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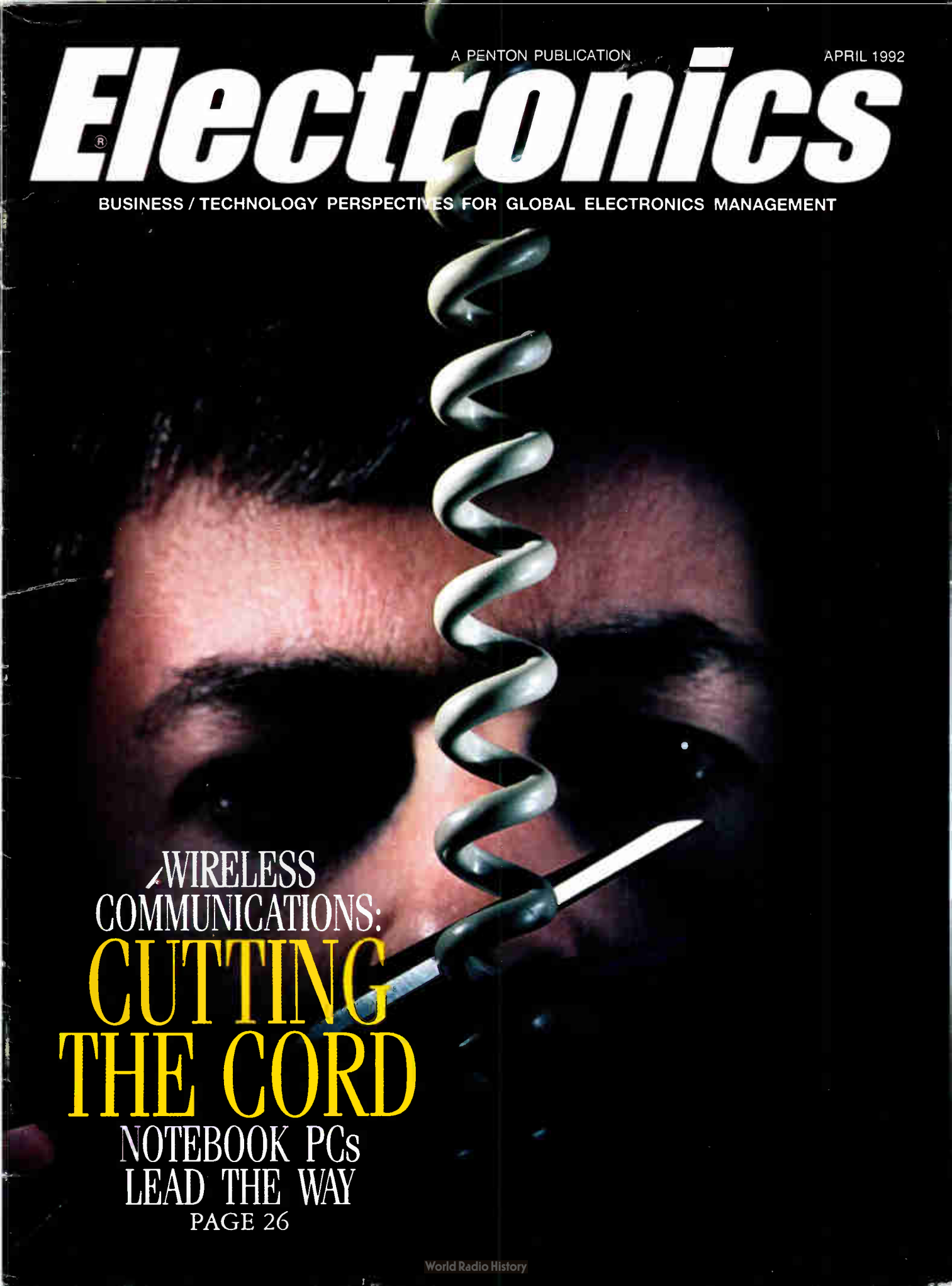
APRIL 1992

Electronics®

BUSINESS / TECHNOLOGY PERSPECTIVES FOR GLOBAL ELECTRONICS MANAGEMENT



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CUTTING THE CORD

NOTEBOOK PCs LEAD THE WAY

PAGE 26

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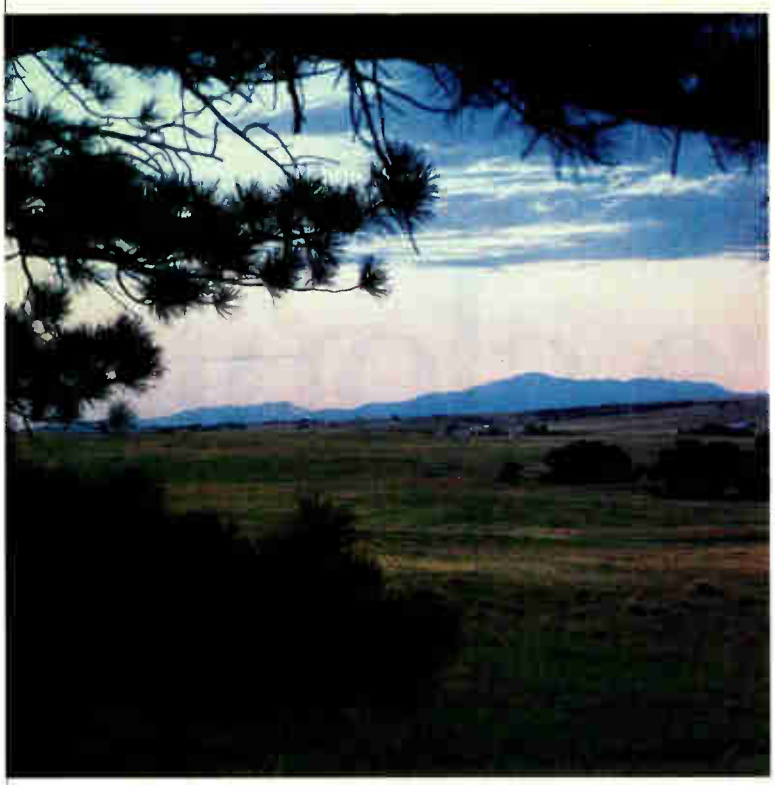

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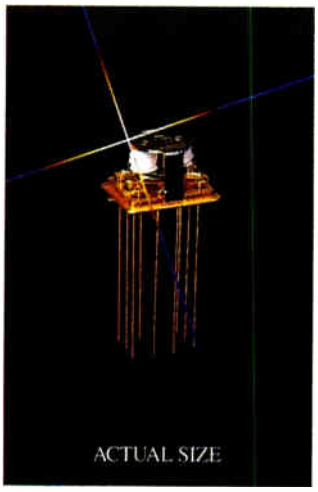

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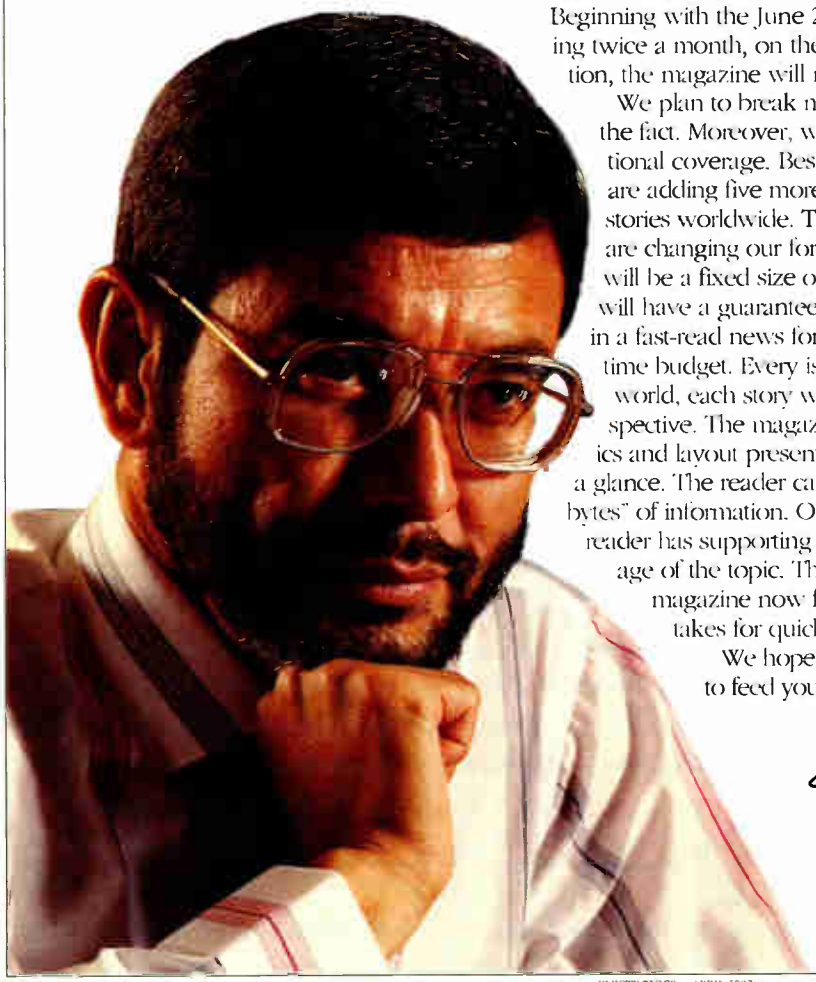
'ELECTRONICS' TWICE A MONTH

As a communications medium, *Electronics* has gone through some pretty drastic changes over the last 10 years. The premier magazine in the industry at the turn of the last decade, this grande dame of trade publishing began to show her age as a couple of publishing companies each took turns trying to dress her up in their image of what they thought she should be.

