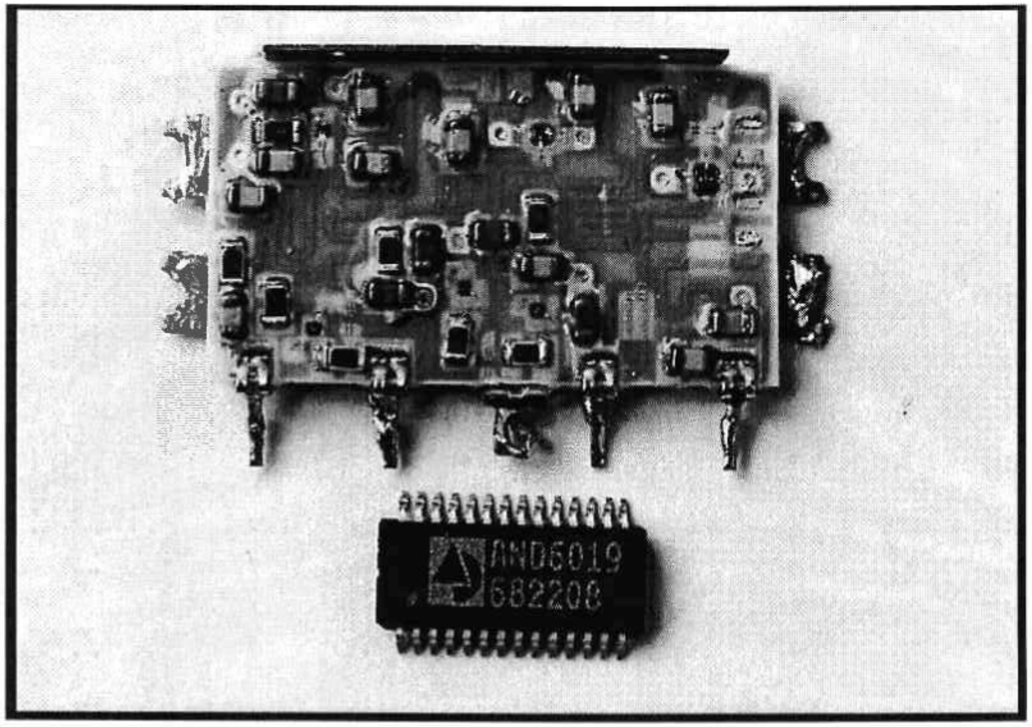


Hybrid Solution



ANADIGICS Solution

ANADIGICS GaAs IC Solution



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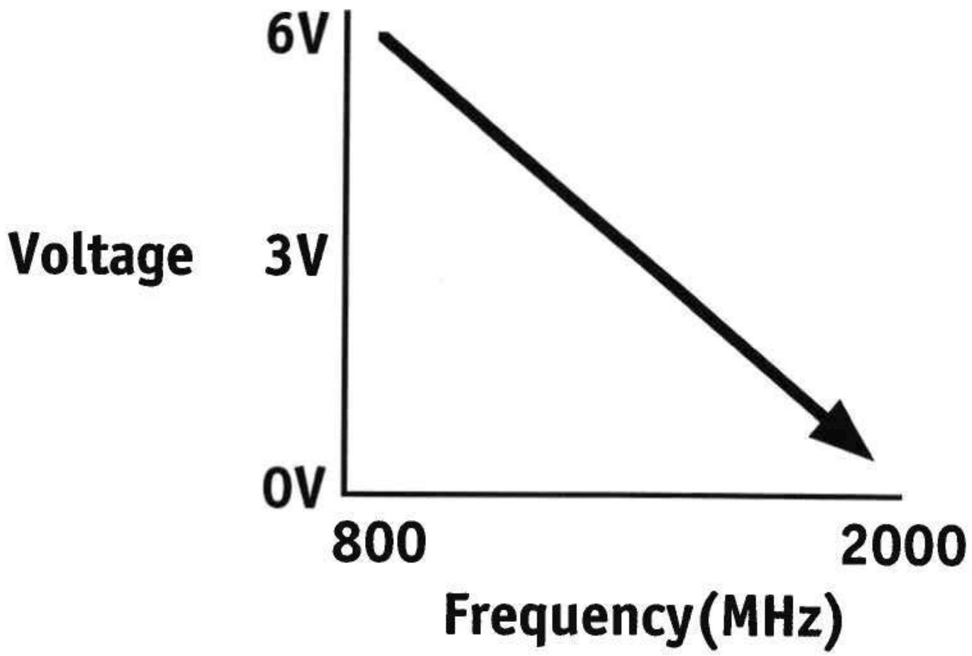
Cellular/PCS Trends Favor GaAs Solutions



- Leading to 3 volt dual band
  - Celluar → PCS
  - 6V → 3V

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First Generation GaAs IC Power Amplifiers

- Dual supply required
- 6V operation
- Two stage designs requiring a driver
- Single-band single-mode operation
- Standard SOIC package

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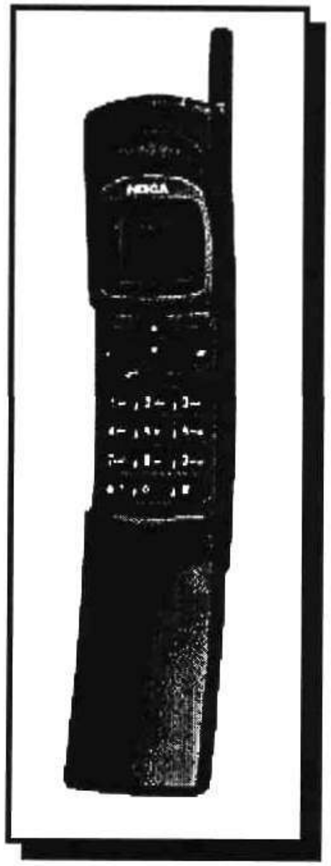
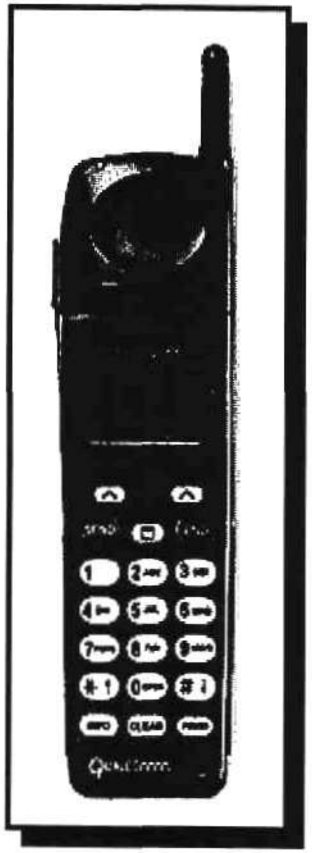
Cellular/PCS Handsets with GaAs IC Power Amplifiers

Nokia GSM (AWT0904)



Ericsson DAMPS (AWT906D)

Qualcomm CDMA (AND6022+AND6014)



Second Generation GaAs IC Power Amplifiers

- Single supply
- 4.8V operation
- Three stage designs
- Thermally enhanced package

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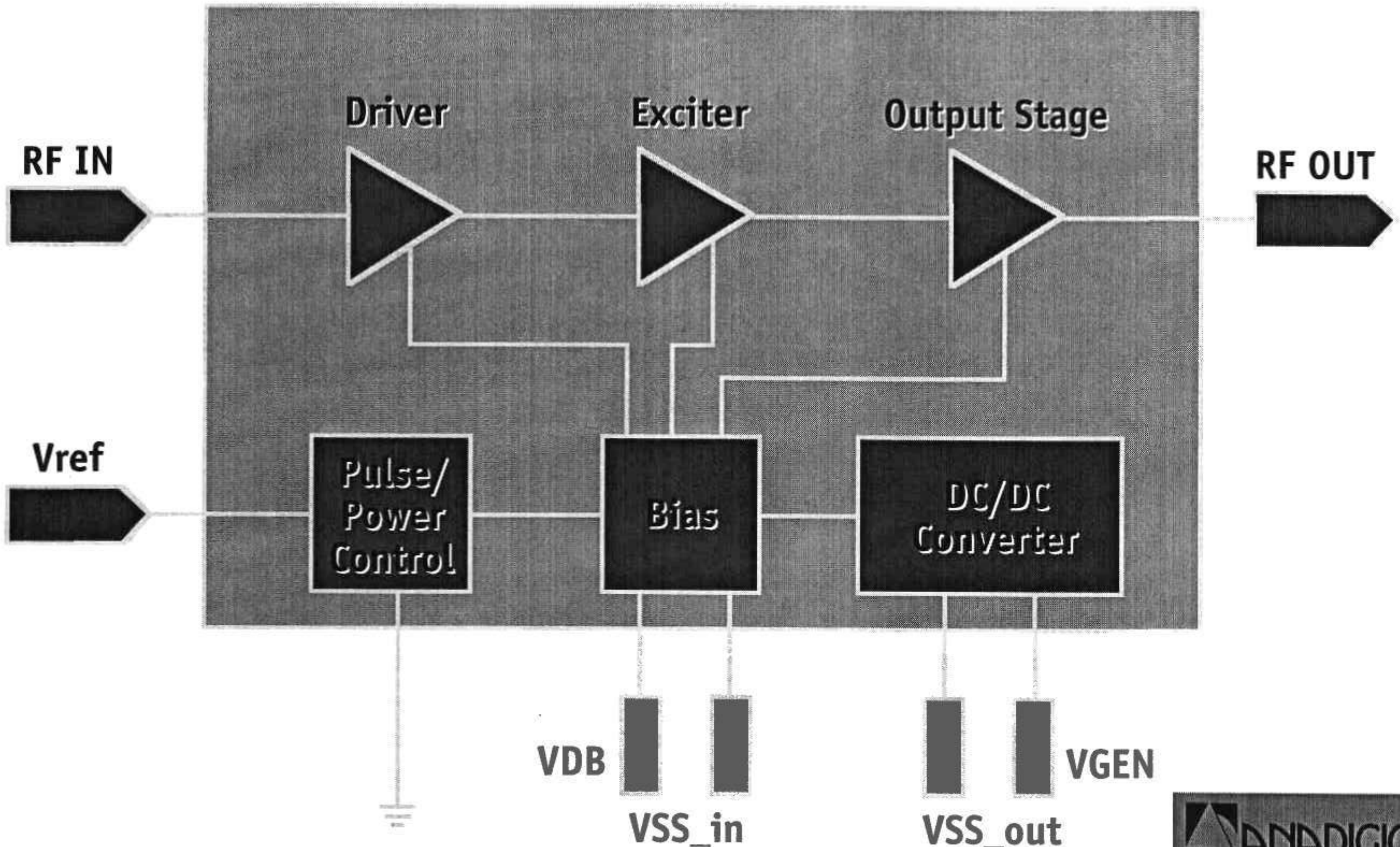
6V GSM900 PA Block Diagram



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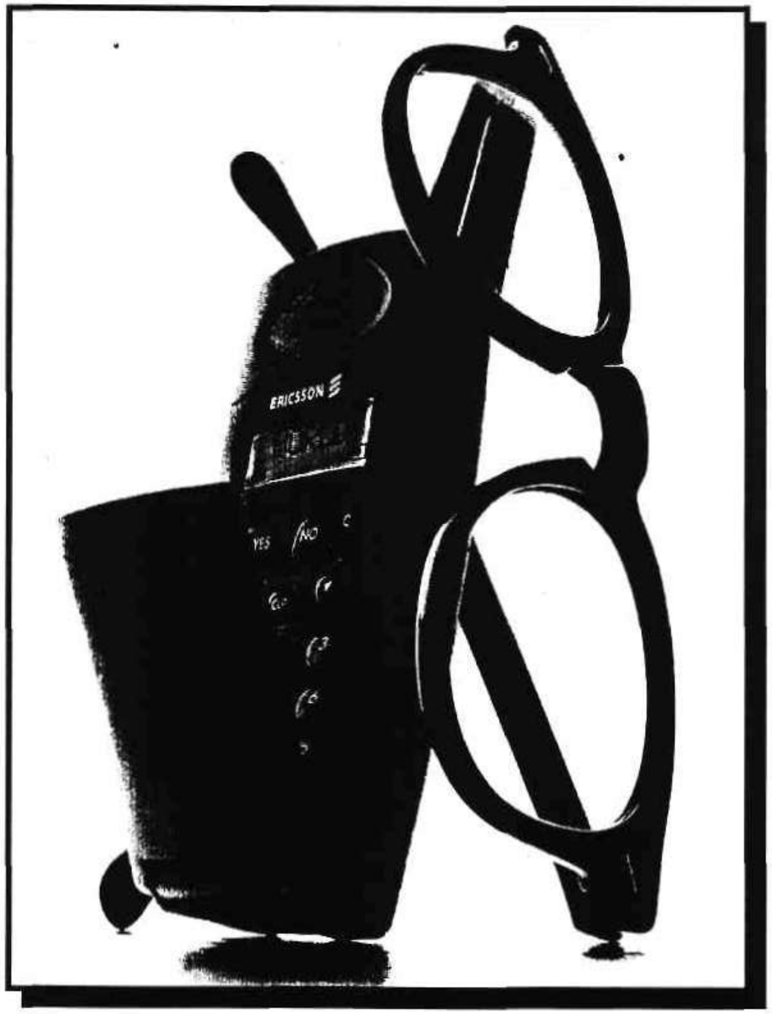
GF788 GSM Phone

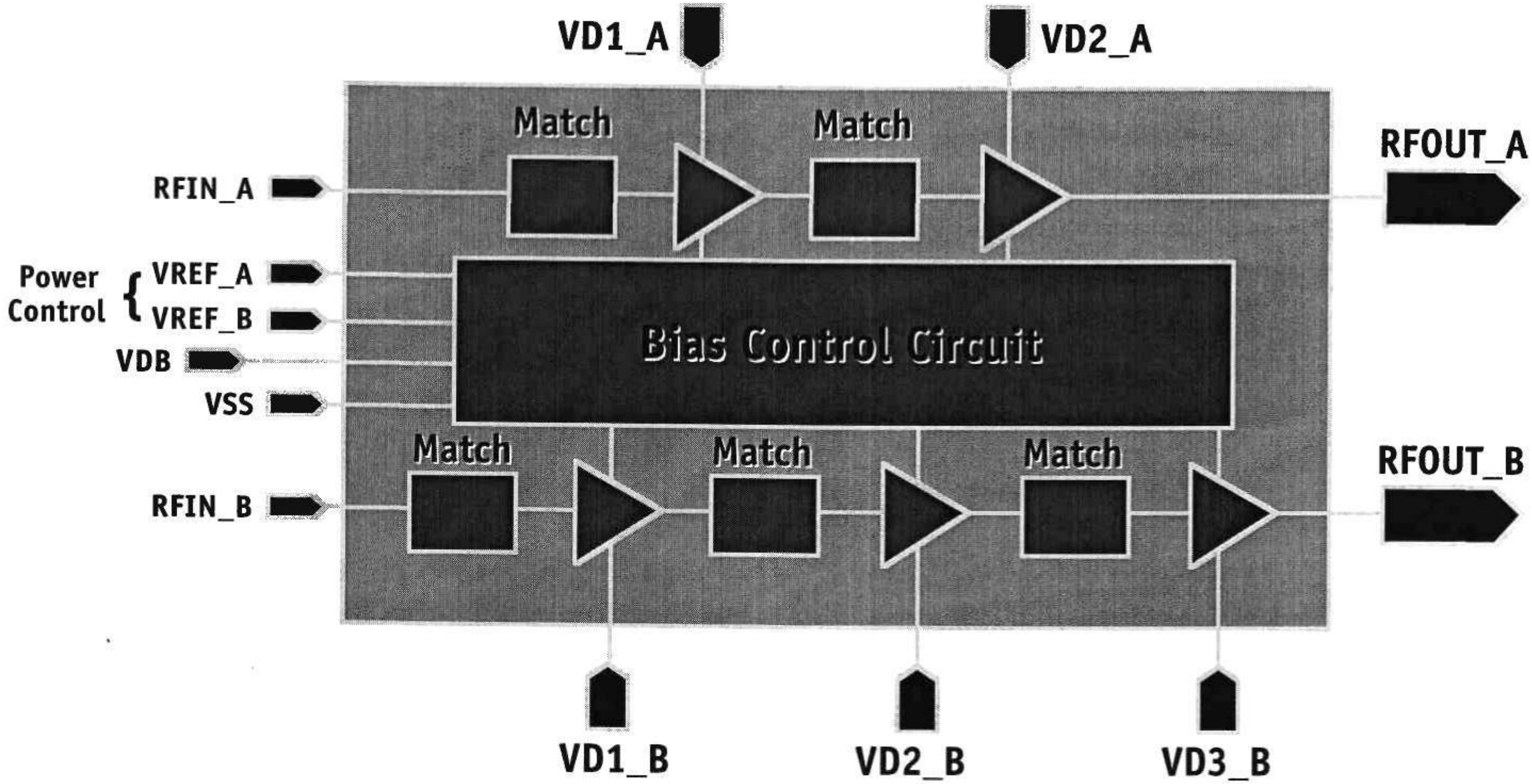


Third Generation GaAs IC Power Amplifiers

- Dual-band operation
- 3.5V single supply
- Smaller packages
- Higher level of integration

ANADIGICS

900/1900 Dual Band DAMPS GaAs IC Power Amplifier



900/1900 MHz Dual Band DAMPS GaAs IC Power Amplifier

DESCRIPTION

The AWT is a highly integrated GaAs monolithic Power Amplifier suited for both 824-849 MHz AMPS/DAMPS and 1850-1910 MHz TDMA/CDMA dual-band handset applications

FEATURES

- High Output Power
- High Efficiency
- Low Distortion
- 28 Pin SOIC Plastic Package
- Surface Mount Package
- Low Cost

ANADIGICS

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

THE AUTONET

Chairman: Mike Williams

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
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Connecting For Growth—
'Internetivity' And The Semiconductor Industry

The Future Of The Navigation System Market

Roy Metcalfe
Market Development Manager
Navigation Technologies

Roy Metcalfe is Market Development Manager for NavTech, based out of their European headquarters in Frankfurt. He has more than 20 years' experience in the electronics industry, including 12 in semiconductors. Roy is responsible for the development of new markets within NavTech and is currently active in the mobile area of transport telematics focusing on dynamic route guidance, inclusion of live traffic and Mayday services. During his time with National Semiconductor, Roy gained experience in applications engineering, sales and marketing, specializing in personal systems AMD communications solutions. Roy has a Honours degree in Electronic Engineering from Manchester.

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1

The Future of The Navigation System Market

Roy Metcalfe
Market Development Manager
Navigation Technologies

2

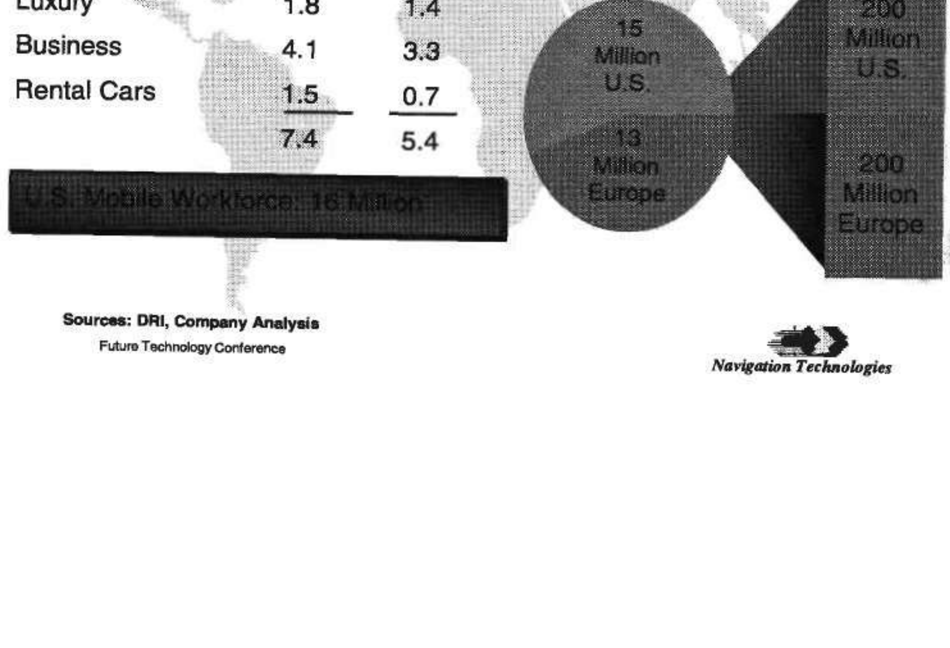
Where Are We Going?

- The Market
  - What's driving it?
  - Potential
  - Projections
- Future Systems
  - Increased functionality
  - System integration
  - Warning and Control Technologies

3

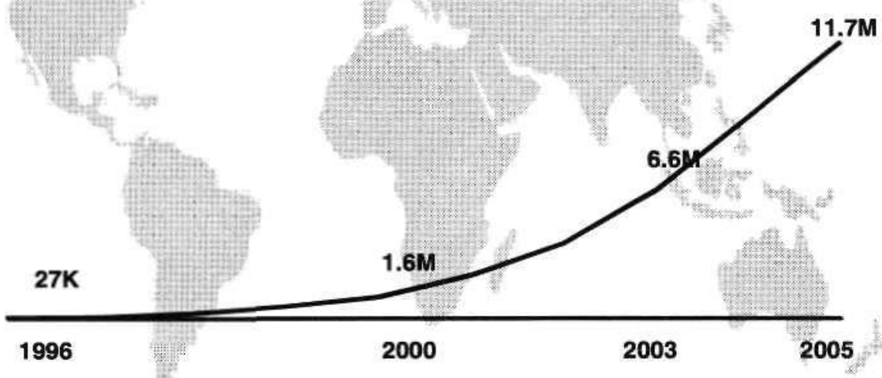

Market Drivers
Available Technology
Increasing Affordability
Expanding Features
Business and Consumer Demand
Productivity
Personal Security
Convenience
Reduced Stress
Future Technology Conference
Navigation Technologies

4


Huge Market Potential
Likely Early Buyers
Annual Vehicle Sales
U.S.
Europe
(Millions)
Luxury 1.8 1.4
Business 4.1 3.3
Rental Cars 1.5 0.7
7.4 5.4
U.S. Mobile Workforce: 16 Million
1996 Annual New Vehicle Sales
Vehicles in Use
15 Million U.S.
13 Million Europe
200 Million U.S.
200 Million Europe
Sources: DRI, Company Analysis
Future Technology Conference
Navigation Technologies

Navigation Market Tomorrow

Initial Unit Sales in U.S. and Europe

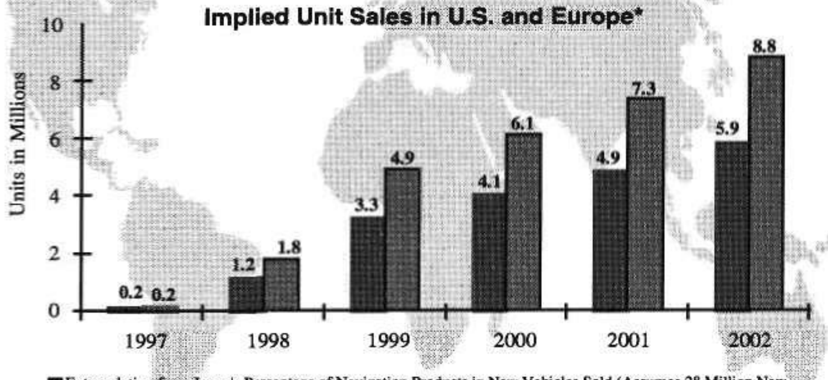


Source: NavTech Analysis

Navigation Technologies

Route Guidance Product Market Estimates

Implied Unit Sales in U.S. and Europe*

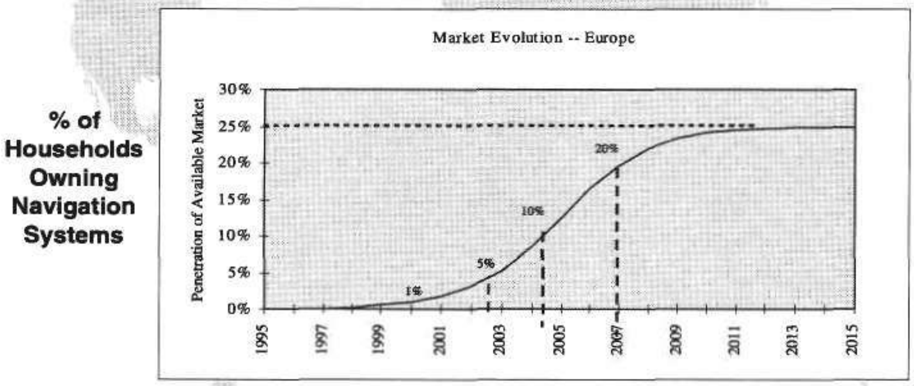


- Extrapolation from Japan's Percentage of Navigation Products in New Vehicles Sold (Assumes 28 Million New Vehicles Each Year)
- Extrapolation from Japan's Percentage of Total Vehicles in Market Carrying Navigation Products (Assumes 400 million Total Vehicles)

*Assumes 1994 for Route Guidance Products in Japan is comparable to 1997 in U.S.

Navigation Technologies

Projected Product Adoption Curves for Navigation Systems-Europe

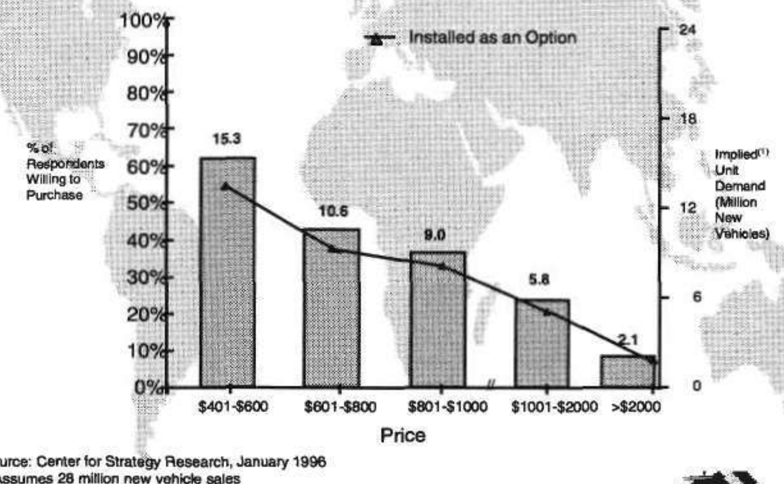


NOTE: 25% household penetration in Europe corresponds to a somewhat higher penetration of vehicle population.

Navigation Technologies

Price Matters

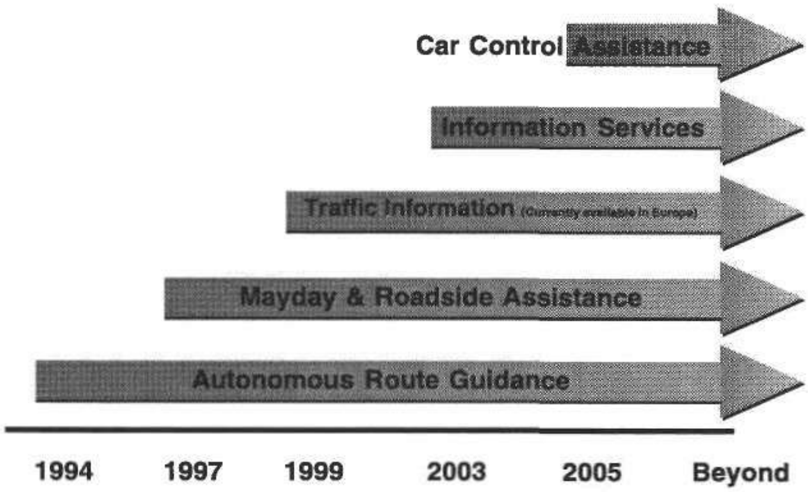
Demand Analysis for Route Guidance Products: U.S. and Europe



Source: Center for Strategy Research, January 1996
(1)Assumes 28 million new vehicle sales

Navigation Technologies

Expansion of System Functionality



Integration on the Horizon

- First Generation of:
  - Route Guidance Product
  - Mayday System
  - Traffic Information Reporting

  are available but unconnected...

Next generation of products will integrate Route Guidance, Mayday, and Traffic Reporting

Future Possibilities for Integrated In-Vehicle System

- Route guidance system can serve as platform for other services:
  - "Office in the Car" / "Dashboard Desktop"
  - Voice mail / E-mail
  - Access documents from office or Internet
  - Conduct business transactions
  - Send/receive faxes
  - Entertainment facilities for backseat

Future Vehicle Warning & Control Systems

- Adaptive Cruise Control
- Fuel Economy Assistance
- Headlight Direction Control
- Obstacle Warning
- Curve Warning
- Lane Following

Increases safety benefits to drivers

13

Enabling Vehicle Warning & Control Systems

- Original thinking required expensive, complicated sensors
  - Video cameras
  - Visual frame analysis
  - Infra-red sensing devices
- Cheaper, less external approach is to use *an accurate map database as a sensor*

14

The Future

- Global navigation market is growing
- System functionality is increasing

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

The Market Of GPS Navigation

Fabrizio Righetti
Manager of Marketing and Sales
Magnetic Marelli TECmobility

Fabrizio Righetti is the Manager of Marketing and Sales and of Business Development and Product Development of TEC*mobility*, the business unit of Magneti Marelli in charge of the development of telematic technologies, namely car navigation systems, locating systems and software for mapping information and route calculation. Previously he worked in the International Activities Department of the Fiat Holding Company, with specific responsibilities for the development of business of the Fiat Group in Japan, Taiwan and former USSR.

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*TEC*mobility

*TEC*mobility is a Business Unit of Magneti Marelli constituted in 1994 for the development of telematic technologies for traffic and transport

TEC mobility

Main Product Lines

- car navigation system
  - stand alone
  - integrated in fleet management systems
  - integrated with traffic control systems, anti-theft and emergency systems
- mapping information and route calculation software for PC
- Location unit for emergency, anti-theft, fleet management systems
- off-board navigation

TEC mobility

The market of GPS navigation

GPS Navigation products

- Turn-by-turn navigation systems
- Routing systems
- Location systems

Turn-by-turn navigation systems competitors

- Alpine
- Bosch Blaupunkt
- Philips
- Magneti Marelli Tecmobility

Competition

Our competitors are consumer electronic companies. They have established their name on audio-video, not software and they are used to work on proprietary OS

Standardization

Several companies are trying to establish their own format as the standard format: Blaupunkt, Navigation technologies, Naviken

These standards works on car navigation systems only: dedicated hw platform installed in the car

Vision

There is the need to develop products on standards that are already available and not limited to car navigation only

We need to integrate different functions in the same HW architecture, not just sharing the same MMI

Products Road Map

Car dedicated Products	PC Connected Products		
RPNAV100	Sensor box	Home Planner	Off-board
RPNAV200	AutoPc		

TEC mobility

Needs

Navigation	Emergency
Traffic information	Car diagnostic and interior
Communication	Car control
Office Productivity	Rear camera view
Multimedia	Anti-theft
News	Telepayment

TEC mobility

RPNAV Family

PC board	Voice messages
Rate-gyro	CD-ROM
Odometer connection	Infrared remote control
GPS receiver	LCD Monitor

MAGNETI MARELLI TEC mobility

Home Planner & Sensor Box

Home Planner code name: a Windows compatible navigation and information software for home and office PC

RP sensor box code name: μcontroller board for sensor data processing (GPS, rate-gyro, odometer connection)

Home Planner & Sensor Box

Turn-by turn navigation performed by a standard portable PC

MAGNETI MARELLI TEC mobility

AUTO PC

The PC into the car: the integration of different functions in the same hardware

Integrates radio & audio functions, navigation,entertainment, connectivity and safety functions

Targeting DIN form factor

MAGNETI MARELLI TEC mobility

Capabilities and functionalities

	RPNAV	HP&SB	AUTO PC
Navigation	Yes	Yes	Yes
Traffic information	Yes[1]	Yes[1]	Yes
Communication	No	No	Yes
Office Productivity	No	No[2]	Yes
Multimedia	No	No[2]	Yes
News	No	No[2]	Yes

[1]: WITH AN OPTIONAL HW &SW ADD-ON
[2]: ACHIEVABLE VIA SW ON PC

MAGNETI MARELLI TEC mobility

Capabilities and functionalities

	RPNAV	HP&SB	AUTO PC
Emergency	Yes [1]	Yes [3]	Yes
Car diagnostic	No	No	Yes
Car control	No	No	Yes
Rear camera view	Yes [1]	No	Yes
Anti-theft	Yes [1]	No	Yes
Telepayment	No	No	Yes

[1]: WITH AN OPTIONAL HW &SW ADD-ON
[3]: WITH SW ADD-ON

TEC mobility

Criticalities

- The car environment has requirements not yet completely addressed by the manufacturers of PC components
- Speech recognition is not yet ready for a noisy and multilanguage environment
- Production cost is a key factor
- System stability (hw & sw)

TEC mobility

Criticalities

- Human I/O interface and security issues
- Standardization of external information
- Status of service providers and infrastructures

TEC mobility

Conclusions

- The AutoPc is the platform for connectivity of the cars of the future
- The technology is not yet ready as well as the infrastructures and service providers
- The goal is to find a viable approach to implement the PC technology into the car following the specifications of the car makers

TEC mobility

Connecting For Growth—'Internetivity' And The Semiconductor Industry

Instant Location Information Using GPS Technology

Kanwar Chadha
Vice President, Marketing
SiRF Technology

Kanwar Chadha is a founder and Vice President of Marketing at SiRF Technology, Inc. He has over 13 years of experience in various marketing management positions. Prior to founding SiRF, he served as Director of Strategic Marketing at S3 Inc. and started the multimedia group at the company. As General Manager of the multimedia group, he led the development of innovative audio and video processing technologies. Before joining S3, Kanwar was the Chairman and co-founder of AQuesT, Inc., a developer of multimedia and 3D graphics acceleration products. From 1983 to 1989, he was at Intel in various product marketing positions. As the product line manager for the i860 RISC processor and floating point coprocessors, he developed the coprocessor business into one of more than $100 million. Kanwar holds a B.S.E.E. from the Indian Institute of Technology, New Delhi, and an M.S. in CIS from the University of Pennsylvania. He also has an MBA from the Wharton School of Business, University of Pennsylvania, Philadelphia.

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands

SiRF

Instant Location Information
using
GPS Technology

GPS & Wireless Innovations

SiRF

Instant Location Information

Knowing instantly

where you are

or

where anyone or anything else is

GPS & Wireless Innovations

Global Positioning System (GPS)

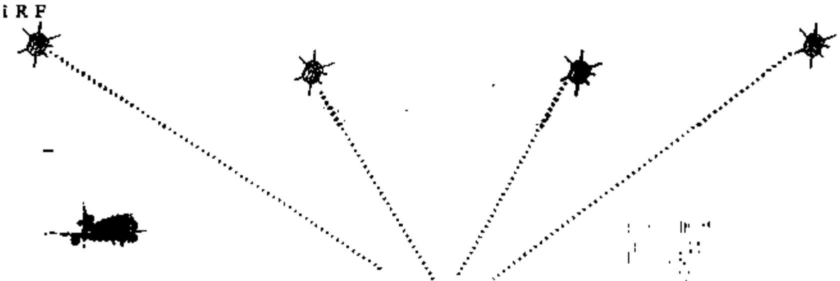
A Technology that provides

Instant Location Information

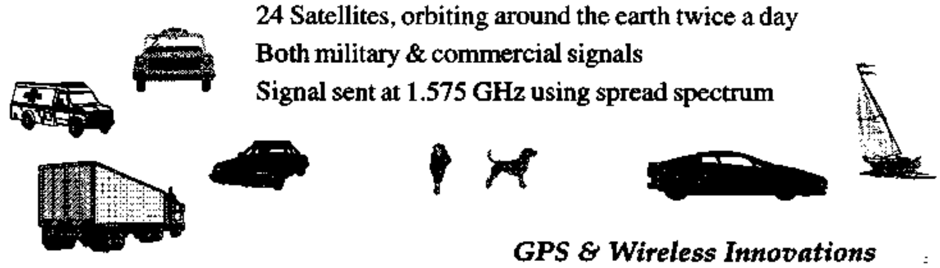
Any where in the world
At any time of the day
For free!!!