Neither succeeded well and gave up trying after a few years apiece. In 1989, *Electronics* found her way to Penton Publishing Co., a 100-year-old trade publisher based in Cleveland. It could be argued that the old girl should have been put to rest, but Penton saw the value hidden beneath her tattered reputation and continued to publish *Electronics* as a monthly business magazine. The publication had some great assets: a 60-year-old name, still known worldwide, and a loyal readership, many willing to pay to subscribe, chief among them. In addition, the magazine had the reputation for being an international publication reporting on worldwide events in the market. This was especially valued as technology development became increasingly global.

Like other publications, *Electronics* has fallen prey to the recession that has gripped the entire publishing industry over the past few years, forcing Penton to make some hard choices on how the magazine should be retooled to survive in such a fiercely competitive market. Penton realized that finding the reason for this general malaise could provide insight into how a magazine could be reconfigured to overcome the market's lethargy.

One problem obvious from the start is that management readers demand more timely information than the monthly *Electronics* can provide. Another is that managers need information about the industry internationally, not only in the U.S. Penton also saw that while the manager has precious little time to read, what he needs most is information. If a magazine is to succeed in the 1990s, it would have to address all these issues. *Electronics* plans to do just that.



Beginning with the June 22 issue, we will commence publishing twice a month, on the second and fourth Monday. In addition, the magazine will reemphasize timely news reporting.

We plan to break major news stories, not cover them after the fact. Moreover, we will rededicate ourselves to international coverage. Besides our three editors in Europe, we are adding five more in Asia. *Electronics* will break major stories worldwide. To address managers' time problem, we are changing our format. Beginning in June the magazine will be a fixed size of 52 saddle-stitched pages. Every issue will have a guaranteed 24 pages of editorial copy presented in a fast-read news format, perfect for the reader on a tight time budget. Every issue will have news from around the world, each story written from a worldwide, not local, perspective. The magazine is being redesigned so that graphics and layout present the greatest amount of information at a glance. The reader can scan the magazine to glean "news bytes" of information. On finding a "news byte" of interest, the reader has supporting text that provides more in-depth coverage of the topic. The longer, multipage articles that the magazine now features will be broken down into short takes for quick reading.

We hope you like what we are about to dish up to feed your professional and intellectual hunger. ❑

Jonah McLeod

JONAH McLEOD
EDITOR

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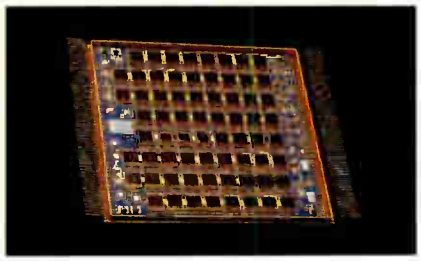

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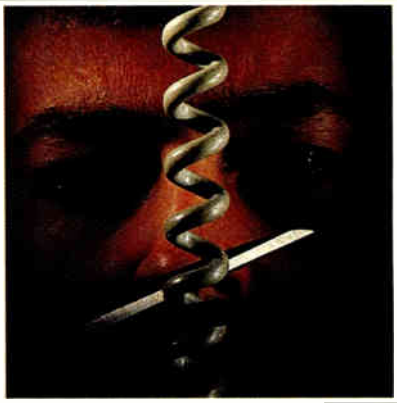

COVER STORY PAGE 26
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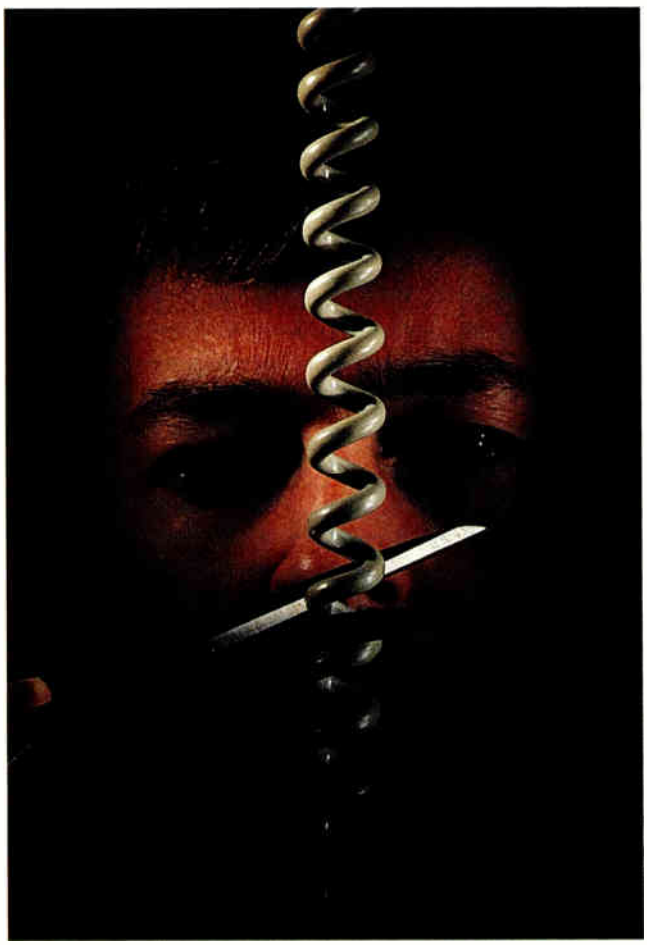


26

COVER: CUTTING THE CORD
Wireless LANs: The virtual workplace

To really cut the cord, the wireless communications industry must resolve issues of standards, power consumption, and spectrum availability.

FEATURES

25

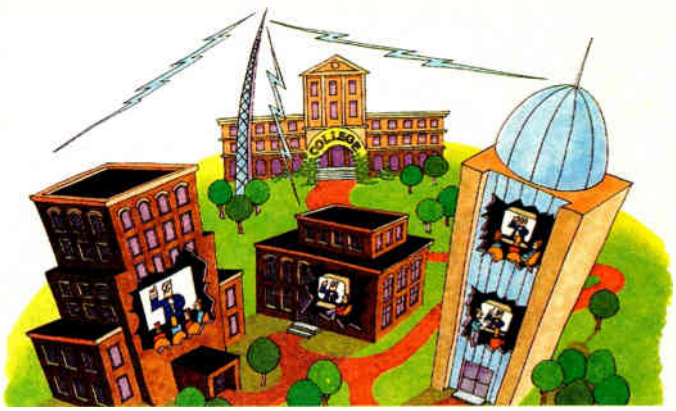
EXECUTIVE BRIEFING
Fighting technical obsolescence
The National Technological University brings scientists, engineers, and managers up to date remotely.

32

Workstation wars: what will it take to survive?
Customer service will be as important as price and performance in determining who the 1995 leaders are in this robust computing market.

36

Ring in the new: HDTV becomes a reality
Large-scale trials at the Winter and Summer Olympics are dress rehearsals for a 1994 commercial debut of high-definition TV in Europe.