GPS & Wireless Innovations

GPS



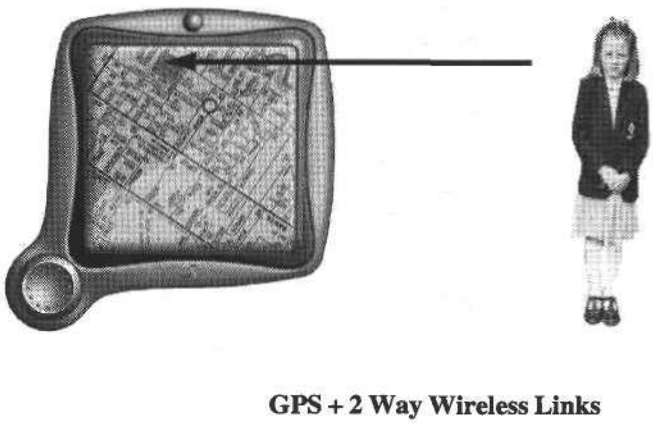
- US government developed and funded
- 24 Satellites, orbiting around the earth twice a day
- Both military & commercial signals
- Signal sent at 1.575 GHz using spread spectrum



GPS & Wireless Innovations

Instant Location Information Applications

Helping Loved Ones

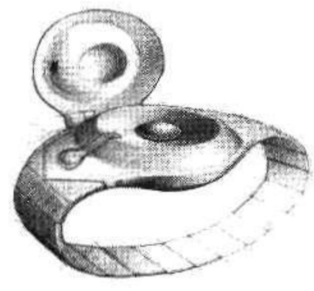


Personal Locator

Panic Button

GPS + 2 Way Wireless Links

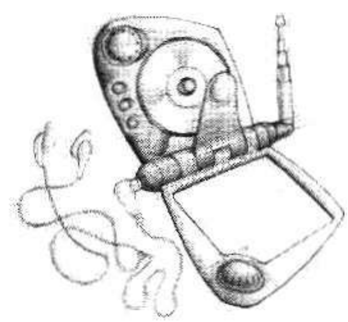
Asset Location & Location Locks



GPS or GPS + Wireless

GPS & Wireless Innovations

Finding Your Way Around

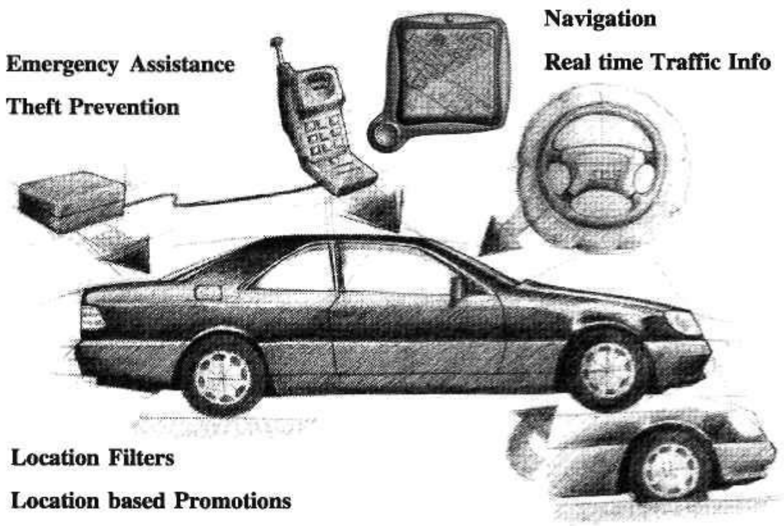


"Navman"

PDA + GPS

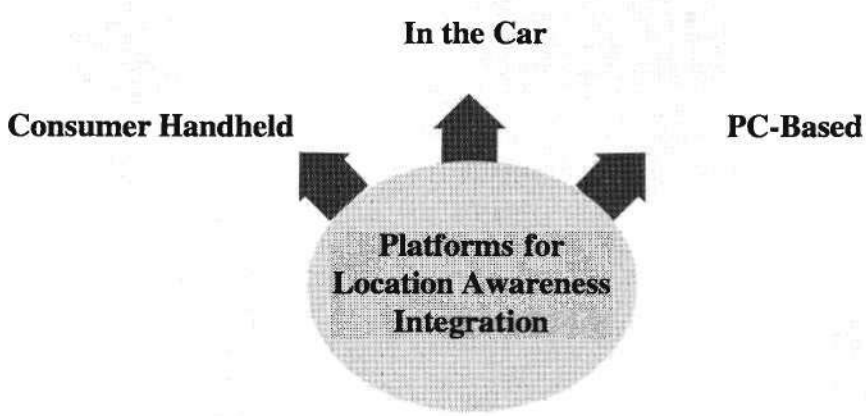
GPS & Wireless Innovations

Linking Auto to Information Highway



GPS & Wireless Innovations

Instant Location Information Platforms



GPS & Wireless Innovations

Instant Location Information in Cars

- Navigation with "Destination Databases"
  - Digital mapping infrastructure
  - "Electronic Yellow Pages"
  - Internet for real time data bases access

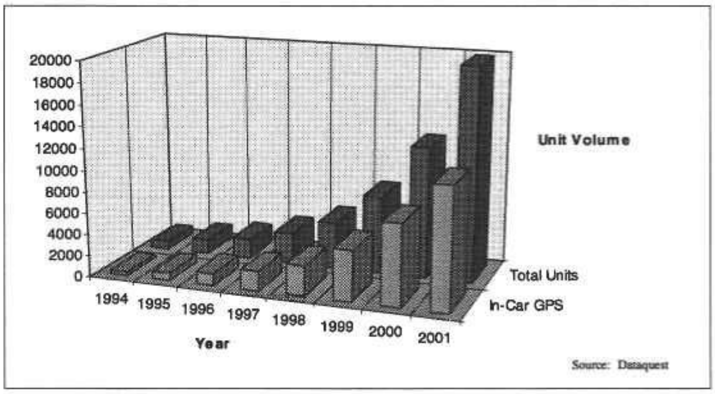
- Real-time routing with Telematics
  - Real-time traffic information infrastructure
  - Digital data and services across cellular

- Emergency response, security and tracking with wireless links
  - Emergency response infrastructure: 911/SOS.........
  - Wireless link infrastructure: Cellular, Radio.......
  - Link to car safety & security system: Airbags, engine control ......

GPS in Cars

- Navigation, Telematics, Tracking, Emergency response.....
- Car navigation market is the largest volume, today
  - 1996 volume of ~800 KU; most of the volume is after-market
  - Significant move towards integrating GPS into future cars
  - Japan has more than 70% of the market: Focus on Entertainment-Navigation systems
- Telematics picking up with digital cellular and real time traffic information infrastructure
  - Germany and Japan leading the way
- Emergency Response driving US market
  - High price ($1500+) reducing car navigation system penetration
- Fleet tracking & management with GPS gaining popularity

GPS Market



Market in its Infancy Stage with High Growth Potential

GPS & Wireless Innovations

SiRF Strategy

Exploit the consumer GPS potential by enabling a range of products with Instant Location Information

SiRFstar™ GPS Architecture

GPS & Wireless Innovations

SiRF

- Company formed in February 1995
  - A fabless silicon and software company based in silicon valley
- First GPS product-line announced in Q4'96
- GPS, spread-spectrum, silicon and RF expertise
  - Pioneers in GPS and spread-spectrum development
  - Multiple GPS receiver designs developed by team members
  - Advanced R&D contracts from Airforce & Navy
- Experienced management team
  - Founding team has done multiple start-ups
  - Management team has understanding of both PC and GPS markets
- Raised $12.5 million in funding so far

GPS & Wireless Innovations

SiRFstarI GPS Solution

- SiRFstar GRF1
  - Highly integrated GPS RF front-end
  - Eliminates the need for expensive components: TCXOs & SAW filters
- SiRFstar GSP1
  - Hard-wired parallel processor for GPS signal processing
  - Flexible interface to multiple CPUs and memories
- SiRFstar GSW1
  - Complete GPS software
  - Modular and portable
  - Enables layered application integration

GPS & Wireless Innovations

Barriers to Mainstream GPS Acceptance

Expensive
- High-end system business model; Vertical market focus

"Not a stand-alone" solution
- Need integration in to existing platforms
- Need wireless link for tracking

Market perception
- Too complex : "Black Magic"
- Niche applications

GPS & Wireless Innovations

SiRF Strategy

Cost effective solutions
- PC market business model

Easy integration
- Chip-set with modular software

Easy to design
- Complete cook book solutions

GPS & Wireless Innovations

GPS Technical Barriers

Limited "Availability" due to obstructions

- Buildings in metropolitan areas
- Tunnels, over-pass bridges
- Foliage in suburbs, rural areas, forests etc.

SiRFstar Solution

Solving the "Urban Canyon" availability problem

- 100 ms SnapLock feature re-acquires satellites in-between buildings and at intersections: 10-20 times faster than existing products
- SingleSat mode allows position updates with a single satellite

Solving the availability under foliage problem

- FoliageLock capability acquires and track signals even in dense foliage as weak as 5% of its original strength

Providing fast start-up

- 20 ms first satellite code search gets rapid position fix
- <10 sec hot start

GPS Technical Barriers

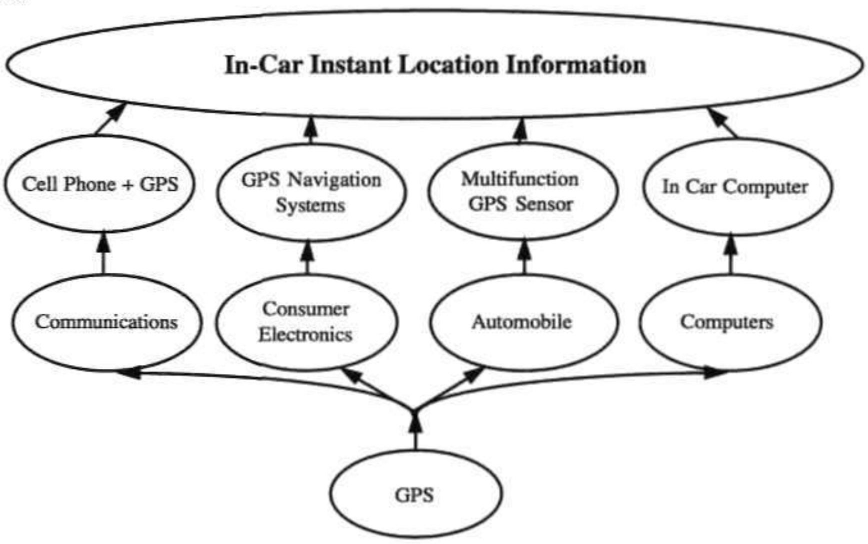
Accuracy problem

- Multipath can introduce significant errors
- Selective Availability (SA) degrades the signal to 100 meters

Improving accuracy

- SiRFstar "Dual multipath rejection" scheme
- Differential GPS support for better accuracy
- 12 simultaneous channels use more satellite data for accuracy
- US government committed to removing SA

SiRF Vision



Connecting For Growth—
'Internetivity' And The Semiconductor Industry

CONNECTING THE INTERACTIVE CONSUMER VIA MULTIMEDIA

Chairman: Paul O'Donovan

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Nokia Mediamaster—Bringing Interactive Services To The End-User

Ari Nieminen
Assistant Vice President, Business Development
Nokia Multimedia Network Terminals

Ari Nieminen joined Nokia in 1988 as an R&D Manager. In 1992, he moved from R&D into Product Management and from there to Business Development in 1995. He sees the introduction of Multimedia Terminals as a major opportunity for Nokia to help the service providers to go into value-added service provision. Ari has a Ph.D. in Information Science, was expatriated in 1991 and has since worked in France and Germany before his move to Sweden.

Dataquest—A Gartner Group Company
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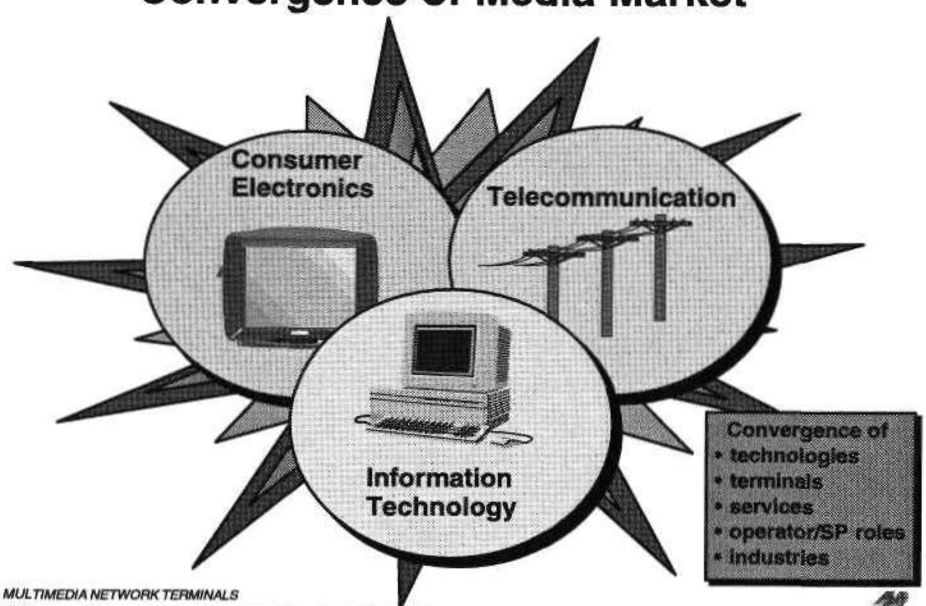
Nokia Mediamaster
Bringing Interactive Services To The End-User

Assistant Vice President, Business Development

Nokia Multimedia Network Terminals

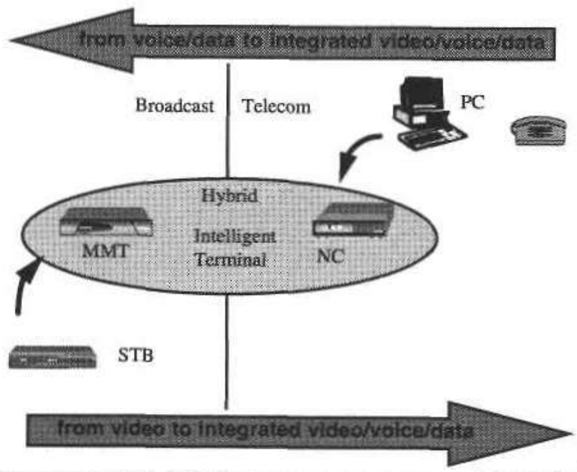
Ari Nieminen

Convergence of Media Market

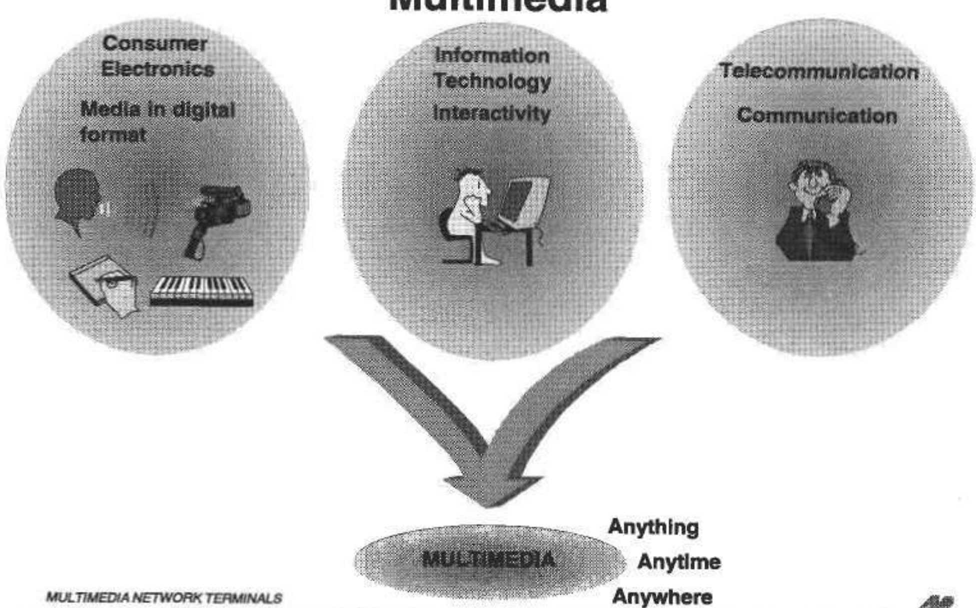


Telecom-Datacom and Broadcast Convergence

Both the industries will offer similar services
- convergence of terminal concepts
- optimal access to a given service and user segment



Multimedia



Content & Services
Segmentation

SOHO
- private administration
- home banking
- home office applications

Home Steering
- appliances monitoring & controls
- security/burglar alarms

Shopping
- home shopping
- travel booking
- reservation services
- interactive advertising

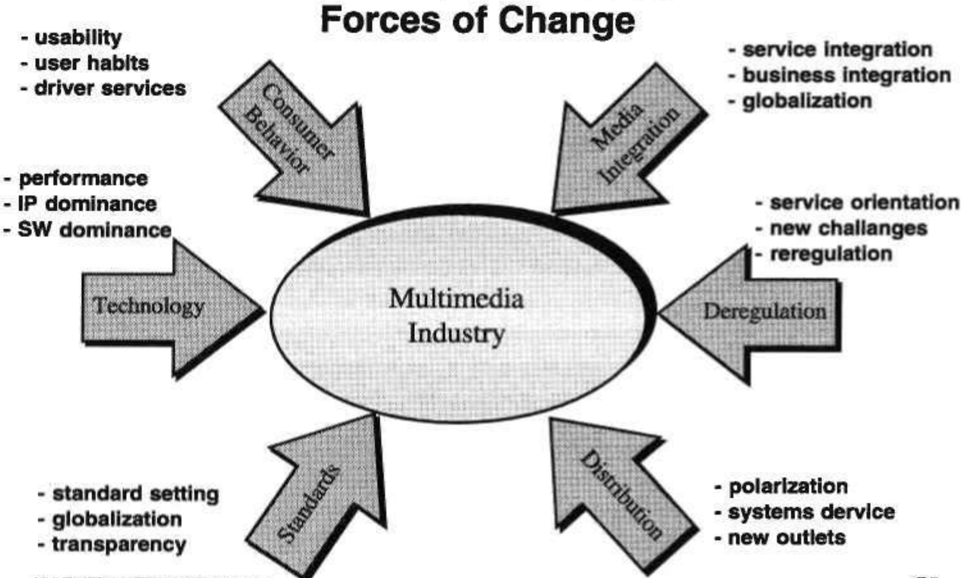
Education
- courses/programs
- private coaching
- continuous education

Communication
- e-mail
- video telephone
- video conferencing
- greetings/family messages

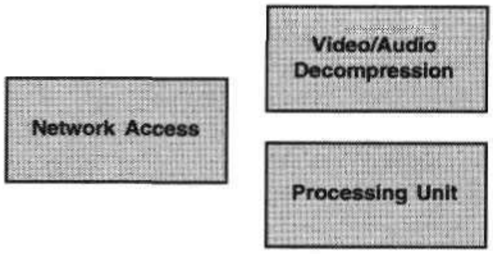
Entertainment
- games
- movies/videos
- novels/magazines
- game shows
- interactive sports
- virtual reality
- gambling

Information
- data bases/info access & services
- local/regional/national info
- health care applications
- subscribtion services

Multimedia Industry
Forces of Change

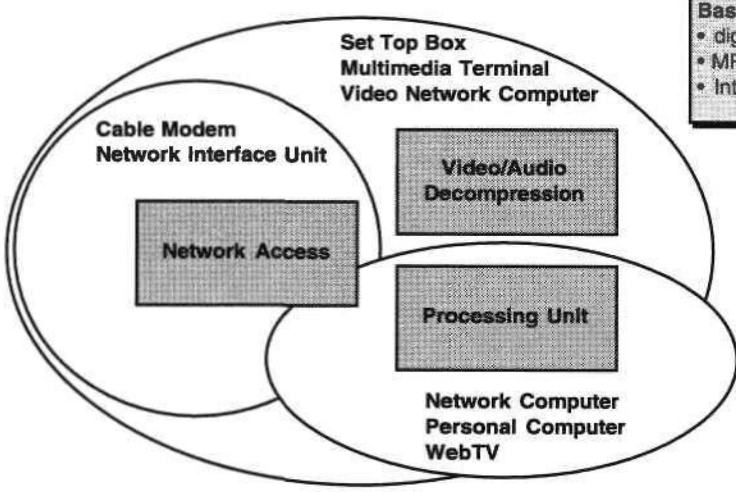


A Simple Terminal Concept

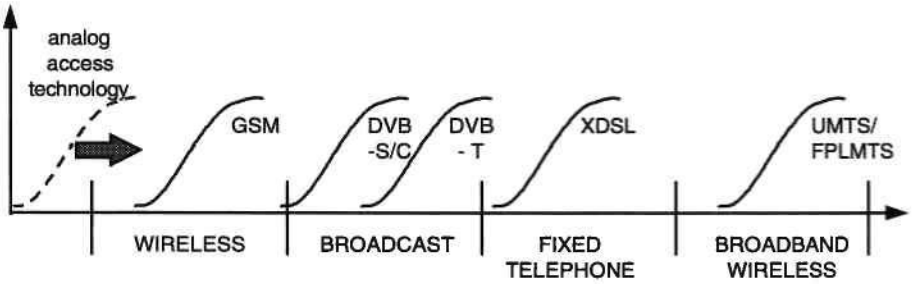


New Terminals

Basic Technologies
- digital modulation
- MPEG2
- Internet

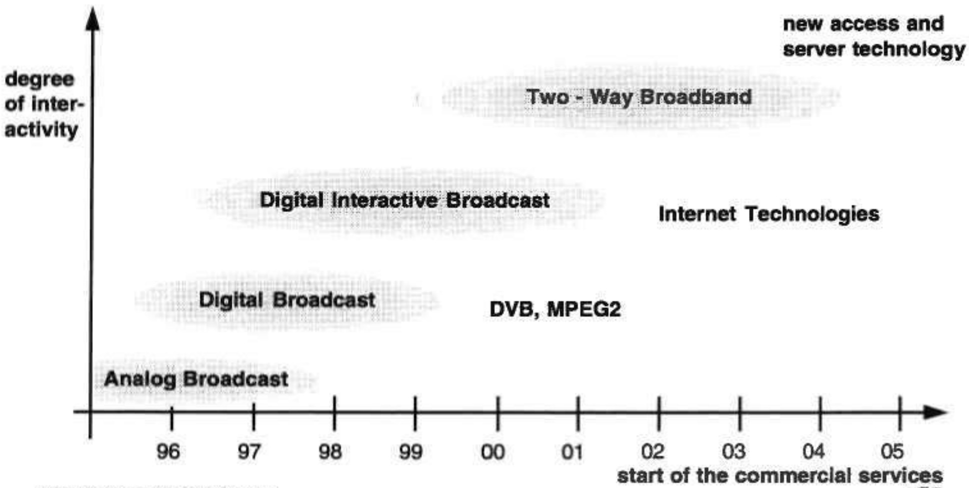


Connecting People - Access Technology Waves

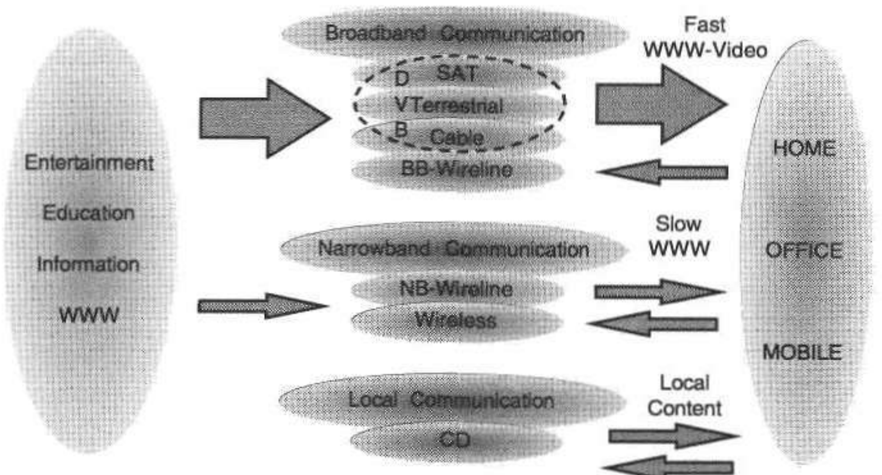


Transition from analog to digital access technologies happening for any distribution method