PAGE 25

PAGE 36

World Radio History

DEPARTMENTS

4 Up Front

10 Letter from Istanbul

16 Face-off: Manufacturing

42 Advertisers' Index

43 Electronics Index

44 The Last Word

NEWS ROUNDUP

12

News Front

- Taiwan makes its telecom move
- A nonvolatile RAM that's as fast as DRAM
- The new IBM: Radical change becomes routine

14

Products to Watch

- Sony uses DOS in CD-ROM player
- MIPS: waging war on Intel with a RISC PC
- Analog Devices targets telecom
- Force delivers single-board Sparcstation
- Hard-disk chip set is configurable

23

European Observer

- Hurtling the language barrier
- Now Jessi is pushing HDTV chip development
- Germans report 53-GHz silicon transistor

Jesse H. Neal
Editorial Achievement Awards

1956 Merit, 1965 First
1975 Merit, 1976 Merit
1977 First, 1978 First
1988 Merit, 1990 Merit

WORLDWIDE NEWS

19

Equipment

U.S. makers of chip equipment are mounting a comeback, gaining market share

20

Locations

The China stampede: Big companies joining low-end suppliers in rush to cross the border

20

Aerospace

Seoul's $400 million Koreasat program aims to develop a domestic satellite capability

COMMENTARY

40

Tom Campbell Speaks Out

Eight steps to economic recovery: The deficit is the single biggest reason we are in a recession

WHITE PAPER

A1

En route to collaborative computing

Telecommunications technology is pivotal to the full flowering of multimedia

Companies covered in this issue, indexed to the first page of the article in which each is mentioned.

Advantest 19
AEG AG 22I*
Alcatel NV 24
Apple Computer Inc. 12
Applied Materials Inc. 19
Ascom 22L*
AT&T Co. 26
Beijing Philips Audio/Video Corp. 20
BEKO 10
BIS Strategic Decisions 26
Bogazici Elektronik Sanay 10
British Telecom 22D*
Broadcast Television Systems GmbH 36
Bull SA 10
Cable & Wireless plc 22D*
Canon 19
Compaq Computer Corp. 26
Cree Research Inc. 12
Daimler-Benz 22I*
Daimler-Benz Research Laboratories 23
Dataquest Inc. 32
Deutsche Aerospace 22I*
Digital Equipment Corp. 32
Eastman Kodak Co. 36
Electronic Devices Ltd. 20
Electronics and Telecommunications Research Institute 20
Force Computers Inc. 14
General Electric Co 20
General Signal 19
German Research Center for Artificial Intelligence 23
Goldstar Information & Communications 20
Grundig AG 10
Heinrich Herz Institute 36
Hewlett-Packard Co 32
Hitachi Inc. 19
Hong Leong 12
IBM Corp. 10, 12, 23, 32
Institute for Applied Information Technology 23
Intel Corp. 14
International Application Solutions 12
International Data Corp. 32
ITT Semiconductors 36
L.M. Ericsson Telephone Co. 12
Mammoth Micro Productions Inc. 14
Marconi Ltd. 20
Matras SA 22I*
Mercury PCN Ltd. 22D*
Microsoft Corp. 12, 14, 26
MIPS Computer Systems Inc. 14
Motorola Inc. 12
National Semiconductor Corp. 26
National Technological University 25
NCR Corp. 26
Next Computer Inc. 32
Nikon 19
Nokia Corp. 36
Novell Inc. 26
Parallel Network Architecture Ltd. 22D*
Philips Electronics NV 20, 36
Proxim Corp. 26
Robert Bosch GmbH 36
Sematech 19
Siemens AG 22D*, 23
Silicon Graphics Computer Systems 32
Silicon Valley Group 19
Siliconix Inc. 22I*
Sony Corp. 14
Sun Microsystems Inc. 12, 14, 32
Taligent Inc. 12
Telefunken Electronic 22I*
Teradyne Inc. 19
The Economist Intelligence Unit 36
Thomson SA 36
Tokyo Electron Ltd. 19
Unitel Ltd. 22D*
US West Inc. 22D*
Varian Research Inc. 19

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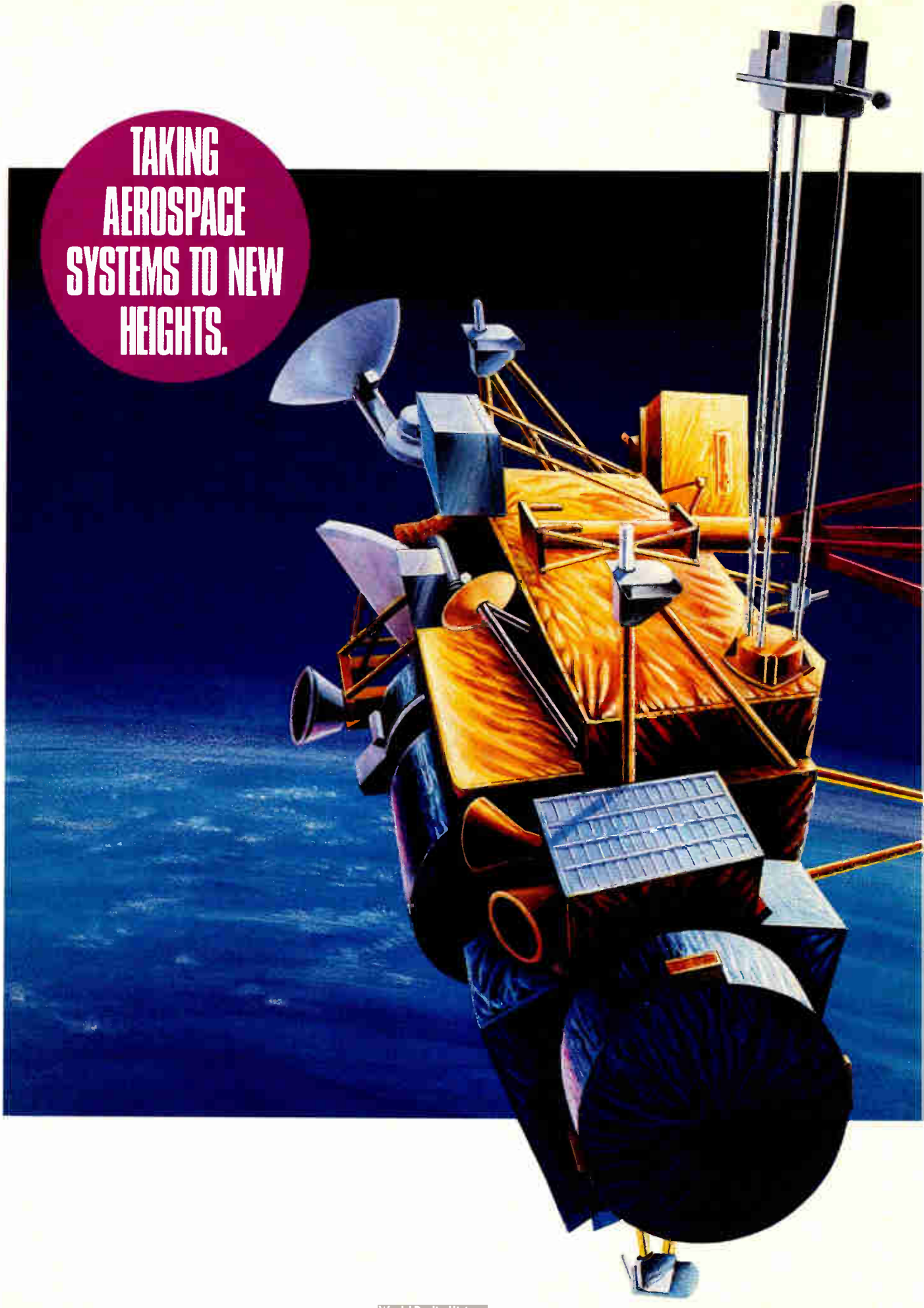

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CIRCLE 172

LETTER FROM

ISTANBUL

IN TURKEY, THE MARKET FOR ELECTRONICS IS GROWING 30% A YEAR

LAND OF CARPETS AND COMPUTERS

BY ANDREW ROSENBAUM

On a typical Istanbul street corner, if you walk past the gypsy holding a dancing bear by a ring through its nose, you will come upon little shops that are labeled "Telekom" or "Elektronik." At the former, you will find cellular phones or modems; at the latter, you might be offered a PC clone at a price that competes with those at New York's 47th Street Photo.

That's why it seems natural that when you go to buy a Turkish carpet from a little stand at the Great Bazaar, a little old man wearing a caftan, sandals, and a turban sits next to a facsimile machine, an electronic cash register, and a credit-card terminal for VISA cards .

Turkey, once dismissed as the Sick Man of Europe, has become a healthy market for electronics. Sales of information-technology equipment there hit $300 million in 1991, and growth is 30% a year. This explains why IBM, Bull, Hitachi, NEC, DEC—in fact, all the major world players in computing—are already there, fighting tooth and nail for market share. "The competition here is especially intense, because the market shares haven't been established yet," says Giovanni Novarini, Turkey branch director in Istanbul for the French computer maker Bull SA.

THE FORMER 'SICK MAN OF EUROPE' HAS DEVELOPED A HEALTHY APPETITE FOR INFORMATION TECHNOLOGY

But how does a country where the average per capita income is $5,000 manage to create a heavy demand for telecommunications and information technology? Analysts say there is a sharp division in Turkey between the traditional economy based on agriculture, which remains stable, and the rapidly growing modern economy based on manufacturing and services. The latter is growing fast, pushing real GNP to grow about 6% a year.

A member of NATO, the country looks to the U.S. as its model for development. "We retain our ancestral culture, but there is no reason why it should prevent us from adopting your technology, " says Riza Nur Pacalioglu, director of the Bogazici Elektronik Sanay data communications firm in Istanbul.

It all started in the 1980s, when Turkey, under the leadership of President Turgut Ozal, who still holds the post, opened its markets to world competition. During the decade a significant part of the state-owned industries was also privatized. As a result, banks and manufacturers began a race to modernize, investing in new technology the better to cope with foreign competition.

The move to a competitive economy has had an enormously stimulating effect on Turkish business. The Istanbul stock exchange, created in 1986, now has capitalization and trading volume that rival those of the Milan and Madrid bourses. Turkish banks provide services that are equal to those of other European countries.

In fact, the banks were the first to move in the Turkish investment wars, and they have continued to purchase equipment at a breathtaking pace. "The banks represent at least 40% of the information-technology market here," says Atilla Vanlioglu, external channels administration manager for IBM Corp. in Istanbul.

"Turkish banks have gone directly from preinformation-technology stages, to mainframe technology, largely with dumb-terminal clients," Vanlioglu continues. "They have also moved rapidly into the most advanced data-communications technologies, for the creation of networks of ATMs."

Happily, banks and other industries can take advantage of the liberal approach to telecommunications taken by the Turkish PTT. In the 1980s, the PTT converted more than 85% of the country's exchanges to electronic switches. It also developed Turkpac, the national packet-switching exchange, to a point where it can be used reliably for electronic funds transfer and data interchange throughout the country.

"The result is that the market for data communications is growing even more rapidly than that of cellular telephones," says Pacalioglu, whose company now earns about half its income from setting up data communications for Turkish industry. He points out that even the outlawed Kurdish Separatist Movement is known to use X.25 communications for its internal communications because it is hard to trace packet-switched messages.

One area where Turkish manufacturers clearly do not need help is consumer electronics. Turkish TVs, manufactured by local producers like BEKO, have found a solid niche market in Germany and England. In fact, German color TV manufacturer Grundig AG recently protested to the European Community about the number of Turkish receivers available in Germany. Turkey exports about $100 million worth of color TVs, mostly to Europe.

But the internal market for consumer electronics is also impressive. Turkey enjoys seven TV channels—more than France—and two of those are private satellite-transmitted stations. Ride through Istanbul and you see satellite dishes on every building; and when one realizes that there are 10 million people in Istanbul, the market potential becomes clear.

All of which only goes to prove that the Turkish market should not be ignored. Just don't feed the bears. ❑

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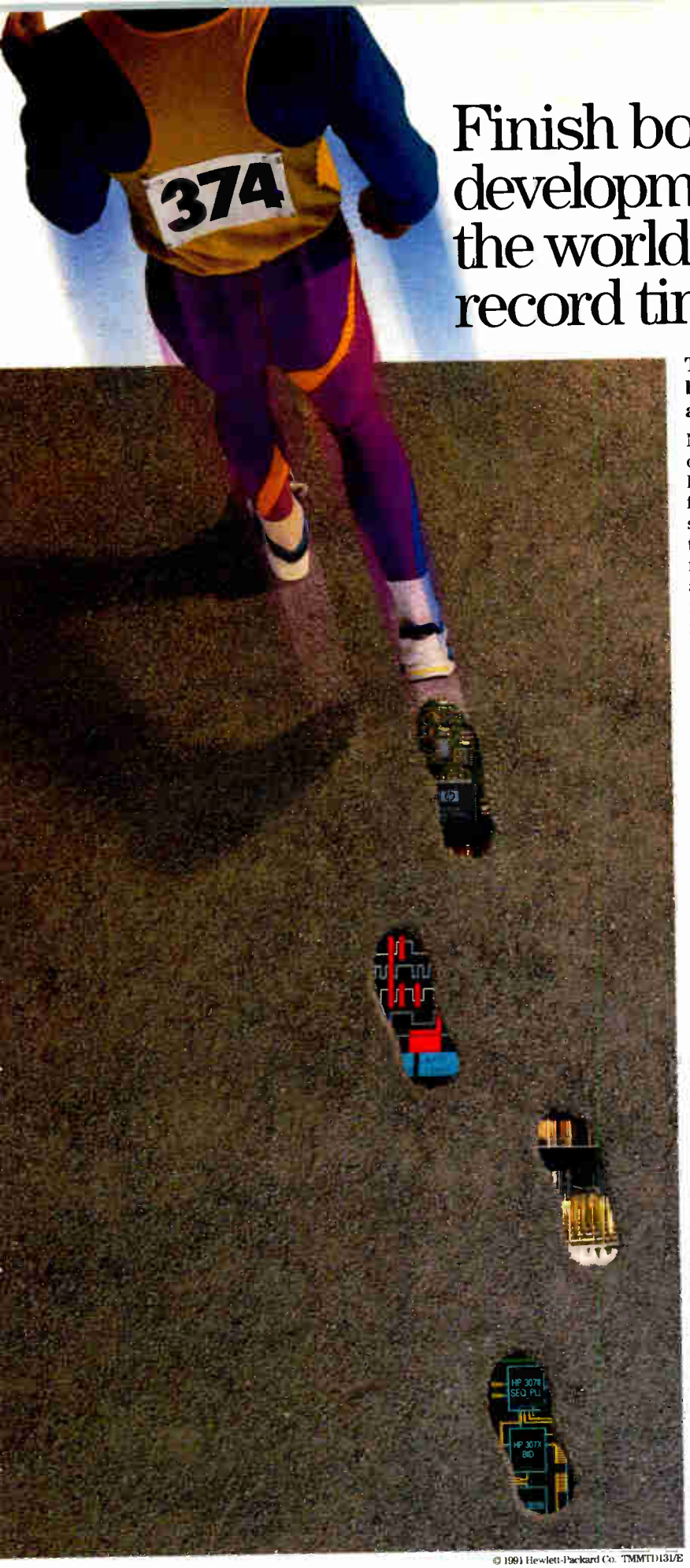

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CIRCLE 187

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TAIWAN MAKES ITS MOVE

Driving to become Asia's financial center, Taiwan is engaged in a sweeping upgrade of its telecommunication system and plans to spend about $7.4 billion to buy material and hire technical expertise as part of its $330 billion Six-Year Development Program. The good news for U.S. and European companies is that the Taiwan government, under political pressure to reduce its Japanese balance-of-payment deficit, is seeking to do as much business in the U.S. and Europe as possible at the expense of the Japanese.

A key part of the plan is construction of an integrated services digital network: the Directorate General of Telecommunications says it will spend $1.3 billion each year on this project alone for the next three years and wants to install 30.7 main ISDN lines per 100 persons by 1995. It estimates that 92% of Taiwan households will have telephones by then.

Also, the directorate plans to provide 42% of its subscribers with digital service by June 1992. Then, by 1995 a majority of all exchanges should be digitized with all levels converted to digital by the end of the century.

Cellular phones and paging systems are another vital part of the Taiwan development plan that is growing rapidly. Taiwan has the world's highest per-capita use of cellular telephones; the basic system, built by L.M. Ericsson of Sweden, consists of an initial 120,000 lines. It is being stretched to the limit and new lines will be sought.

In paging, Motorola Inc. set up the system last year and now controls 60% of the market in unit sales. But almost 200,000 subscribers have applications pending for the pager service so the government plans an additional 1.5 million lines to be installed by 1993.

Lastly, the DGT is planning a sweeping set of packages to install telephone lines where none currently exist, to provide additional pay phones, to increase its own research and development programs, and to increase exports of telecommunications equipment manufactured in Taiwan.

U.S. companies remain the dominant force in investments in Taiwan, but the Europeans are making significant inroads by taking quick advantage of the opportunities available under the development plan. However, the Americans still have going for them the fact that most of the political leaders and technocrats obtained their advanced degrees in the U.S. ❑

A NONVOLATILE RAM THAT'S FAST AS DRAM

A nonvolatile competitor to existing memory technologies is starting to make waves in the research community. Using silicon carbide instead of silicon, the technology, developed under contract with the U.S. government's Strategic Defense Initiative program, is the first to offer read/write speeds comparable to those of dynamic random-access memories and a cell small enough for very-large-scale integration. The devices, dubbed NVRAMs, even can boast of some advantages over silicon when it comes to manufacturing processes.