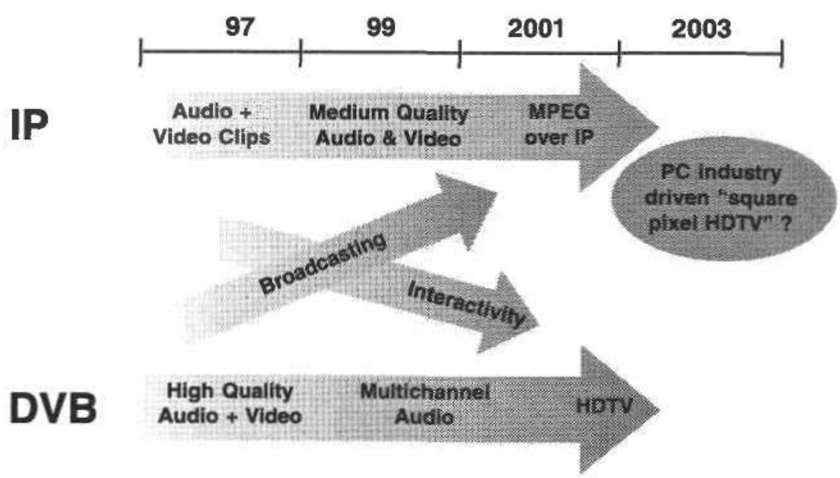
Digital System Evolution



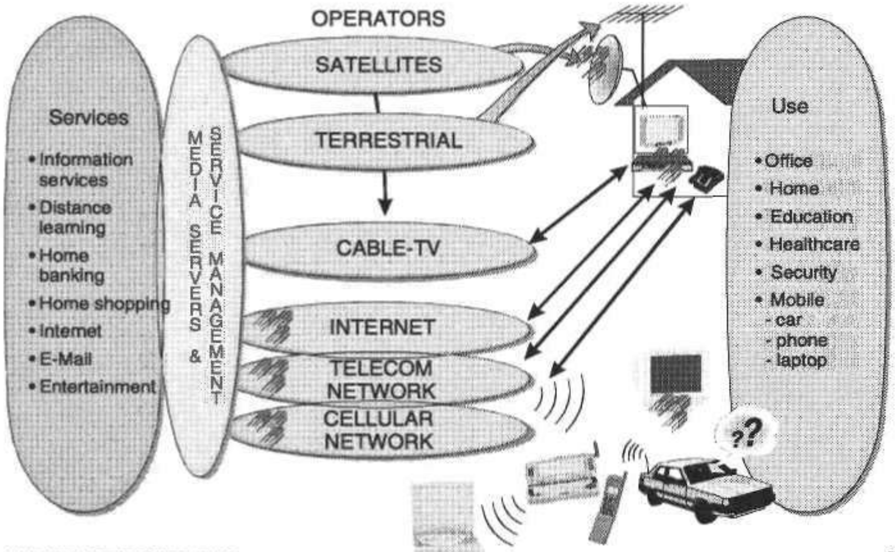
Network Centric Market



Interactivity/Video Roadmap



Nokia and interactive multimedia



MULTIMEDIA NETWORK TERMINALS

MULTIMEDIA NETWORK TERMINALS

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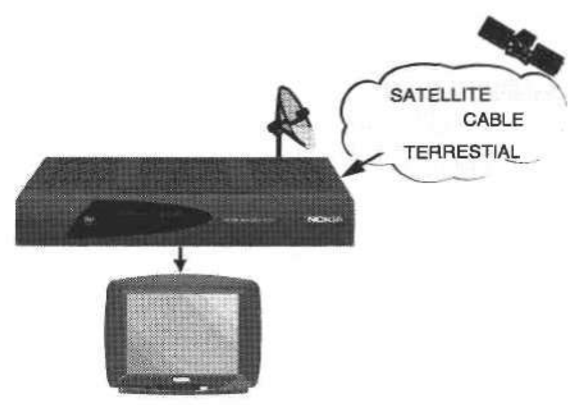
NOKIA

Digital Set-Top-Box Becomes ...

MORE CAPACITY



MULTIMEDIA NETWORK TERMINALS

MULTIMEDIA NETWORK TERMINALS

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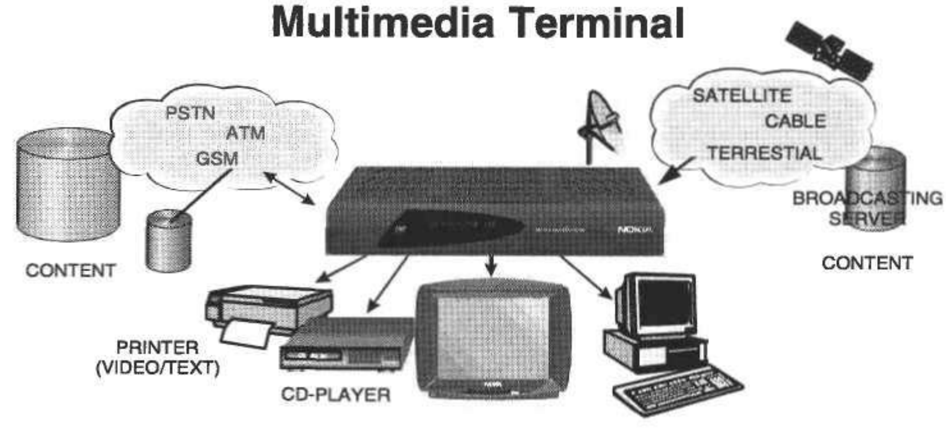
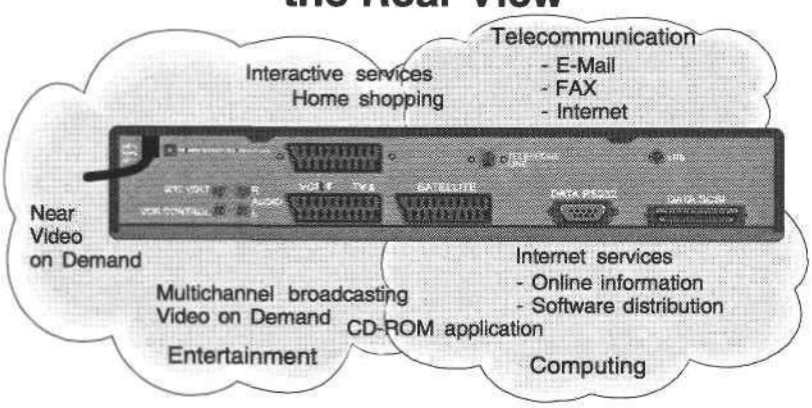
NOKIA

Multimedia Terminal



MORE CAPACITY | MORE INTERACTIVITY | MORE CONNECTIONS

Multimedia Terminal, the Rear View



MULTIMEDIA TERMINAL
Integration of telecommunication, computing and entertainment
Nokia brings multimedia to your livingroom

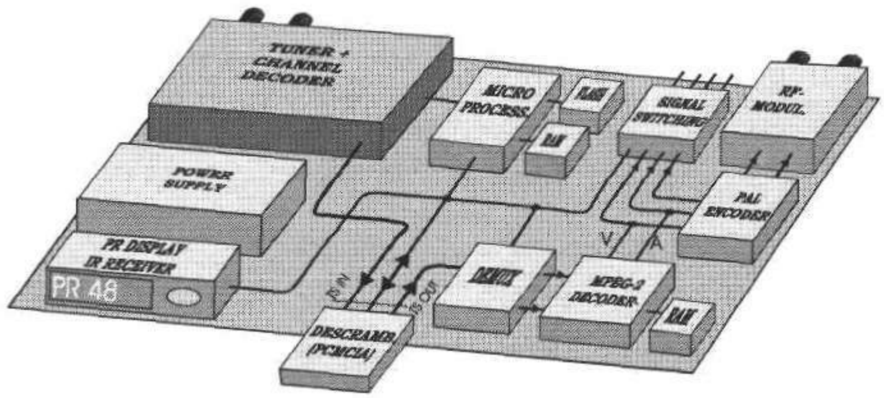
Digital TV Market in Europe 1996

- Kirch
- Telepiu
- Multichoice
- Canal+

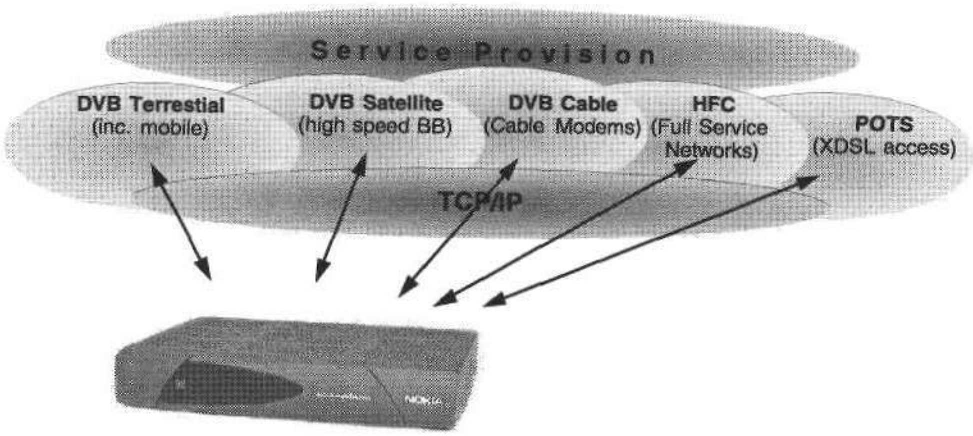
Digital TV Market in Europe 1997

- Canal+
- Kirch
- Telenor
- AB, TPS
- Premiere, DT
- Telia, Kinnevik
- BSkyB, UK cable co's
- Telefonica
- Teracom, BBC, Retevision

Digital Terminal, Block Diagram



Multimedia Terminal
Product Concept



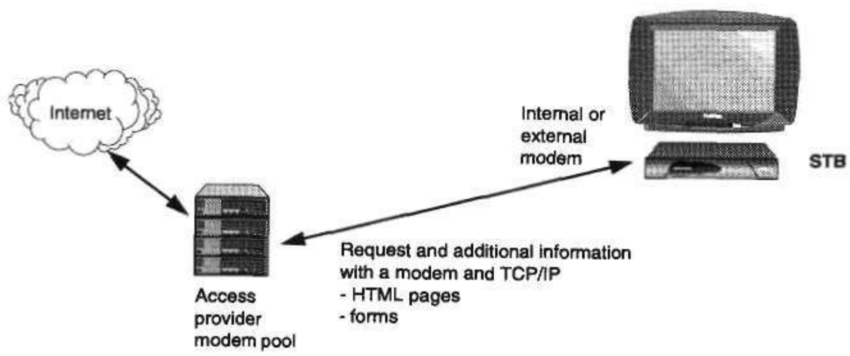
Interactive Services

- Problem
  - There is no standard (in STB world) for defining interactive application and it's requirements (HW requirements, OS system version, etc.)
  - Current downloadable applications are in proprietary format (proprietary run-time engines, proprietary authoring tools)
- Solution
  - HTML offers a standardised way to offer most of the additional services offered today in proprietary format

HTML in Interactive Services

- HTML is widely used in Internet
  - Electronic commerce
  - information sharing
  - advertising, ...
- Huge existing base of applications
- Applications easy to create and many authoring tools available
- Easy to find qualified people to create applications
- No need to create the same applications again for a different platform or media
- Does not currently directly support multimedia features, extensions and plug-ins needed

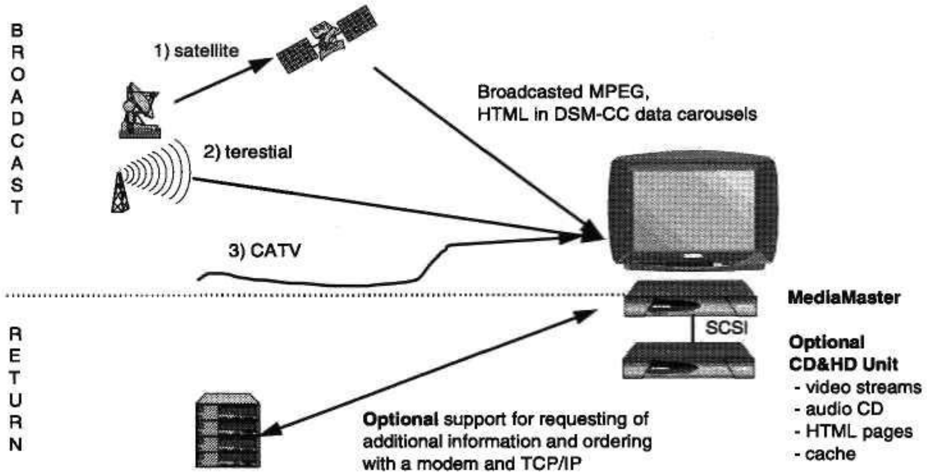
HTML for Interactive Digital TV



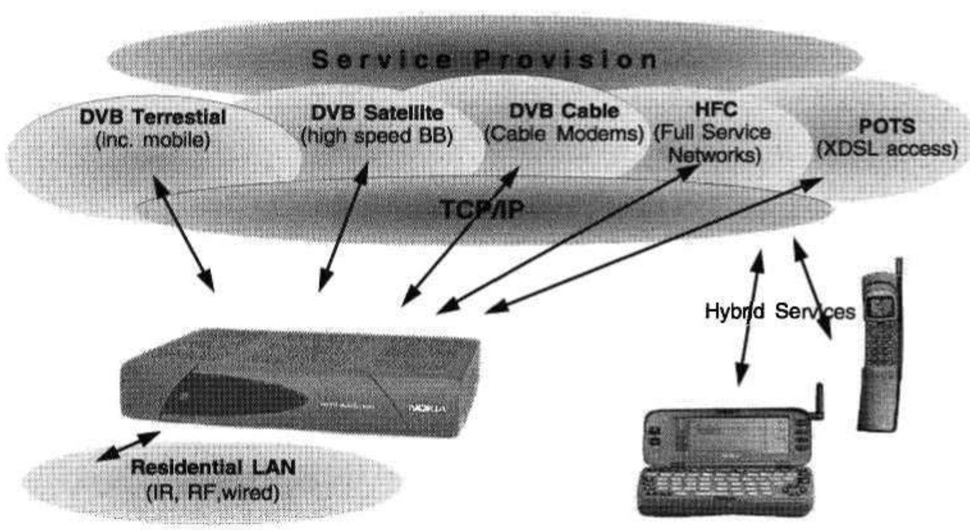
HTML for Interactive Digital TV

- Current DVB services are enhanced with HTML linking capabilities to increase interactivity
- Offers additional information together with SI data
- Offers enhanced teletext features
  - Easy moving from page to page
  - possibility to refer to services outside teletext
- Can be used for selecting the channel
- Additional information from local CD or HD, or from Internet
- Interactive subtitling for creating applications for
  - homeshopping, education, news, games, ...
- Internet access is a natural extension to DVB services

HTML for Interactive Digital TV



Terminal Interoperability



Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Providing Interactive Needs To The Consumer

Jean-Pierre Coustel
Director of France Telecom Pay TV
France Telecom

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands

France Telecom

MULTIMEDIA BY FRANCE TELECOM

Company Profile

France Telecom Télévision à Péage (Advanced Television Services) is part of the Multimedia Division of France Telecom.

The Multimedia Division has corporate authority for Television and Multimedia Services, On-Line Data Services, and Directories and Databases. Some distinctive corporate brands in these market segments are: France Telecom Cable, Wanadoo, Teletel, Viaccess, Pages Zoom.

France Telecom is the fourth largest telco worldwide, with revenues of 151.3 billion French Francs in 1996 (including b14.2 FF in multimedia), and 164 000 employed. It is the largest cable MSO in France, and a partner in several ventures in the multimedia industry, from edition to distribution, ranging from thematic TV channels to innovative developments on the communication marketplace: their potential is best represented by TPS ("La Télévision Par Satellite"), where advanced high-speed multimedia services are converging with digital television on satellite and cable.

France Télécom Advanced Television Services (FTTP) is in charge of driving the Group's actions in the area of Access Control services, and contributing to the development of multimedia applications, toward nationwide pay-TV, Pay-per-view and advanced television services. The Business Unit has especially managed the European developments based on the "VISIOPASS" Set-Top Box and the business development of the Viaccess™ Access Control system.

Providing Interactive Resources to the Consumer

Marc du Peloux
France Telecom Advanced Television Services

Presentation at the Dataquest Semiconductor Conference
May 20-21, Amsterdam

Several type of distribution systems

◊PSTN
◊Cable
◊Satellite
◊Hertzian broadcast

These systems differ on both the topological and on the economical plan

same information to everybody →satellite
advertising, local info→hertzian, cable
point-to-point→PSTN

Future Services

◊Trend toward fully transactional and interactive Services

◊The business model
All communication services will be digital
and integrated on the same broadband distribution
system

◊Dynamics generated will be shaped by the quality
of "Intermediation Resources"
inside the broadband distribution system

The Multiservices Network

◊Generalisation of Interactive Services

◊Integration on the same broadband support of all the communication services, from the narrow-band (phone) up to the broadband (television)

◊Distribution servers for approxim. 200 connected homes

◊ATM transport to the distribution servers

HFC

FTTNeighbourhood

Selected Factors of Change

◊Will of producers (movie studios and the like) to replace home video distribution with broadcast solutions

◊Ambitions of telcos to extend system capabilities from Telephony (2-way!) to television

◊Alliance policies in the video game industries

◊Policies and actions of personal computing industries in the areas of display techniques and program-software development

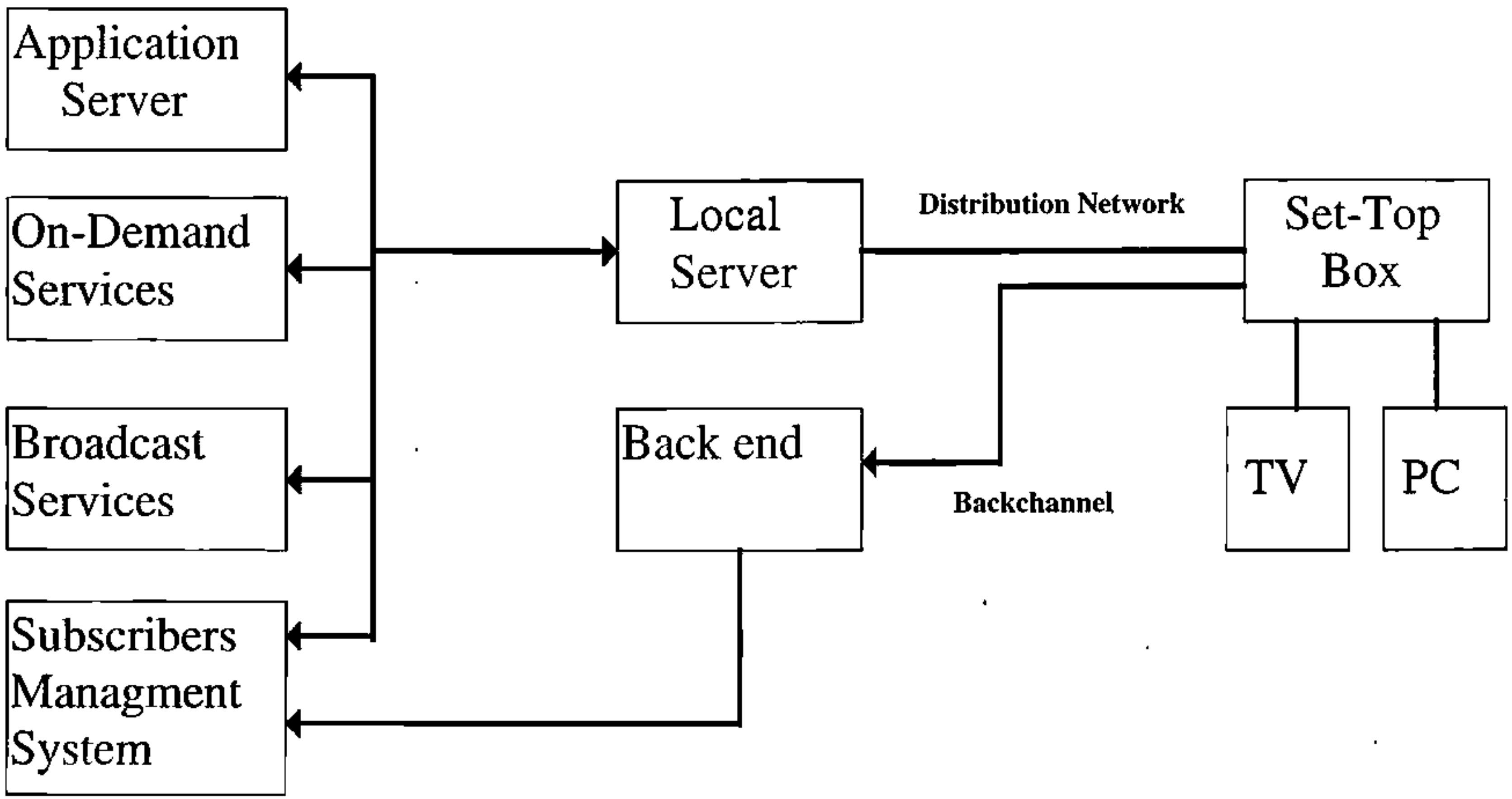
Which network solutions?

◊The right solutions

- HFC networks: "Hybrid Fiber Coax"
- FTTN networks "Fiber To The Neighbourhood"
- ADSL distribution "Asymmetric Digital Subscriber Loop" (high data throughput on phone twisted pair)

◊False good idea:
FTTH networks: "Fiber To The Home"
(all optical networks from the head-end)

Distribution System Architecture



Examples of Services

◊All services linked with TV broadcast:
Electronic Program Guide (EPG)
Teleshopping
Games
Information, Sport, Meteo,...

◊Software and games services
downloading, multi-players network

◊High Speed on-line services e.g. Internet access, via PC or TV screen

Broadband Internet Access

◊ADSL

◊Cable modem for Cable TV networks

◊Satellite :

TV decoder

PC card (e.g. DirectPC, ...)

Cable modem

◊Broadband Internet Access over Cable TV network

◊To access to the Internet through cable network

◊Several Mbit/s shared among a grape of users

◊Always « on », no dialling

◊Subscription for unlimited time connection

◊Better with servers located near the head-end

ADSL modem

◊Over PSTN

◊Throughput: up to 8 Mbit/s

◊Used for TV broadcast and high speed Internet access

◊For non-cabled area

Satellite access

◊Broadband Internet Access through geo satellite

◊The Internet requests are sent through a telephone line

◊The Internet answers (HTML pages) are broadcast through satellite, to be downloaded

◊Maximum throughput:

connected mode (TCPIP): 2 Mbit/s
non-connected mode (UDP): several Mbit/s

Network computers

◊To access to the Internet with a TV connected through a STB to PSTN network

e.g. WebTV, Netbox from NetGem

◊The network computer can be integrated in a TV decoder

◊For non computer users

Conclusion

◊Integration of interactive services originates from the digital TV decoder

◊The trend starts from TV broadcast, adds local interactivity (e.g. EPG) to full interactivity, then adds Internet navigation

◊Personal computer platforms used as STB to integrate TV failed.

Conclusion: France Telecom actions

◊Digital TV: Viaccess Conditional Access System developments in Europe and all over the world

◊Cable Modem: St Quentin '97, Metz, Marseille

◊ADSL: Noisy-le-Grand

◊Satellite: TPSnet

◊JASMIN: Interactive Services over ATM (VOD...)
ADSL in Rennes, HFC in St Quentin

Connecting For Growth—'Internetivity' And The Semiconductor Industry

Internet Access For The Consumer From The Armchair

Jan Arisse
Product Manager, WebTV
Philips Electronics NV, Sound and Vision Division

Jan Arisse is certified in Accounting, Fiscal Law, Computer Science and Management Consultancy. After working for a financial institute, an auditing firm and a trading enterprise, he joined Philips. He has experience in International Business, Strategic Planning and Business Development, Software Development, Value Added Networks and Electronic Shopping Malls and Development of Marketing Concepts. Jan has been involved in a number of "start-up" companies for the generation of new business. At this moment he is developing terminals, software and service concepts for Internet Access for the TV platform as well as interactive TV.

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16th Annual Dataquest European Conference

"Internet Access for the Consumer from the Arm Chair"

by Jan Arisse Philips Sound & Vision
Robert Bense Philips Sound & Vision

Amsterdam, 21 May 1997

16th Annual Dataquest European Conference

Thoughts about the Internet

- Internet is typically the PC world
- Barriers to broader Web use
  - Complexity of setup and access
  - Complexity / reliability of use
  - High equipment cost
  - Relevance & quality of content
  - Poor performance

16th Annual Dataquest European Conference

Concept

- Make Web surfing as simple as TV channel surfing
  - Internet Access at the press of a button
  - Attract a new, broad demographic
- Provide affordable system solutions, low entry threshold
  - Fast and unlimited communication to anyone in the world
  - Provision of most up-to-date Education, Information and Entertainment to the homes
  - Balanced combination between local news - national news
  - Very easy to install and to start, simple and intuitive navigation
- Current today, compatible tomorrow

16th Annual Dataquest European Conference

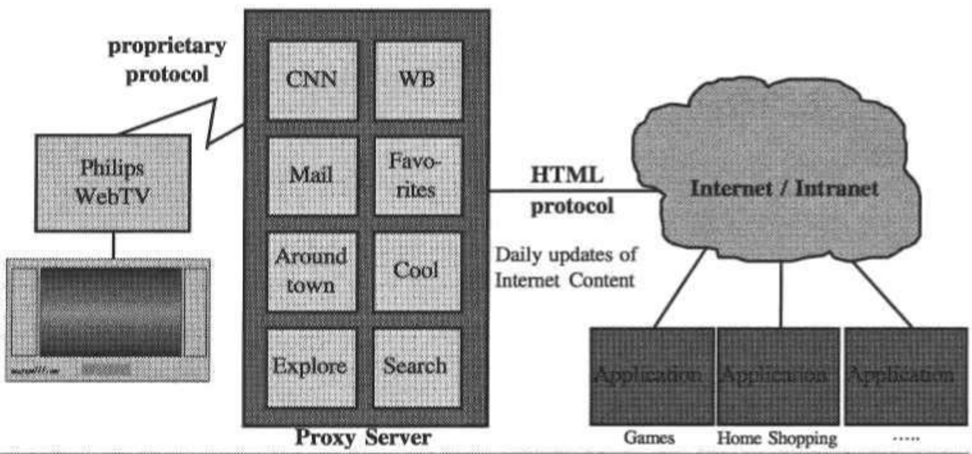
Functionality

- Everything you need to surf the Internet is all in one box with wireless remote control and infrared keyboard
- Easy hookup and connection: first Internet surfing within minutes
- Explore section with previews and categorized best Internet sites without getting lost
- Family concept, more e-mail boxes and safe for kids
- Search capabilities and visual favorites storage
- Around Town news and worldclass integrated services

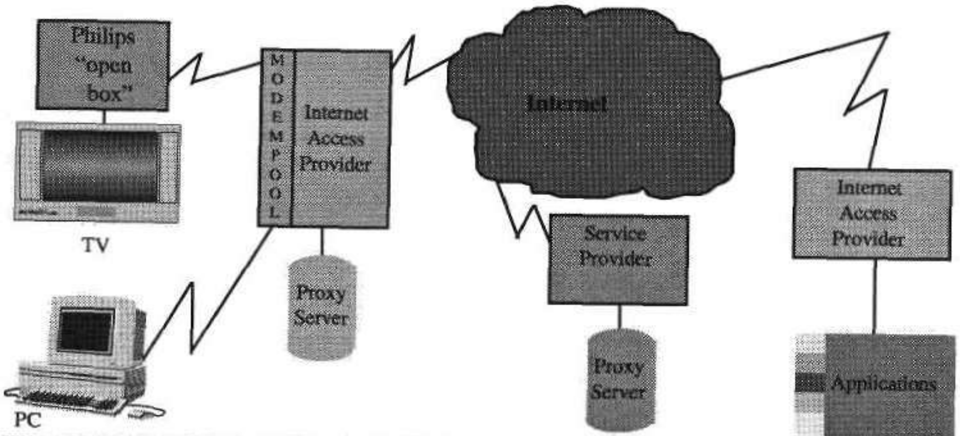
Key message

"Works anywhere where is a phone line and TV"

Service model "closed box"



Service model "open box"



Vision of the future

Question 1: Conversion of PC world and TV world or coexistance and extention of functions on the distinguised platforms ?

Question 2: Dedicated Internet appliance ?

Question 3: On demand pull model versus push model ?

Question 4: Infrastructure versus added demand (vertical applications, schools, churches, ...)

TV box could be a step in the right direction !

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

PROCESSOR SOLUTIONS FOR CONNECTIVITY

Chairman: Joe D'Elia

Dataquest—A Gartner Group Company
Dataquest European Semiconductor Industry Conference
May 20-21, 1997
Amsterdam, The Netherlands

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Connecting With Embedded Devices

Robin Saxby
Chairman, President and CEO
Advanced RISC Machines (ARM) Ltd

Robin Saxby is Chairman, President and CEO of Advanced RISC Machines' world-wide operations. He joined the company from the ASIC manufacturer, European Silicon Structures (ES2), where he was Vice President of Northern Europe, Managing Director of ES2 Ltd and President of its American sister company - US2. He was with ES2 for five years. Prior to ES2, he was the CEO of Henderson Security Systems and before that Robin, now 50, spent 11 years with Motorola Semiconductors in various sales, marketing and engineering management positions. The early part of his career was in design and development at Philips and the Rank Organisation. He holds a degree in Electronics from Liverpool University. Besides directing ARM, Robin is also the Chairman of the ESPRIT OMI (Open Microprocessor Systems Initiative) Advisory Group, a board member of the Belgian Sirius Communications and an advisor to Oxford Parallel.

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Connecting with Embedded Devices

Robin Saxby

President & CEO

email: rsaxby@arm.com

http: www.arm.com

Introducing ARM

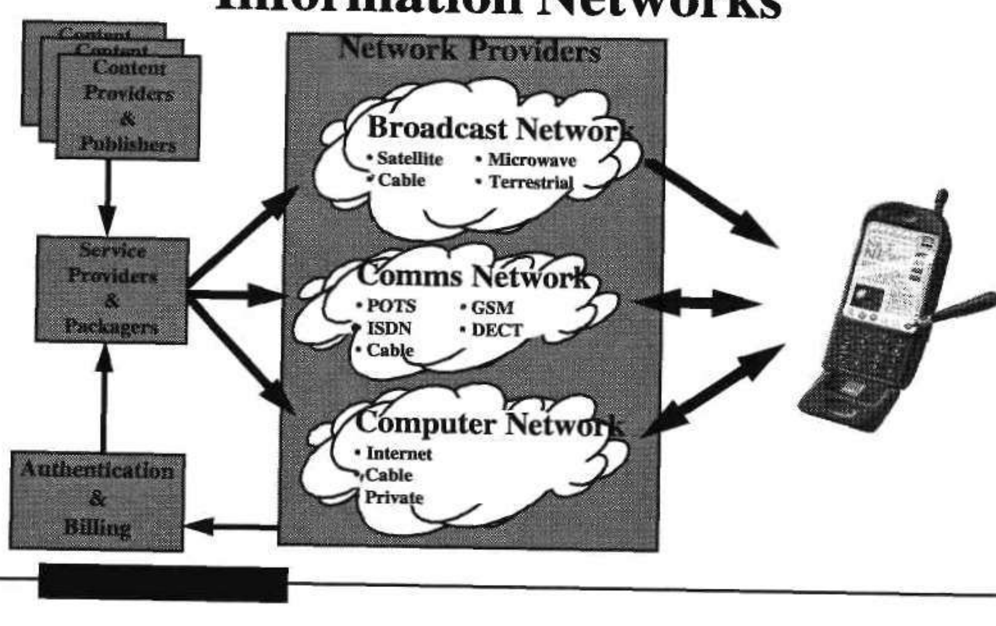
"To become the Global Volume Embedded RISC Processor Standard"

- **Intellectual Property Licensing Business Model**
  - Build Partnerships with
    - Semiconductor Companies
    - Software Companies
    - EDA & Tools Companies
    - System Manufacturers

What are we talking about today?

.. the convergence of Consumer Electronics, Computing & Communications

Information Networks



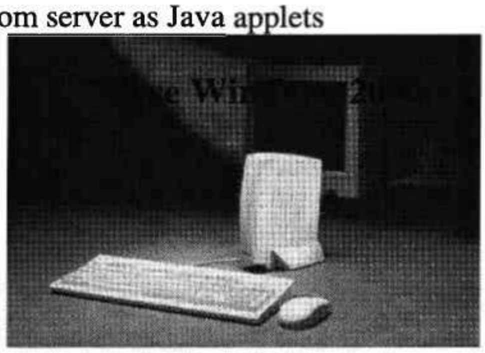
Connection on the Move

- **Personal Digital Assistant**
  - Contact Database/Organiser
  - Email
  - Internet Browser
  - Fax
  - 160MHz StrongARM processor
- **Connection**
  - Wireless (GSM)
  - Ethernet
  - IR

Apple Newton 2000

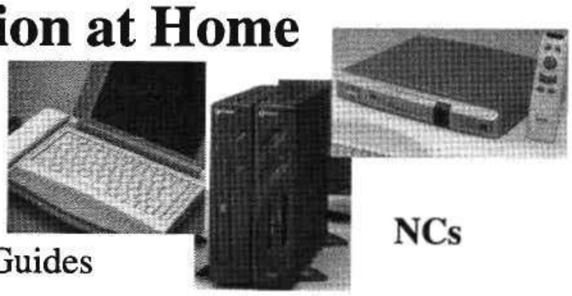
Connection at Work

- **Network Computer**
  - JavaOS Terminal connected to a Windows NT server
  - All the functions of a PC
    - Applications downloaded from server as Java applets
  - Fraction of the Cost
    - Purchase price
    - Maintenance costs
- **Connection**
  - Ethernet
  - ISDN



Connection at Home

- **Digital Television**
  - MPEG2 Video
  - Pay per view
  - Electronic Program Guides
  - Downloadable Applications & Games
  - Internet Browser
- **Connection**
  - Terrestrial, Satellite, Cable
  - POTS, ISDN



NCs

SHARP Interactive TV

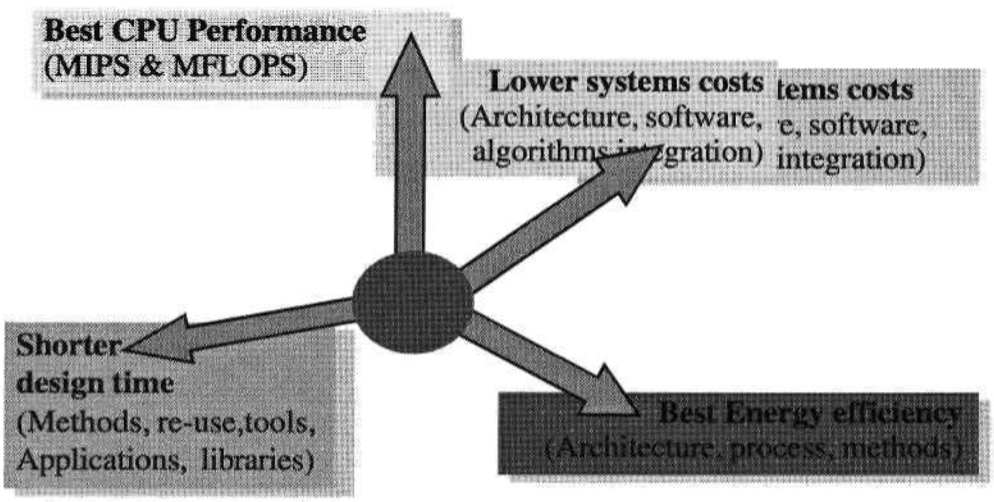
The Demands of Embedded Connectivity

- **Very High performance processors**
  - Pentium class and above
- **At very low costs**
  - 1/10th of the cost of the Pentium Class processors
  - Low power < 1 watt
- **High Levels of Integration**
  - Wide variety of peripherals to match application
  - AMBA on-chip bus