Since the energy bandgap of silicon carbide is 2.5 times that of silicon, thermally generated leakage currents are thousands of times smaller. Memory should be stable for hundreds of years, according to Cree Research Inc. of Durham, N.C., which with Purdue University in West Lafayette, Ind., is conducting the NVRAM research. So far, a bipolar charge-storage capacitor has been fabricated to prove the concept; a full-blown device should be working within a year, say the researchers.

NVRAMs can retain the same charge as a DRAM in a cell 25% the size, and since the charge is held in the cell, 1-Mbit NVRAMs do not require the tunneling technology that must be used in high-density DRAMs. Silicon carbide is compatible with existing silicon fabrication technology and does not have the "wear-out" problem that plagues ferroelectric RAMs or flash memory. Also, since refreshing DRAM soaks up as much as 80% of the power consumption in notebook computers, NVRAMs hold the promise of being able to operate with much smaller batteries.

Now the bad news: they won't be available for a while. Despite their promise, NVRAMs are at the beginning of the research curve and even a 64-Kbit commercial product is five to seven years away, say scientists at Cree Research. ❑

THE NEW IBM: RADICAL CHANGE BECOMES ROUTINE

The reshaping of IBM Corp. has become a string of dramatic changes and startling about-faces. Not only did last month see the departure of a raft of its operating executives, but the company reversed a keystone of its marketing strategy by declaring that it would begin selling PCs made by someone else. That was followed quickly by the news that IBM was courting Sun Microsystems Inc. as a partner in Taligent Inc., the software firm set up by IBM and Apple Computer Inc.

The decision to market clones, to be manufactured by an independent Asian subsidiary and sold in Europe, amounts not only to an admission by IBM that it cannot reduce its costs enough to enable it to compete in the cutthroat and price-driven low end of the market, but also a radical change in IBM's corporate culture. It is believed that the new computers would be made in Singapore by Hong Leong, with which IBM established a joint venture last year to sell PCs in Asia. The new company is called International Application Solutions.

The Sun-Taligent gambit—the goal would be to control the direction of desktop software—is also a challenge to Microsoft Corp., IBM's sometime partner, which later this year is to introduce its own workstation software. IBM and Apple formed Taligent to create software based on object-oriented programming for desktop computers and workstations. ❑

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TO WATCH

SONY USES DOS IN CD-ROM PLAYER

Sony Corp. will push consumer and computer electronics even closer together this fall by introducing a personal information device that runs on MS DOS 3.1 and plays CD-ROM XA discs.

Code named Bookman, the player is about 7-in. wide, 2-in. high and 6-in. deep. Microsoft Corp., Redmond, Wash., will adapt a version of its Viewer software for the player, which uses a NEC V20 microprocessor. Mammoth Microproductions Inc., Colo., wrote the software for streaming audio, graphics, and text data off the disc.

To accelerate market acceptance, Sony has positioned the Bookman as an "open-architecture" product and is encouraging software companies to create tools and titles that can also run on multimedia PCs.

Bookman has some superficial incompatibilities with computer-based CD-ROM XA. It displays CGA graphics instead of VGA, for example, and cannot support XA's hard-disk caching scheme. Since there are few CD-ROM XA discs on the market, there is little installed base to be incompatible with, however, and Sony is encouraging title developers to support multiple platforms by recording multiple format versions on the same disc. The product will cost under $1,000. ❑

Future models of Sony's player may include a PCMCIA card slot for MS-DOS applications software.

MIPS: WAGING WAR ON INTEL WITH A RISC BOX THAT RUNS WINDOWS

MIPS Computer Systems Inc.'s 50- and 67-MHz RISC PCs make it clear the Sunnyvale, Calif., company is vying for a piece of Intel Corp.'s business.

Based on the R4000 chip, the computers run Windows and Unix applications at two to three times the performance of 486-based PCs, MIPS says. The RISC machines—the first R4000-based PCs to comply with the Advanced Computing Environment's Advanced RISC Computer (ARC) specification—run the DOS/Windows, RISC/os, or Santa Cruz Operation Unix operating systems. They arrived as MIPS announced a merger with Silicon Graphics Inc.

The Magnum 4000 PC-50, rated at 40 Specmarks, sells for $8,000 to $12,000. Prices for the Magnum 4000 SC-67, at 80 Specmarks, range from $12,000 to $17,000. ❑

ANALOG DEVICES TARGETS TELECOM

Analog Devices Inc., is pushing into telecommunications with a chipset for PC motherboards that embeds modem, facsimile and data-pump functions.

The AD20msp500 chipset consists of an interface to the phone network and a 16-bit digital signal processor. Besides CCITT V.32bis and fax applications, the chips handle data compression and error correction usually done by a modem's microcontroller, says the Norwood, Mass., company. The chipset will cost $19 in volume quantities.❑

FORCE DELIVERS SINGLE-BOARD SPARCSTATION

The first single-board version of the Sun Sparcstation 2 workstation is intended for embedded and real-time use in manufacturing process control and factory automation. The Sparc CPU-2E from Force Computers Inc., Campbell, Calif., uses the same chip set, SunOS operating system, and application software as its fully configured counterpart from Sun Microsystems Inc.

The Force unit executes as many as 28.5 million instructions/s on a standard VME board using the 6U form factor. It is also represents the first commercial use of the Source Synchronous Block Transfer Method. This protocol doubles bandwith and throughput from 80 to 160 Mbytes/s.

A version with 16 Mbytes of dynamic RAM will sell for $7,995; with 32 Mbytes, the price is $9,495. Deliveries will begin in July. ❑

HARD-DISK CHIPSET IS CONFIGURABLE

Micro Linear Corp.'s BiCMOS chip family for hard-disk drives provide a complete solution for 1.8-, 2.5- and 3.5-in. drives with data rates up to 36 Mbits/s.

A configurable read-channel chip, the FC3560, has 800 logic gates that can be used by designers to implement an encoder/decoder, address mark or other function.

The ML6006 read-channel filter-equalizer has a programmable cut-off frequency. A continuous-time filter makes the chip's filter response independent of interconnect parasitics. The third chip, the ML4610, is a disk-head amplifier. The chips are available now. Pricing on the FC3560 depends on customization. The ML6006 costs $6 and the ML4610 costs $2 in high volumes. ❑

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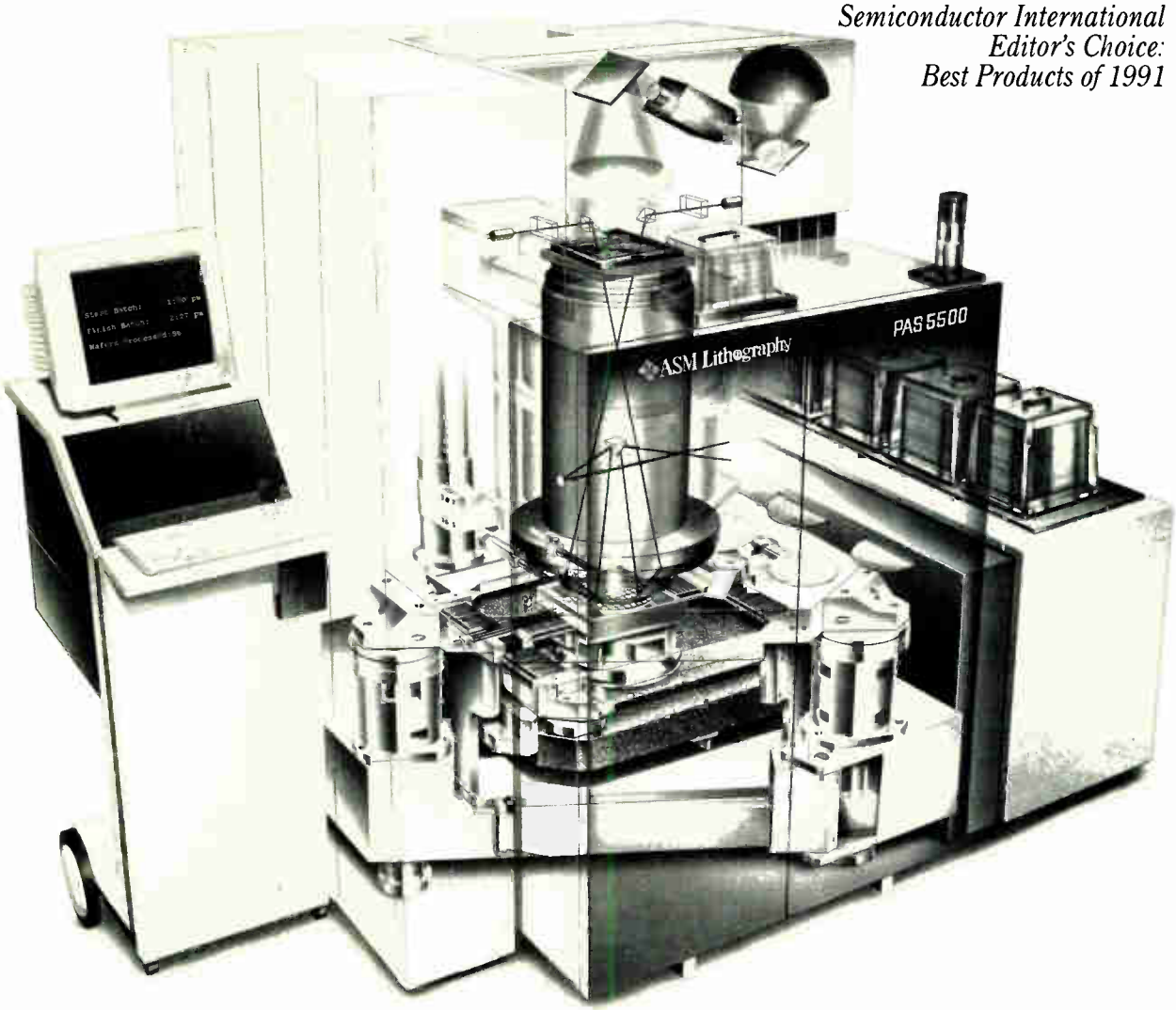