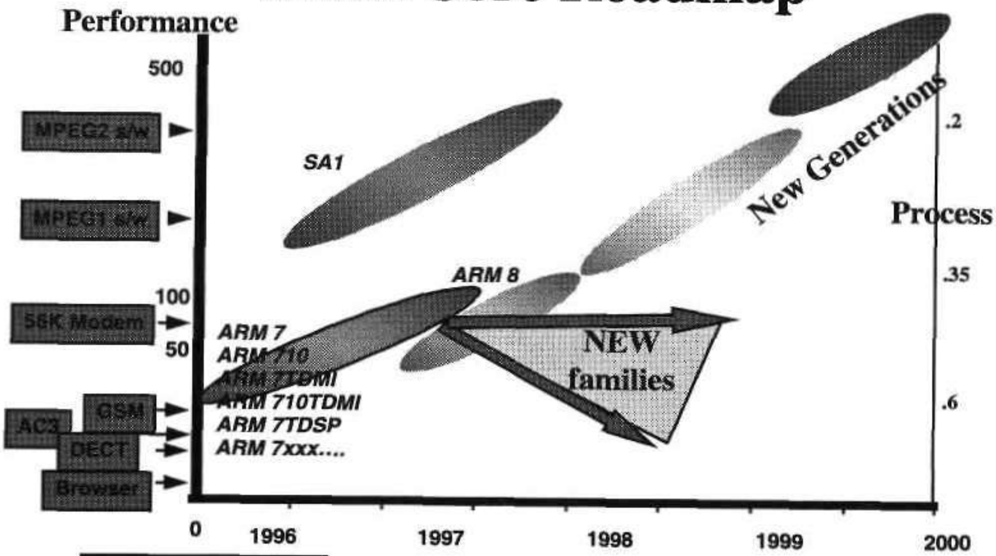
Reducing Cost

- **Using processor performance instead of silicon**
  - Soft Modems, Soft Surround Sound, Soft MPEG decode
- **High Levels of integration**
  - Single chip solutions
- **Reducing development times**
  - Fast Efficient Tools
  - On-chip bus methodologies
  - Methodologies for the re-use of IP
  - Virtual Socket Interface

ARM Technology Thrust

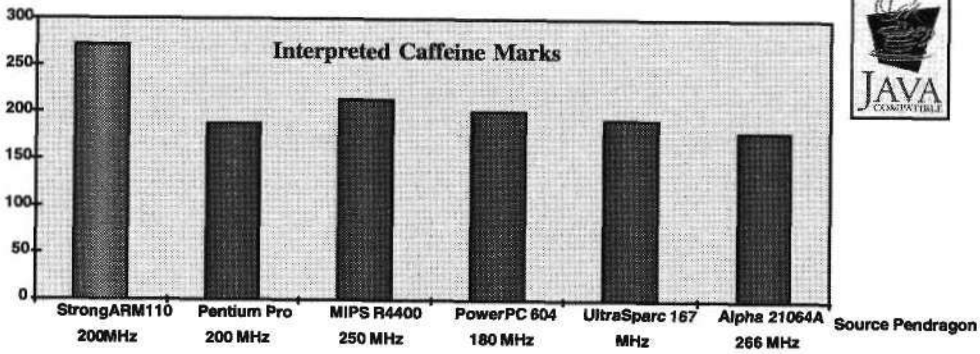


ARM Core Roadmap



JAVA Performance

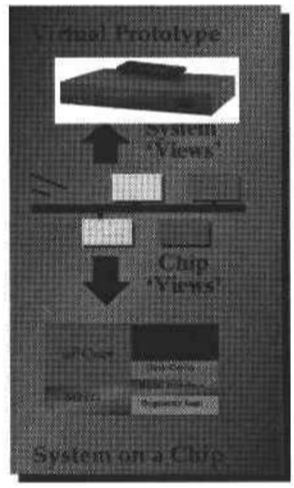
- ARM architecture well suited for running interpreted languages



- Just In Time Compiler Available Q4 1997

Virtual Socket Interface Alliance

- **EDA, IP, Semi, & Systems Cos:**
  - » Accelerate standards
  - » More efficient integration & design
  - » Grow the market for IC's, tools & IP
  - » Reduce development cost
  - » Shorten design cycle time
- **Status**
  - » 120+ members, charter working groups
  - » http://www.vsi.org



VSI Alliance™

ARM Partnership

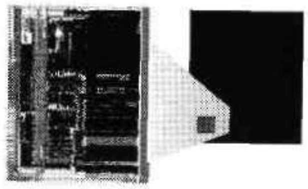
OS

Tools & Dev Systems

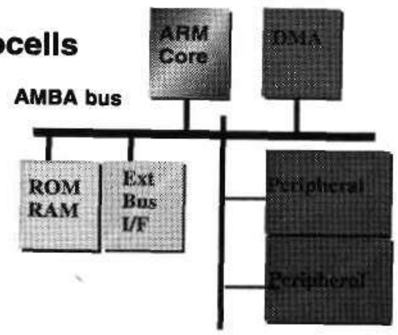
Design Services

App. Sware

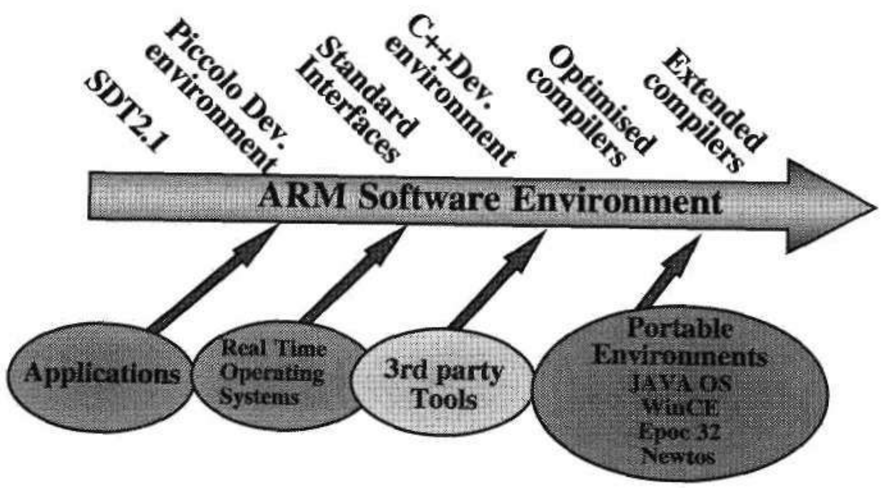
AMBA Bus Enables Silicon Systems



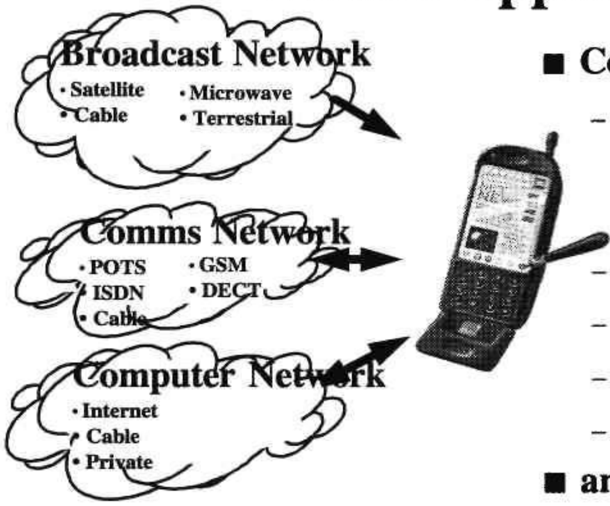
- Easy interconnection of macrocells
- Optimises system power
- Simplifies reuse
- Eases testing
- Proven in real customer apps.
- Reduces time to market



Software Strategies



Future Applications



- **Connect all three networks**
  - Digital TV
    - » offers 60-90Mbps download rates
  - Videoconferencing
  - Organiser
  - Communicator
  - Information Appliance
- **and make it mobile!**

Future Processor Requirements

- **500 - 750 MIP Performance**
  - MPEG2 in software
  - All protocol handling for Broadcast, Comms and computer networks
- **200mW power consumption at max performance**
- **> 0.1micron process**

Conclusion

- **ARM is designing Microprocessors that will**
  - have the performance to do most functions in software
    - » MPEG2 / JPEG
    - » 56K / Cable Modems
    - » GSM / DECT
  - can be easily integrated into a single chip to reduce cost
  - is powered from batteries for portable applications
- **Above all - high performance at low cost**
- **Low cost portable info appliances will emerge**

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Java™—The Answer For Connectivity

Peter Harverson
Director and General Manager
Sun Microelectronics (SME) Europe

Peter Harverson, Director and General Manager of Sun Microelectronics (SME) Europe, is responsible for Sun microprocessors, chipsets, modules, boards and technology licenses. The SME portfolio includes SPARC (TM) processors, SPARC board level products along with Java (TM) core and chip products. Mr Harverson joined Sun in August 1994 having previously spent 4 years as European Vice President and General Manager of Cadence Design Systems, growing Cadence to the leading design automation software supplier in Europe. Between 1985 and 1990 he was a Vice President within Daisy Systems Corporation, now Intergraph. Prior to that, he spent 7 years at Intel—2 years as European Major Accounts Manager in Brussels and then as UK Regional Manager. Before this, he was with Texas Instruments and The Plessey Company after initially training as an electronics engineer with AEI Telecommunications Group. Peter is a Senior Industrial Fellow of DeMontfort University.

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SUN MICROELECTRONICS

Java™- The Answer for Connectivity

Peter Harverson
Dataquest Semiconductor Conference
21 May 1997

AGENDA

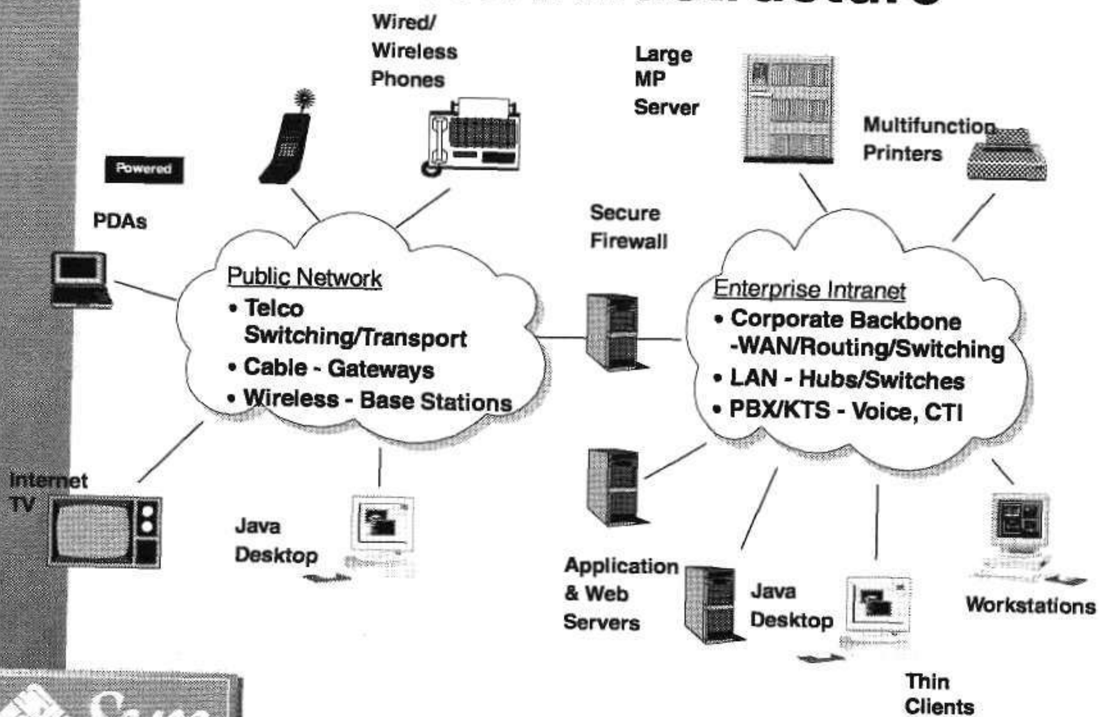
- The Networked World
- Java - The Platform
- Java - Applications
- JavaChips™ - Implementation

Fast Changing Computing World

- Demand for Zero/Low Maintenance Clients
- Network Bandwidth
- Scaleable Server Cost/Performance
- Demand for Network Centric Languages
- Growth of Networked Embedded Applications

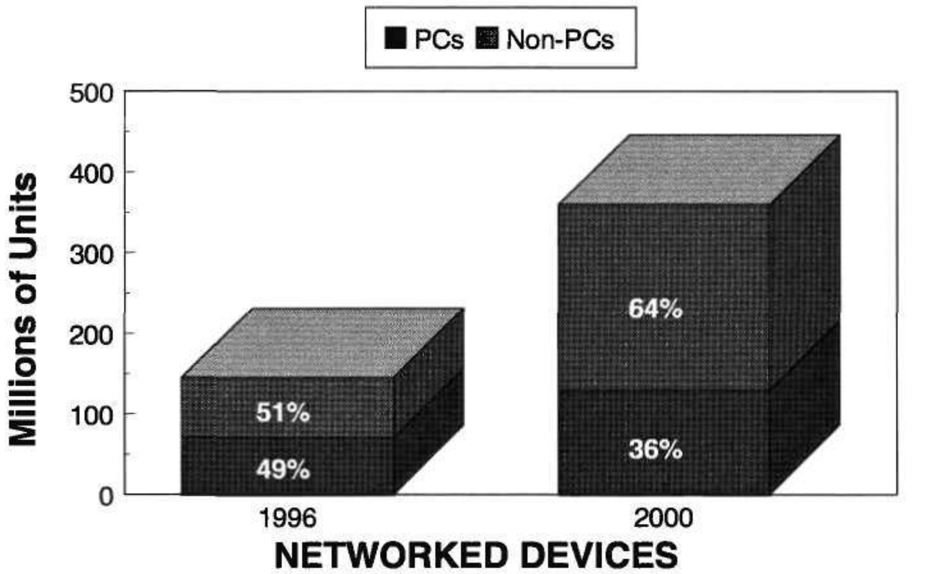
Sun microsystems

New Network Infrastructure



Sun microsystems

Expansion of Net-Centric World



Total Worldwide Shipments
Data compiled from IDC, Dataquest

Software Development Challenge

- Re-useable Code
- Platform Independence
- Application Security
- Networked - Distributed Applications
- Robustness

Java Language is Compelling

- **Compile & Run**
  - No compile-link-load-test-crash-debug cycle
- **Simple**
  - No pointers, memory management
- **Robust and Secure**
  - Strong typing, extensive checking, exception handling
- **Extensible, Reusable Code**
  - Consistent object-oriented approach
- **Scaleable**
  - Built-in multithreading, networking
- **Widely Supported**

Java is Pervasive!

- **400,000 Java Developers**
- **300,000 Downloads of JDK1.1 in March 1997**
- **162 Universities Teaching Java - Many as First Language**
- **150 Java Books**
- **9,000 Java Developers Attended JavaOne in San Francisco**
- **Applications**
  - Corel
  - Lotus
  - IBM
- **Tools**
  - Symantec, SunSoft, Borland, Microsoft

Sun microsystems SUN MICROELECTRONICS

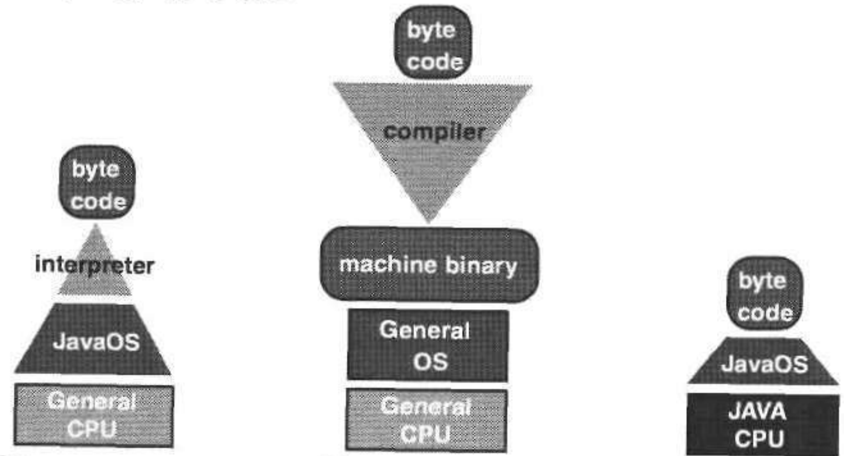
Virtual Machine: Revolutionary

- **Simple Stack-based Architecture**
- **Easily Implemented On Top of Any Hardware/OS**
- **Programs Compiled for the Virtual Machine ("byte codes") are:**
  - **Platform-independent ("Write once ...")**
    - Single Source
  - **Location-independent ("... Run Anywhere")**
    - Semantically rich "byte codes" can be verified upon download
    - Dynamic run-time binding
    - Compact code
    - Distributed support

Java APIs and Libraries

- **Required in Addition to the Virtual Machine**
- **Create the Interface to Application Programs**
- **Make Java Technology Useful, Useable**
- **Configurable to the Different Requirements of Different Sorts of Programs**
- **API's for**
  - Media, Enterprise, Commerce, Security, Management, Embedded, Java Beans, Servlet, Telephony
- **Libraries for**
  - Media, Connect, Commerce, Crypto (security)

Three Alternatives for Executing Java Code

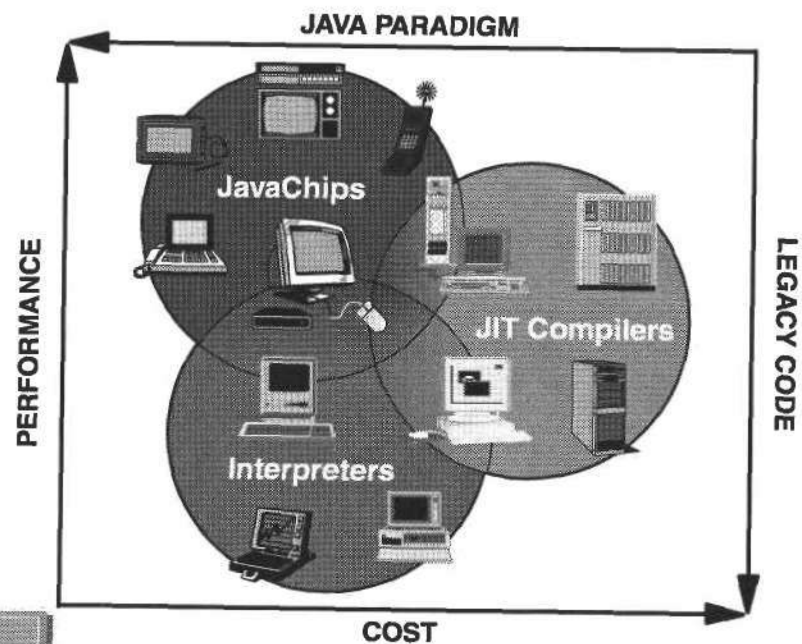


① **Interpreted**
Optimized JVM

② **Compiled**
Transform the byte-code into a machine binary
- Statically
- Dynamically (JIT)

③ **Direct Execution**
Transform the CPU into a byte-code execution engine

Java Execution Alternatives



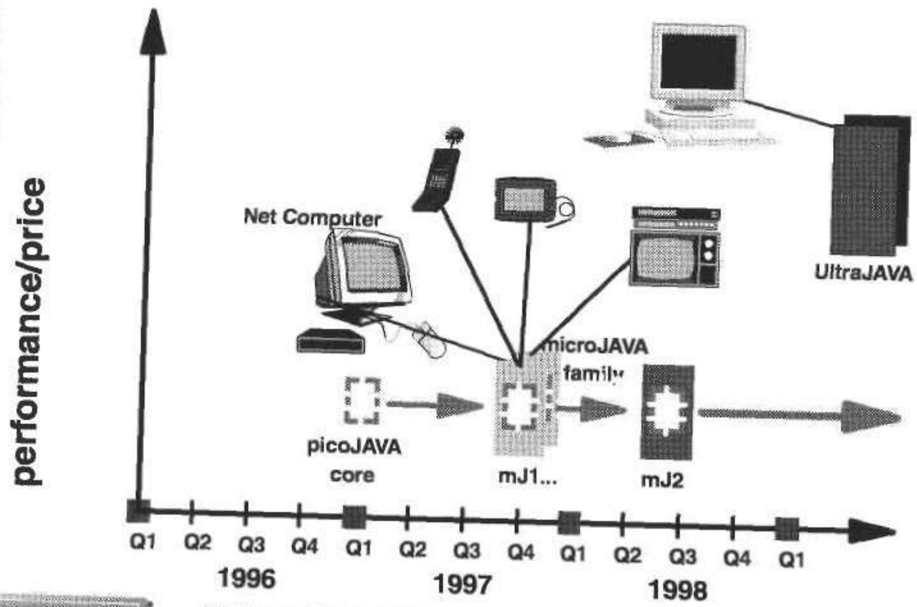
Benefits of JavaChips™

- **Optimized CPU Design for Java Code/Java Virtual Machine**
  - Specialized hardware support for run-time environment
  - No "overhead" blocks for legacy code (e.g., MMU/TLB)
- **Minimum 2X Performance Advantage at Same MHz**
  - vs. any JIT compiler
  - More vs. any interpreter
- **Reduced System Costs**
  - Less Software (no Interpreter/JIT compiler)
  - Less Memory (no expansion from byte code to native code)
- **Maximum Reliability/Security**
  - No intervention (interpreter/JIT) between byte codes and hardware

Where Are JavaChips™ Useful?

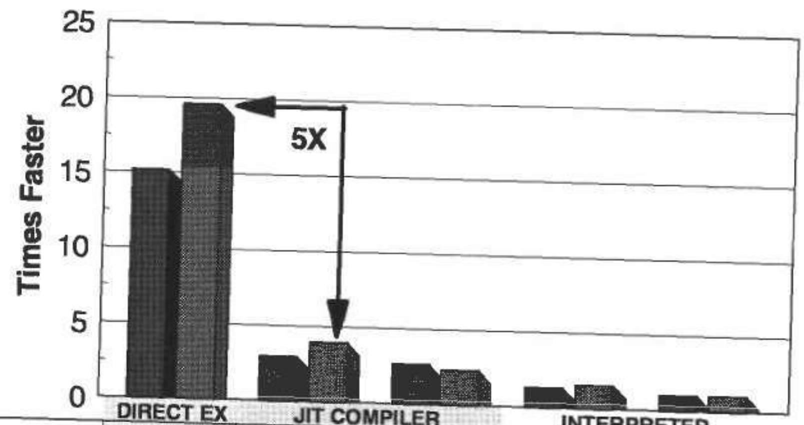
- **Optimized for Java Code**
  - Intended for Applications Where Efficiency at Executing Java Code Dominants
- **Targeted to Inexpensive "Thin Clients"**
  - Networked Devices
    - Natural environment for Java code
  - Where Interpreters are Too Slow
    - JavaChips also may be cheaper
  - Where JITs are Too Costly
    - JavaChips also may be faster
  - Great for NCs, Many Embedded Devices
    - Including Internet TVs, GPSs, Screen Phones, PDAs, etc.

JavaChips™ Roadmap



All dates are for production (FCS)

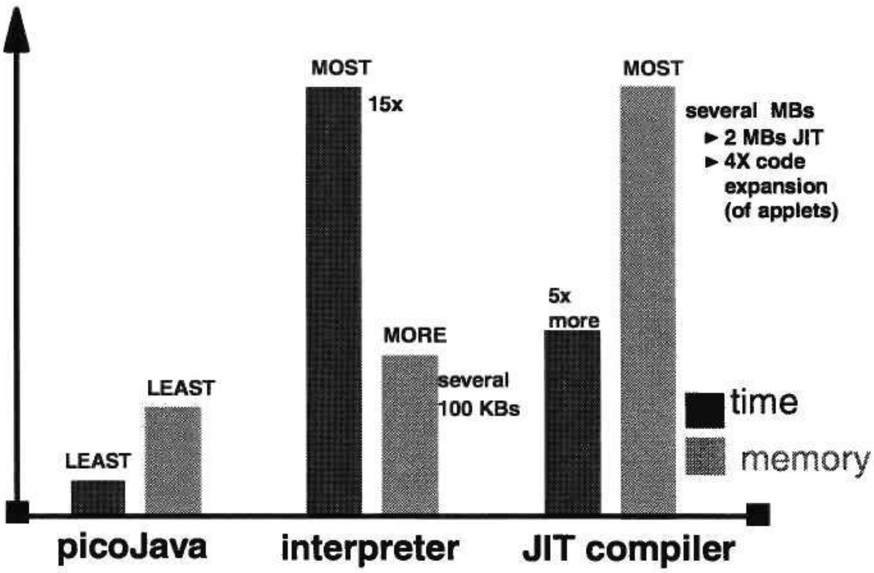
picoJava I Performance



	DIRECT EX	JIT COMPILER		INTERPRETER	
	picoJava I	Pentium	486	Pentium	486
JAVAC	15.2	2.9	2.6	1.3	1.0
RAYTRACER	19.6	3.9	2.3	1.5	1.0

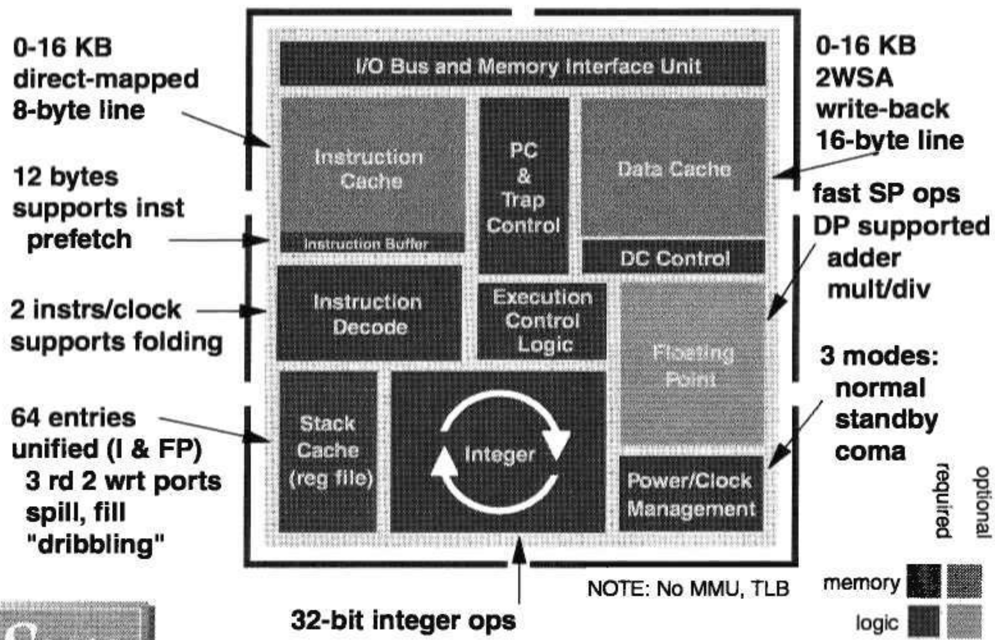
All comparisons at the same frequency (100 MHz)

Running Java



comparison running Java code only

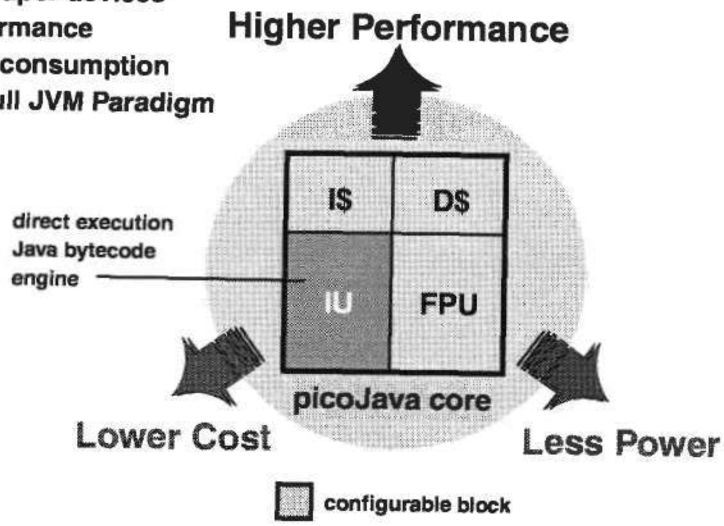
picoJava I Architecture



picoJava flexibilty

SME picoJava Technology enables a new range of Java-based devices:

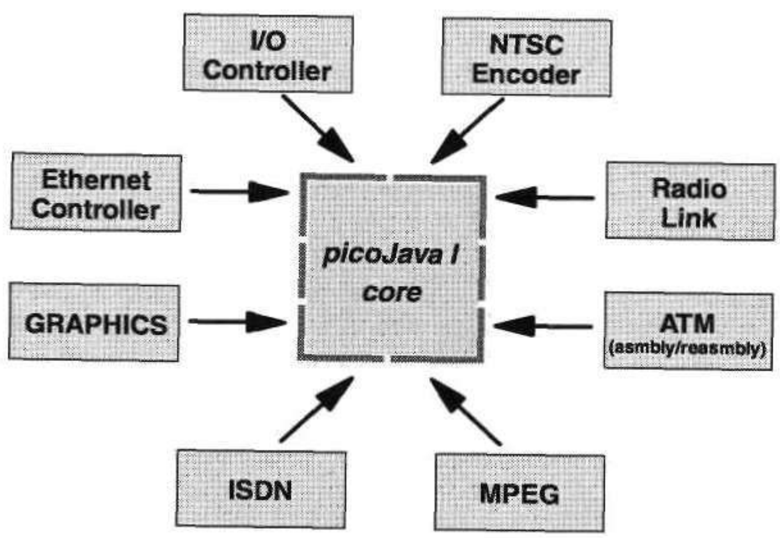
- Smaller, cheaper devices
- Better performance
- Less power consumption
- Preserves full JVM Paradigm



Sun microsystems

SUN MICROELECTRONICS

Some Possible Integrations



Add application-specific:
- I/O
- Memory
- Control Functions

Sun microsystems

SUN MICROELECTRONICS

Summary

- Network Bandwidth will be Free and not a Barrier to Connectivity
- Requirement for Lower Cost, Higher Performance Connected Devices Redefines the Partition between Client and Server
- Java - the Language Designed for Connected Applications - Write Once, Run on any Platform
- JavaChips™ provides the Cost Effective Solution for Running Java Applications

Connecting For Growth—
'Internetivity' And The Semiconductor Industry

Microprocessors For Networked Computing

Steve Poole
Director, European Operations
Intel Corporation (UK) Ltd

Steve has been in the semiconductor industry since 1974, gaining experience in American, European and Japanese semiconductor sales organisations. Steve joined Intel in 1982, and became responsible for all UK sales and service activities in 1984, Assistant General Manager of Europe with responsibility for sales and marketing activities in 1987, and Director and General Manager of Europe in 1991. In 1992, Steve was appointed Vice President Sales and General Manager Europe and held this position until 1997 when, prompted by family health problems, he stepped down from the General Manager role. Today, Steve is Director of European Operations for Intel, having responsibility for F&A, IT Customer Services/Logistics, Customer Support, Legal and Security. Steve graduated in Electronic Engineering from Birmingham, UK in 1971.

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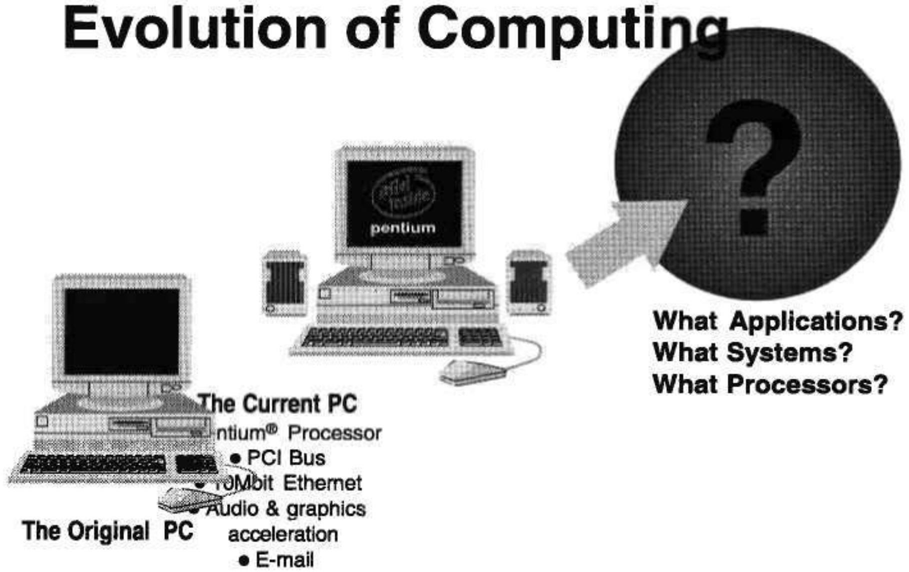
Microprocessors for Networked Computing

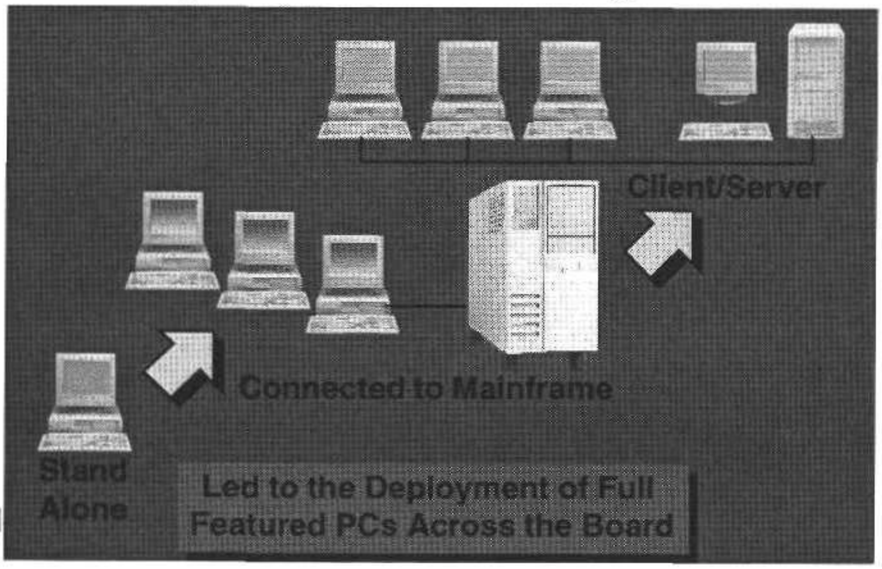
Steve Poole
Director of Operations
Intel EMEA

May 21 1997

Evolution of Computing

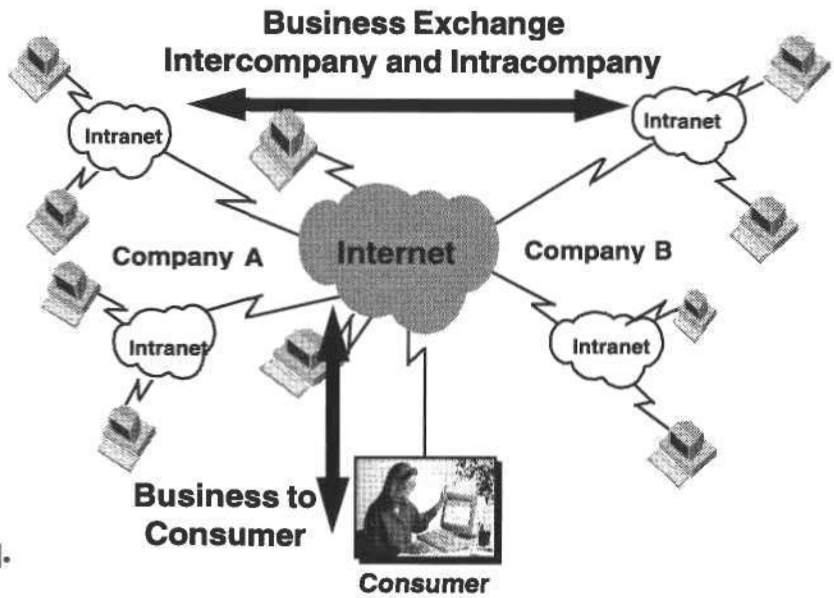


The Role of the PC in the Enterprise Has Changed



intel

Internet and Intranet



intel

Basic Premise for the Future:

All computing is networked computing

intel.

However, . . .

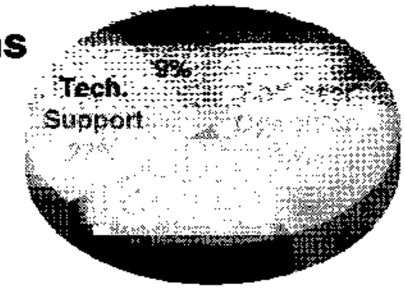
There is a problem with PCs connected to a business network:

intel.

Unmanaged PCs Are Costly

- End-user operations
- Technical support
- Administration
- Capital cost

LAN-based PC



Source: Gartner Group

Megatrend One:

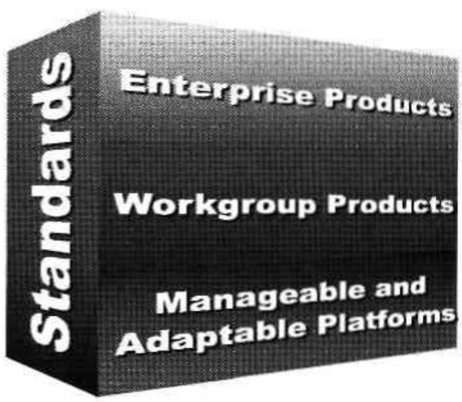
Reducing the total cost of ownership of networked PCs & servers

Our Goal:

To reduce TCO while retaining appropriate level of flexibility

(= ready for the future)

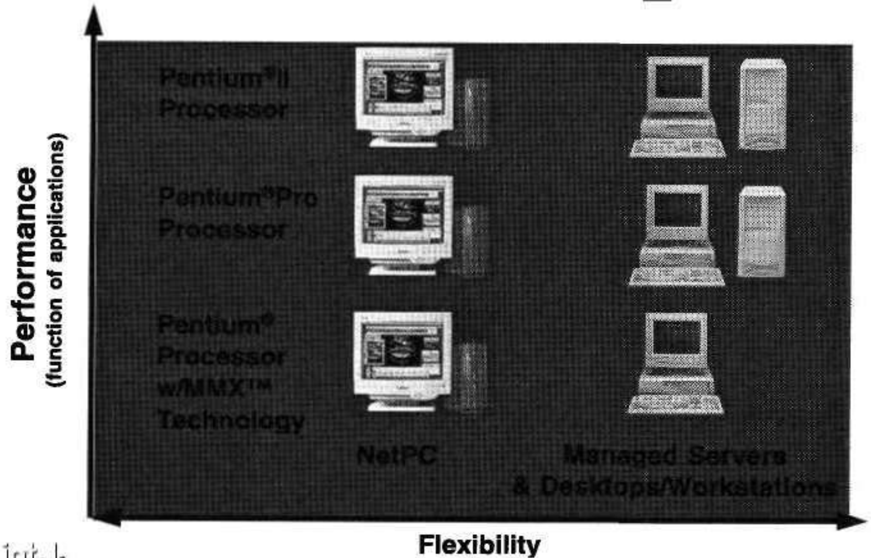
Intel Wired for Management Initiative



To Reduce TCO by Increasing the Manageability of the PC

Make PCs and Servers Universally Managed and Universally Manageable

Spectrum of Managed PCs



intel.