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CIRCLE 181

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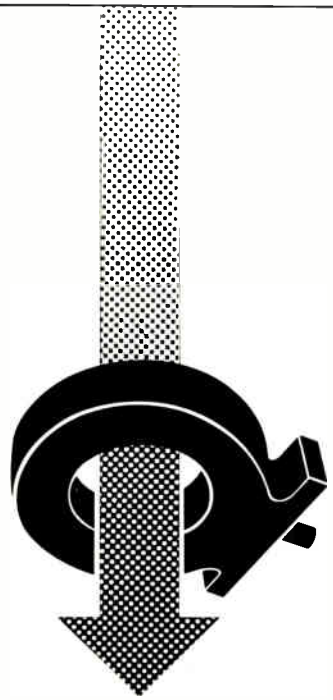

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CIRCLE 197

FACE

OFF

WHAT GOVERNMENT MUST DO;

Charles Schultze once compared the federal budget deficit to termites in the basement: a problem that would, if not treated, weaken the structure of the economy by barely perceptible degrees. The decline in U.S. manufacturing competitiveness is much the same kind of problem—one that takes its toll gradually.

In fact, we have only recently reached the point when it seems that people who think there is a competitiveness problem outnumber those who do not. The 1985 report of the President's Council on Economic Competitiveness defines competitiveness as "the degree to which a nation can...produce goods and services that meet the test of international markets while simultaneously maintaining or expanding the real incomes of its citizens." So far, the U.S. has done neither.

JULIE FOX GORTE

Over the past two decades, American incomes have shrunk (in constant-dollar terms). American goods have become a smaller share of world imports and the U.S. has bought an increasing share of world exports. Beyond macroeconomic evidence is an avalanche of studies, anecdotes, and data that confirm U.S. competitiveness is dwindling.

As is the case with all massive, systemic problems, solutions are neither simple nor easy. In the main, U.S. competitiveness problems are of American making (and, contrary to some rhetoric, not primarily a consequence of foreign trade barriers). We have emphasized consumption over production; we have spent too much and saved too little; we have rested on our laurels for too long.

To improve competitiveness, we must improve our ability to develop and diffuse technology and increase productivity. A productive economy needs patient capital invested in productivity and quality enhancement, a labor force capable of supporting rapid innovation, a commitment to continual improvement, and reasonable access to foreign markets. These days, that means government must act as business's partner.

In the Office of Technology Assessment's recent report, *Competing Economies: America, Europe, and the Pacific Rim*, policy options were set out in five areas. First, government can help make patient, low-cost capital available by eliminating the budget deficit and revising the capital-gains tax schedule to reward long-term investment and penalize short-term speculation. More selective instruments to reduce the cost of productivity-enhancing activities include investment tax credits or accelerated depreciation for production equipment and a permanent, broader R&D tax credit.

Since many technologies—such as X-ray lithography, where R&D costs are in the billions—are beyond the resources of many companies to pursue alone, the government should share the cost, as many foreign governments do. Another step, which a few states have taken already, is to support technology diffusion to help small businesses keep up.

Improving the workforce will also require a major initiative. It has to start with our schools, an effort that will take years to pay off. In the meantime, we might support the needs for well-trained workers by measures like a payroll-based levy dedicated to worker training, tax preferences for midcareer training, and redoubled efforts—perhaps scholarships or grants—to encourage more young people to enter engineering and science curricula.

Our competitiveness problems were decades in the making, and there are no silver-bullet solutions. But failure to mobilize the nation to improve manufacturing competitiveness will mean a continued decline of American living standards. In short, we need a new, and major, national initiative to be world-class manufacturers.—*Julie Fox Gorte, senior associate, U.S. Office of Technology Assessment*

World Radio History

WHAT INDUSTRY MUST DO

Manufacturing is the wealth-generation segment of the American economy. By reinventing it, U.S. industry has an extraordinary opportunity to expand the international marketplace in ways that will expand prosperity for us all.

One such opportunity comes as a result of a recent industry-led report on *21st Century Manufacturing Enterprise Strategy*. This strategy was forged by a team of industry experts from more than a dozen companies in a project facilitated at the Iacocca Institute. Together they developed a vision of the "agile enterprise"—one that competes on the skill base of its employees, a flexible management structure that empowers individuals and teams, and flexible technology that gets the right information to the right person at the right time.

ROGER N. NAGEL

Government and academia have a vital role to play in enabling, accelerating, and shaping the transition to agile manufacturing in America. But industry itself must lead the way.

As we begin to compete on the ability to customize rather than mass produce; to produce wide varieties of product families; and to introduce new products at an increasingly faster pace, then the design process must become a production capability. We must make the development of designs for new products effective and efficient. Design information must be linked closely with marketing and sales to know what customized features are required; and with R&D, manufacturing, etc. to know the systems' capabilities.

These requirements deal with enhancing the thinking and information-handling capabilities of our employees. As the agile competitive world emerges, the skill base of employees becomes the most valuable asset, and enhancing the scope and effective capabilities of employees to make decisions and convert ideas into designs is the challenge for technology. In the agile competitive arena we change our focus from leveraging muscle power to leveraging the competitive impact of intellectual power.

Skilled leaders will use agility to make giant corporations entrepreneurial competitors. Vertical partnerships, teaming, and opportunistic leadership will be used to form confederations of entrepreneurial profit centers. Individual profit centers in the same organization and across different ones will organize into rapidly formed teams or "virtual companies" to meet a competitive opportunity. Such confederations can be the American answer to the Japanese *keiretsu*—but a more powerful and flexible version.

The agile company will depend on a new type of information infrastructure. Analogous to today's interstate highway system or telephone system, this web of information will enable enterprises to form joint ventures in which far-flung units of different companies are joined in real time by standardized computer hardware and software. Agile companies will use the web to find suppliers and designers through a "Factory America Network" clearinghouse. Today, isolated islands of such an infrastructure are already in place. In the future, it will be pervasive.

In the agile company, authority will be diffused and information will flow freely among manufacturing, engineering, marketing, purchasing, finance, sales, inventory control, and research. Agility in manufacturing will be more than a competitive advantage in the future. It will be a condition of survival.

The transition to agile enterprises is inevitable. It is already being pursued by our industrial rivals. American prosperity is profoundly at risk unless a coordinated effort is made in this country, too, toward the new agile-manufacturing system.—*Roger N. Nagel, operations director, Lehigh University's Iacocca Institute, Bethlehem, Pa.*

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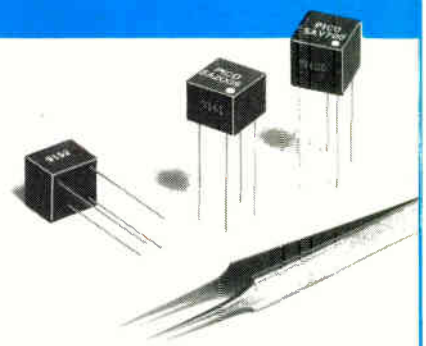

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LEADING U.S.MAKERS OF CHIP EQUIPMENT GAIN MARKET SHARE, LATEST SURVEY SHOWS

MOUNTING A COMEBACK

BY HOWARD WOLFF

EQUIPMENT

Resurgent U.S. manufacturers of semiconductor equipment are regaining some of the ground lost to Japanese competitors in the past decade. The latest edition of an annual market study by VLSI Research Inc. of San Jose, Calif., shows that American equipment makers that ranked among the top 10 suppliers in 1991 picked up an additional 3% of the market shared by that group. "This represents a significant comeback for America," says the report, adding, "It is a noteworthy milestone for [the semiconductor-manufacturing research consortium] Sematech, which has been working closely with all of these companies to improve American manufacturing."

The authoritative study, completed last month by VLSI Research, places the 1991 worldwide total spent for systems and services at $9.9 billion with the top 10 accounting for $4.2 billion, or 43%, about the same as the 1990 figure. But the U.S. companies' slice edged up to 40.8% of the total from 38.0%, a gain of $297 million.

The same companies appear on the list as in 1990, but only four of them are in the same position. With Tokyo Electron Ltd. maintaining its No. 1 position, Applied Materials, the highest ranking U.S. company, displaces Nikon in second place with Nikon dropping to third. Filling out the top five, Advantest, fourth, and Canon, fifth, retain their positions.

Among the second five, four of the players are in new positions. Varian moves from ninth to sixth, Hitachi from sixth to seventh, Teradyne from ninth to eighth, General Signal from seventh to ninth, and Silicon Valley Group remains in tenth position.

In its analysis of the rankings, VLSI Research credits Tokyo Electron's top-rated showing to the company's "broad product-line offerings in critical manufacturing areas such as chemical vapor deposition, etch, and diffusion. Etcher sales jumped 23% to $134 million in this recessionary year," says the report, "while CVD increased 15% to $77 million. Diffusion was caught in the recession and dropped 13%, keeping Tokyo Electron lower than would have otherwise been." The company has estimated 1991 sales of $764 million.

Crediting Applied Materials "with leadership in market penetration wherever it has gone," the report points out that "it was one of the first American companies to open offices in Beijing, China" and "also one of the first to manufacture semiconductor equipment in Japan." In addition, Applied has retained its title as the No. 1 supplier of epitaxial equipment since the early '70s." Applied Materials' sales totaled $654 million.

In third place with sales of $616 million, "Canon is the No. 2 stepper supplier worldwide, with about half the sales of its nearest rival. Canon's main strength has been in producing a set of equipment that stimulates a great deal of loyalty among its customers."

At Sematech headquarters in Austin, Texas, top officials of the consortium couldn't be happier about the American companies' pickup of market share. They see the advance as a validation of their policies.

"[Gaining share] was my one wish," says William J. Spencer, president and chief executive officer; "we have turned the corner."

Spencer says that whatever role Sematech played in the gain may be credited to the fact that "60% of our budget gets 80% of our attention: outside work with equipment and materials suppliers on improvements or new processes and machinery as well as the Sematech people: assignees [from member firms] and employees."

The news also comes as a needed pick-me-up for the consortium. There has been concern in this period of tight budgets about the half of sematech's $200 million annual funding that comes from the Defense Department. Also, in January it suffered its first defection when LSI Logic Inc. of Milpitas, Calif., quit. And there have been rumors that another chip house, Micron Technology Inc. of Boise, Idaho, is also preparing to leave.

Spencer says funding is set. As for the resignation of LSI Logic and the possible departure of Micron, he says that Sematech is ready and able to continue as before and carry out its ambitious programs.

Among them: reducing by 25% the time it takes to get new technology to market; developing manufacturing systems for a 0.18-μm process; defining and working on factory-control systems with controls built into tools. And, says William George, executive vice president and chief operating officer, "The way production equipment is designed now is basically empirical: there is no modeling of what happens to the wafer. ICs are designed by computer; tools are designed by lathe. We want to extend the discipline used in designing semiconductors to the design of equipment." ❑

THE TOP 10 FOR 1991

1991 Rank	Estimated Sales ($M)	Company	1990 Rank
1	764	Tokyo Electron	1
2	654	Applied Materials	3
3	616	Nikon	2
4	448	Advantest	4
5	360	Canon	5
6	328	Varian	8
7	316	Hitachi	6
8	263	Teradyne	9
9	243	General Signal	7
10	235	Silicon Valley Group	10

Source: VLSI RESEARCH INC.

World Radio History

BIG COMPANIES JOINING LOW-END ELECTRONICS SUPPLIERS IN RUSH TO CROSS THE BORDER

THE CHINA STAMPEDE

BY JAMES B. STEPANEK

One can get dizzy watching factories move to China. What began as a rush of textile and toy makers years ago has turned into a stampede by low-end elecronics and appliance manufacturers. "All of my friends are making things in China," says Tommy Zau, managing director of Electronic Devices Ltd. in Hong Kong, the world's largest manufacturer of transistors and semiconductors for consumer electronics. "Sooner or later, I will have to go too."

LOCATIONS

It's the same story up and down China's coast. Koreans are arriving by the boatload at Weihai in Shandong province, which has direct ferry service with Inchon. They are turning Shandong, China's third most populous province, into a major export base for South Korean manufacturers of TV tubes, calculators, car stereos, and digital clocks. Japanese factories are moving mainly to the cities of Tianjin and Dalian, where many Japanese executives were born and grew up during the wartime occupation, and also to the three provinces in northeast China—Liaoning, Jilin, and Heilongjiang—that make up the former Japanese puppet state of Manchukuo, an area almost twice the size of Germany. Meanwhile, Taiwanese firms are flocking to Fujian province across the Taiwan Strait.

This trend is nothing new. In fact, the Americans started it years ago by moving factories to Asia for its lower wages. Then the Japanese began to go offshore too, followed by Korea, Taiwan, and Singapore. As their living standards rose workers have refused to do jobs that were dangerous, dirty, or dull, but the "3D" phenomenon has not yet hit China, where people clamor to work in foreign plants that pay the equivalent of about $95 a month.

The sheer magnitude of the transfer of production lines to China is stunning. Some 80,000 people and 15,000 trucks cross the border each day from Hong Kong into China at the Shenzhen crossing, which is just one of a dozen crossings into China from Hong Kong that are serviced by a vast network of air cargo lines and high-speed ferries. Three million Chinese in Guangdong province now work in Hong Kong-run factories, the Hong Kong General Chamber of Commerce estimates. And in neighboring Fujian province, a quarter of the total industrial output comes from foreign-managed factories, sources say.

Now, the electronics giants are joining the rush. Philips NV, the Netherlands-based electronics multinational, recently opened six more plants in China. It now boasts nine, making radio cassette recorders, integrated circuits, optical fiber, fluorescent lamps, color cathode-ray tubes, electric shavers, and video cassettes, among many other commercial and industrial products. Total investment is conservatively estimated at $130 million, making Philips the largest single foreign investor in China's electronics industry.

Philips is not deterred by the political cloud over the nation, nor are others. Human rights may be violated by the Beijing regime, but most foreigners still seem positive about doing business in China. "After all," notes one seasoned executive, "the people I meet hate the government too. So I actually feel that I'm helping by working there."

But moving plants to China can be tricky. "It's not like Eastern Europe, where the Berlin Wall came down and suddenly you have a market economy that everybody understands," a China trader remarked. In China, the wall between communist central planning and fee-market forces still stands. Worse, the wall runs up and down every street and alley in the country, which confuses beginners. In China there can be a state factory belching smoke and producing nothing but losses, and right across the street a semiprivate firm exporting electronic gadgets to California.

Like many multinationals, Philips chose the wrong side of the street when it first entered China. An early showcase, the Beijing Philips Audio/Video Corp., was a huge headache for many years, according to an engineer familiar with the project. Philips had to close a processing plant in Shanghai in 1984 that was "choking to death in bureaucracy," according to a manager who was involved in the closure. Today, four of its nine plants are located in open economic zones in south China close to Hong Kong, where things are reportedly run with the spit and polish the Dutch expect of their facilities.

Philips obviously hopes to gain a cost advantage in China, and a cheap source of supply, to attack archrival Sony Corp. "Either you're in or you're out," says Electronic Devices' Tommy Zau. "To survive you need a production base in China." ❑

SEOUL'S $400 MILLION KOREASAT PROGRAM AIMS TO DEVELOP A DOMESTIC SATELLITE CAPABILITY

KOREA LOOKS TO SPACE

BY KIM NAK-HIEON

South Korea is joining the growing club of countries developing a space industry. Scheduled to launch a communications satellite by 1995, Korea aims to get critical system capabilities from foreign companies in a program designed to make it self-sufficient by the time a second craft blasts off.

AEROSPACE

The $400 million Koreasat program, managed by state-run Korea Telecom, is strong on local partnership and technology transfer. For example, General Electric Co. has won the $143.465 million prime contract for satellites that it will build with a Korean

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partner, Goldstar Information & Communications. Key technologies to be transferred cover payload, ground-control equipment, systems integration, and quality assurance and improvement. And Marconi of the UK is to build transponders and offer technology that GE might be barred from providing by U.S. laws.