Megatrend Two:

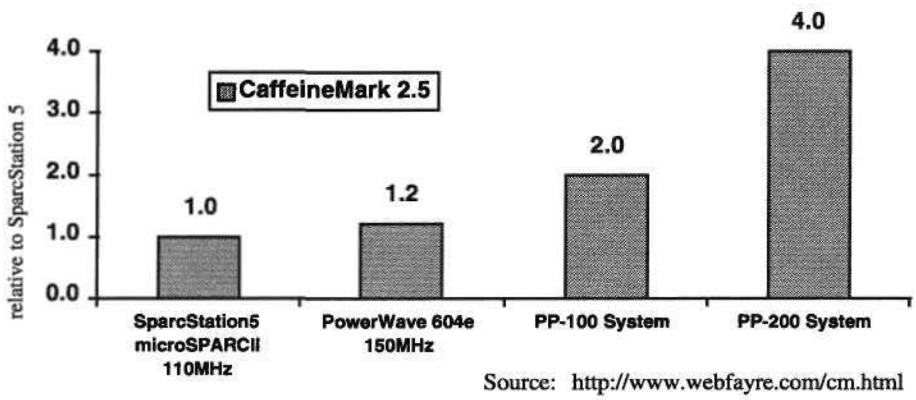
Java emerges as a tool for connected applications

intel.

Java* Programming Language

- "Communications" oriented language for the Internet
- Java is capturing IT attention as a front-end application to legacy databases
- Intel is actively making sure that Java is best on IA:
  - Extending Java environment on IA–optimized virtual machine
  - Java is fastest on IA & scales w/ processor
  - Java/Active X programming happening on Windows/IA

Java Performance



Source: http://www.webfayre.com/cm.html

Java* Runs Fastest on IA

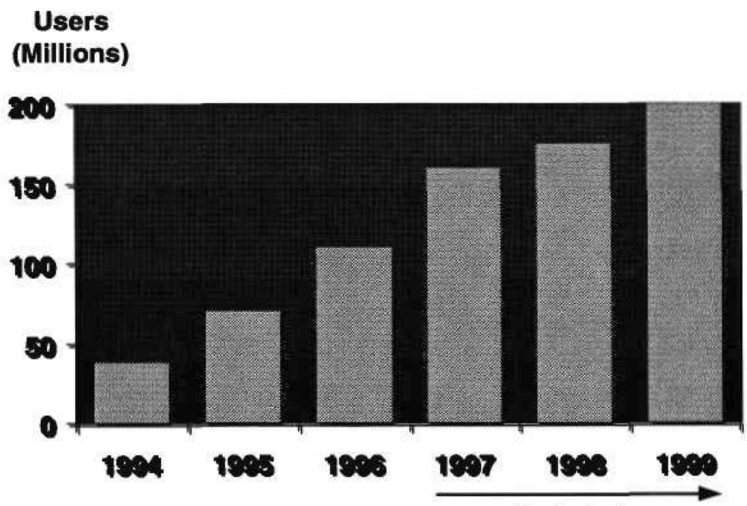
PP, PP/MT: Dell Dimension, 16MB RAM using Symantec Café v1.5 with JIT 2.0
PPC 604e-150: Power Computing PowerWave, 56MB RAM using Internet Explorer 3.0
microSPARCII-110: Sun SparcStation 5, 32MB RAM, using Sun Solaris SPARC Edition JDK/JIT v1.0.2

Intel Architecture delivers the best performance on Java plus the ability to run today's PC applications

Megatrend Three:

Emergence of the Internet in business-to-business & business-to-consumer communication

Worldwide Growth in Internet



Source: IDC, 12/96

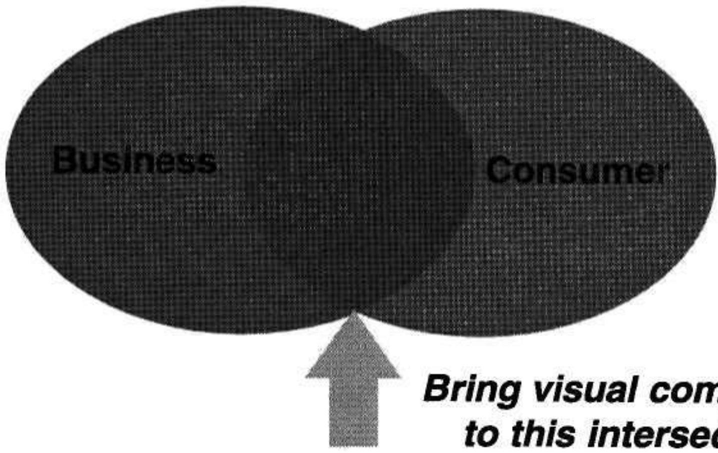
In the future, commerce will be conducted "screen-to-screen"

Megatrend Four:

Visual computing

intel.

The Intersection Is Enhanced By Visual Computing

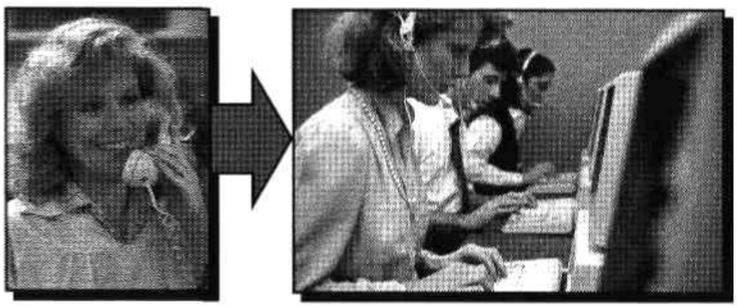


Bring visual computing to this intersection

intel.

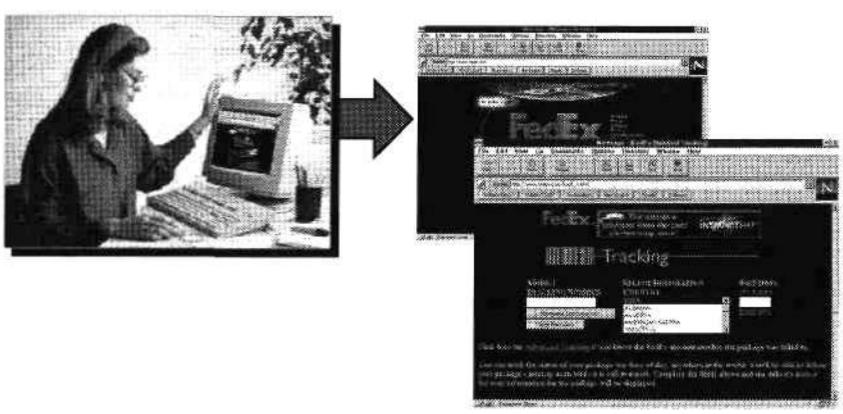
Example:
Federal Express Shipment Tracking

Traditional Shipment Tracking



Example:
Federal Express Shipment Tracking

Internet Shipment Tracking



Megatrend Summary:

All computing is networked computing

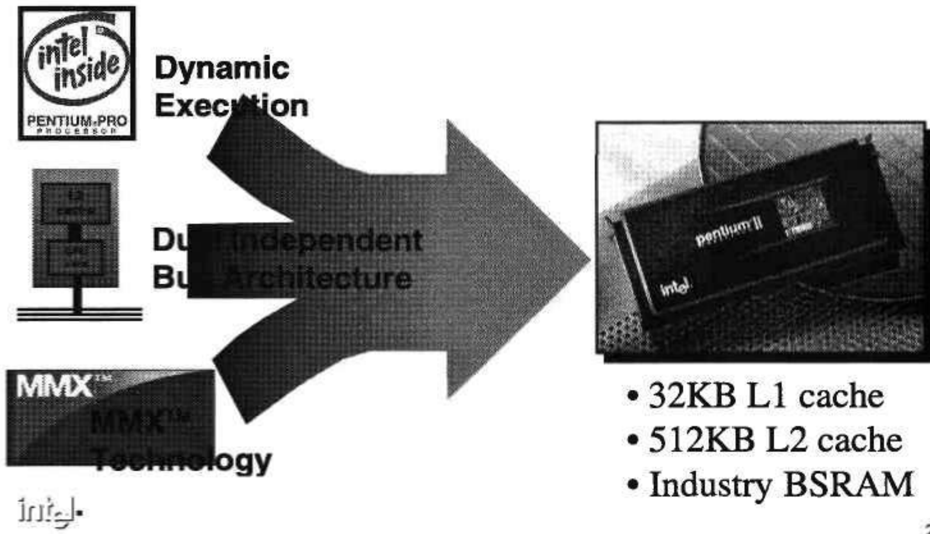
Increasingly it will become visual computing

intel

Networked Computing + Visual Computing requires balanced high performance

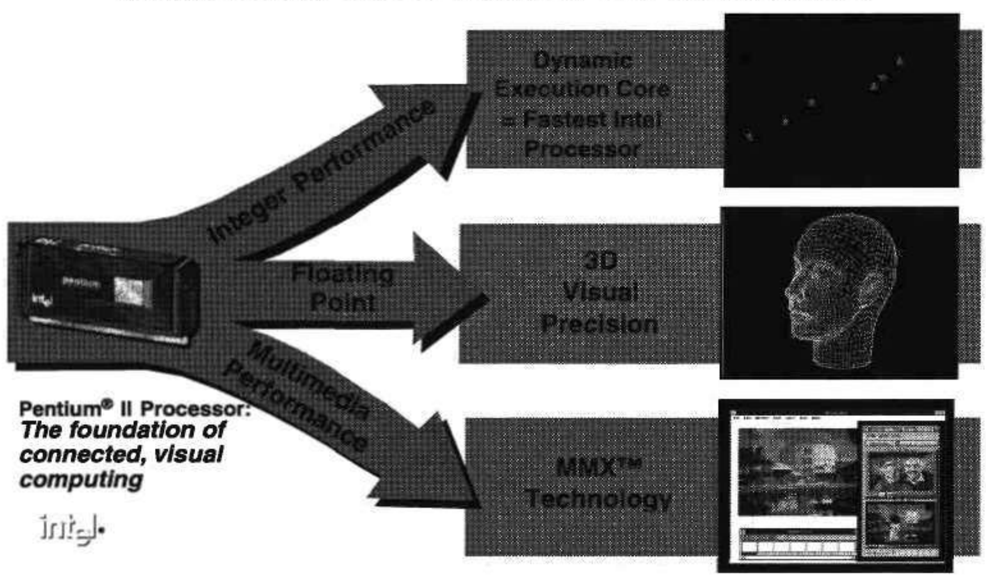
intel

Pentium® II Processor
Enabling High-Performance Computing



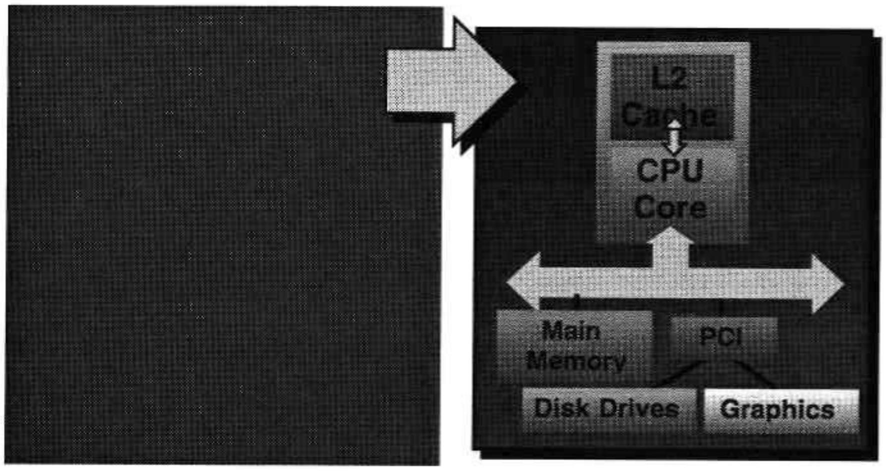
- 32KB L1 cache
- 512KB L2 cache
- Industry BSRAM

Pentium® II Processor
Delivers All Three Vectors of Performance

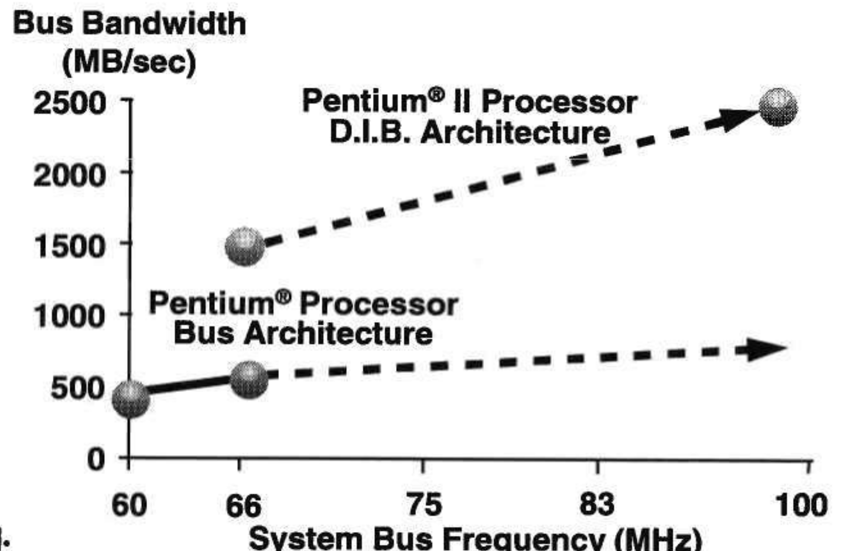


Pentium® II Processor:
The foundation of connected, visual computing

Transition to Better Technology



PC Bus Bandwidth

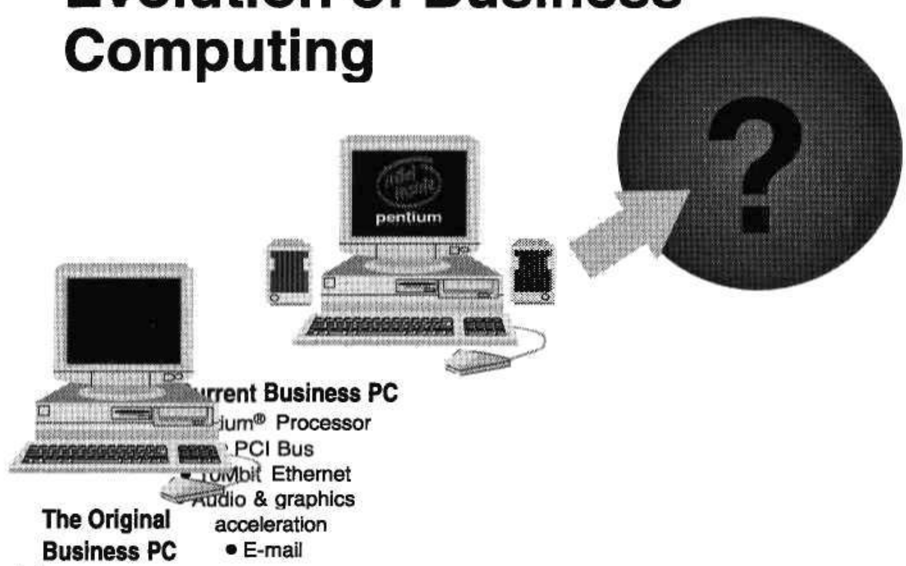


Source: Intel[28]

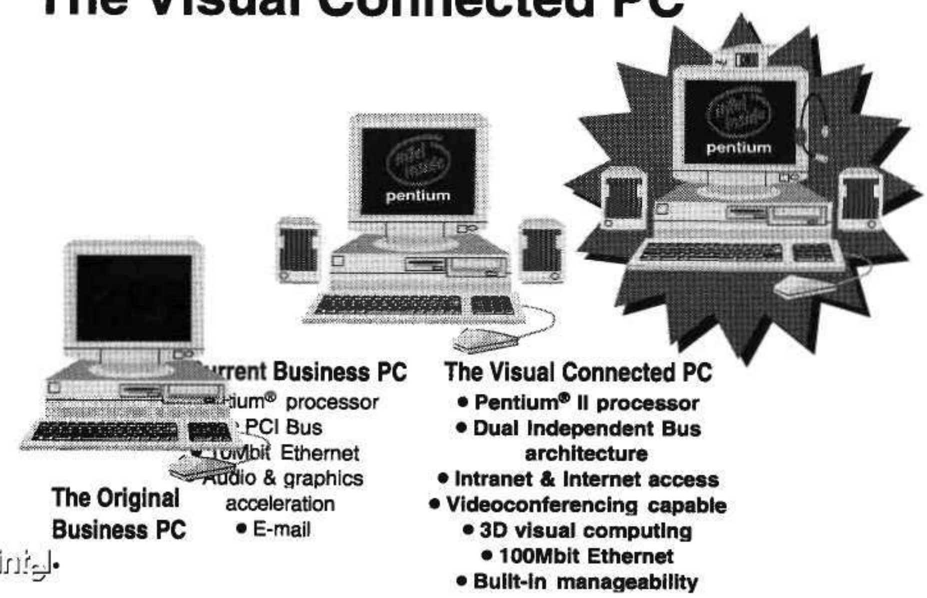
Pentium® II Processor Adoption

- A&A
- Acer
- Actebis
- Albacomp
- AutoCont
- Birg
- Brett
- CDC
- Cinet
- Comelta
- Commodore
- Compaq
- Compulink Res.
- Dan Technologies
- Datalogic
- Dell
- DGC Systems
- Digital
- Fujitsu
- Gateway2000
- HP
- IBM
- Investronica
- Intergraph
- J&W
- JTT
- Macroda
- Maxdata
- MEPCD/Apricot
- NEC
- NetPower
- Olidata
- Olivetti
- Optimus
- Opus
- Peacock
- R&K
- Sitre/APD
- Sintronic
- Siemens-Nixdorf
- S Plus S
- Triline
- Tulip
- Vikomt
- Vist
- ZDS

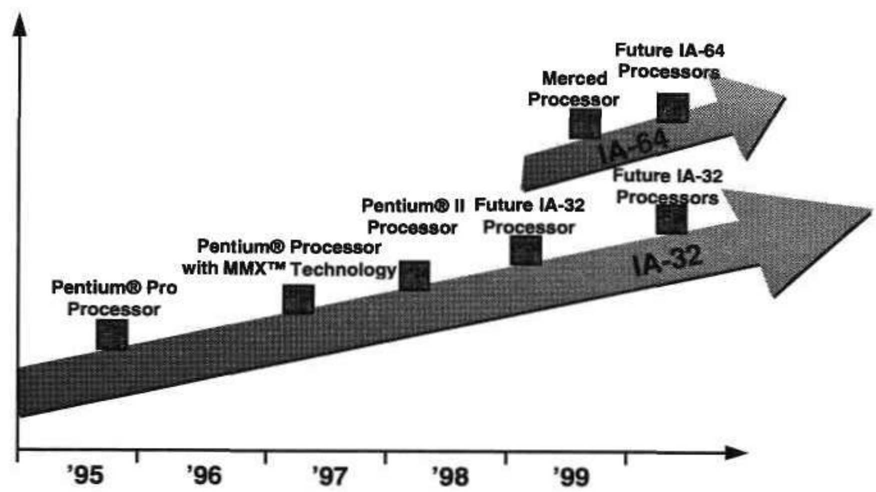
Evolution of Business Computing



Evolution of Business Computing: The Visual Connected PC



Intel Product Roadmap



Summary

Processors for Networked Computing:

- All computing is networked
- PC industry is addressing TCO
- Networked computing demands ever-higher performance
  - Java*
  - Visual Computing
- Intel's role: Deliver high-performance processors in very high volume

Spectrum of Managed PCs

Flexibility

- **Task specific applications**
- **Requires limited flexibility:**
  - **Limit configuration**
  - **Not user upgradeable**
  - **Remote management**
  - **Remote SW & OS configuration**

- **Full range of applications use**
- **Require full featured flexibility:**
  - **Flexible configuration**
  - **User upgradeable**
  - **Remote management**