The knowledge transfer will be handled by itinerant on-the-job-training teams of 30 Korean engineers that will travel to each manufacturing and test site. "They will lead the next-generation satellite project," says Han Hwanglio, executive vice president of Korea Telecom's Satellite Business Group, which has led the Koreasat project.

"With the program, they are able to go through from system design and manufacturing to test and launching. In a word, our primary goal in this program is to accumulate system engineering experience and knowledge for communications satellites for the second one," says Hwanglio.

He says the next satellite could be developed by local firms, except for the bus sector, with considerable aid from a research institute for satellite communications to be set up by Korea Telecom by 1994. At the same time, Goldstar plans to begin developing and exporting satellite parts, using the technology acquired from the foreign companies. Its aim is to become the prime contractor for the second Koreasat, which is expected to be contracted out early in the next decade.

The Koreasat blueprint calls for two Ku-band dual-purpose birds—one as a backup—to provide direct-broadcast and fixed-station telecommunications. The two will be built between 1992 and 1994, with the primary craft to be launched in April 1995. Satellite service will commence in October of the same year after the backup is aloft. To receive signals, Koreans will need a 24-ft dish.

Six companies—each with a Korean partner—are competing for the launch contract, to be awarded this month. They include U.S. firms McDonnell Douglas, Martin Marietta, and General Dynamics; France's Arianespace; China's Great Wall Industry; and the former Soviet Union's Glavkosmos.

Hwanglio doesn't seem to expect a considerable technological transfer in launch technology. "Most of the technology is barred by the Missile Technology Control Regime," he explains. "Price could be the first consideration in selecting prime contracts for launching service, if their stable technological capabilities are assured," he adds.

In the meantime, ground systems for satellite communications will be developed and manufactured by the Electronics and Telecommunications Research Institute, the leading state-run research institute, and local private firms by next year. About 100 researchers in ETRI alone are doing satellite-communications research in preparation for construction of five earth stations that will be built this year. As Goldstar is participating exclusively in the satellite sector, other Korean firms are likely to focus more on ground systems.

Currently, 30 researchers from the Electronics and Telecommunications Research Institute and local firms are participating in the Canadian VSAT hub development project and Italian Allenia Spazio's DAMA single-channel-per-carrier development project. ❑

ADVERTISEMENT

Small Company's New Golf Ball Flies Too Far; Could Obsolete Many Golf Courses

Pro Hits 400-Yard Tee Shots During Test Round

Want To Shoot An Eagle or Two?

By Mike Henson

MERIDEN, CT — A small golf company in Connecticut has created a new, super ball that flies like a U-2, putts with the steady roll of a cue ball and bites the green on approach shots like a dropped cat. But don't look for it on weekend TV. Long-hitting pros could make a joke out of some of golf's finest courses with it. One pro who tested the ball drove it *400 yards*, reaching the green on all but the longest par-fours. Scientific tests by an independent lab using a hitting machine prove the ball out-distances major brands dramatically.

The ball's extraordinary distance comes partly from a revolutionary new dimple design that keeps the ball aloft longer. But there's also a secret change in the core that makes it rise faster off the clubhead. Another change reduces air drag. The result is a ball that gains altitude quickly, then sails like a glider. None of the changes is noticeable in the ball itself.

Despite this extraordinary performance the company has a problem. A spokesman put it this way: "In golf you need endorsements and TV publicity. This is what gets you in the pro shops and stores where 95% of all golf products are sold. Unless the pros use your ball on TV, you're virtually locked out of these outlets. TV advertising is too expensive to buy on your own, at least for us.

"Now, you've seen how far this ball can fly. Can you imagine a pro using it on TV and eagle-ing par-fours? It would turn the course into a par-three, and real men don't play par-three's. This new fly-power forces us to sell it without relying on pros or pro-shops. One way is to sell it direct from our plant. That way we can keep the name printed on the ball a secret that only a buyer would know. There's more to golf than tournaments, you know."

The company guarantees a golfer a prompt refund if the new ball doesn't cut five to ten strokes off his or her average score. Simply return the balls — new or used — to the address below. "No one else would dare do that," boasted the company's director.

If you would like an eagle or two, here's your best chance yet. Write your name and address and "Code Name S" (the ball's R&D name) on a piece of paper and send it along with a check (or your credit card number and expiration date) to National Golf Center (Dept S-203), 500 S. Broad St., Meriden, CT 06450. Or phone 203-238-2712, 8-8 Eastern time. No P.O. boxes, all shipments are UPS. One dozen "S" balls cost $24.95 (plus $3.00 shipping & handling), two to five dozen are only $22.00 each, six dozen are only $109.00. You save $55.70 ordering six. Shipping is free on two or more dozen. Specify white or Hi-Vision yellow.

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A SPECIAL SUPPLEMENT TO ELECTRONICS

DATAQUEST/ELECTRONICS

En Route to Collaborative Computing

Telecom Technology Is Pivotal to the Full Flowering of Multimedia

This White Paper was developed by Dataquest Inc. and Electronics and written by Samuel Weber

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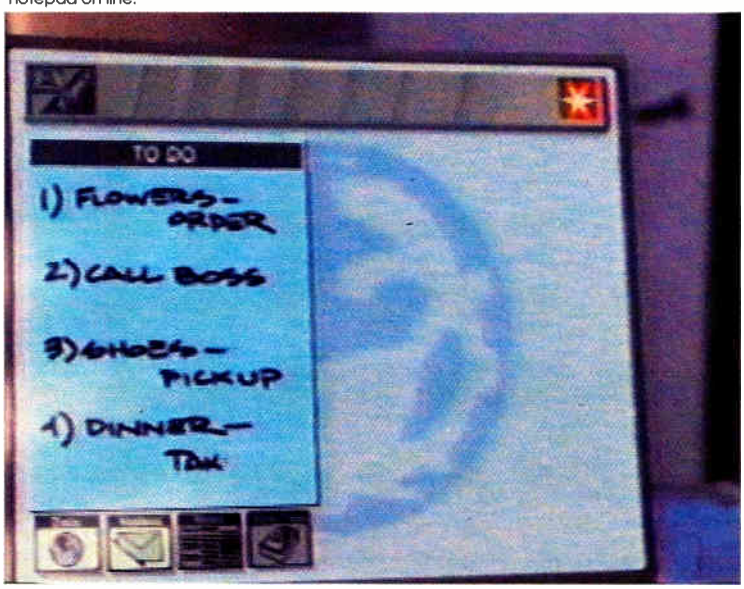
THE TELEPHONE'S New Frontier

Multimedia has been much ballyhooed without making substantial gains in the marketplace. But now its time has come.

This is the year that hardware and software will begin shipping in volume and making their way into the offices of Fortune 500 companies, according to Dataquest Inc. The San Jose, Calif., market research company pegged 1992 as multimedia's watershed in a recent survey of telecommunications, software, and hardware vendors as well as end users and content producers. Already there are multimedia systems at work in schools, offices, advertising agencies, and merchandising centers fulfilling functions the proponents of multimedia have long claimed for it. And that's just the beginning.

Tomorrow's telephone will have such conveniences as an electronic version of the ubiquitous paper notepad on line.



Combining the dynamic graphics and sound of TV with the interactive capability of computers, multimedia is an unprecedentedly powerful form of information processing and presentation. The ability to navigate in a nonlinear, visually intuitive fashion through a data base or other application gives the user easy access to all kinds of information that he or she can seek at will. Linking multiple users via video teleconferencing is already enhancing worker productivity, providing training to geographically remote classrooms, and saving corporations time and money by reducing the need for travel.

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In its full flowering—when multimedia workstations are linked by local- and wide-area networks—users at different locations will be able to share data and files, and work on problems simultaneously. In short, we are about to enter the age of what has variously been called computer-supported collaboration or collaborative computing.

Much has been made of the issue of which of two warring delivery vehicles will dominate multimedia: the TV or the PC. The answer may be both, each in its own way. Consumer electronics companies are bringing interactivity to the TV set via an attachment that plays an optical disk or other type of storage medium, giving viewers access to an extensive library of games, instructional material, electronic books, and other types of information. On the personal computer front, CD-ROM drives offer sophisticated games, books, and other information sources in a format that permits storage, editing, printout, and transmission of captured images.

The true power of multimedia will emerge via the convergence of technologies: computing, TV, and telecom.

HOLD THE PHONE

Less attention has been paid to another, equally vital multimedia platform: the telephone. Universally available, the phone provides both home and office with an input and an output for information, to which extra functionality can be added. The true power of multimedia will emerge not through a single delivery medium but with the convergence of all three technologies: computing, TV, and telecommunications. In fact, the overwhelming majority of the Dataquest survey respondents believe telecommunications will be not just an integral part of multimedia computing, but a major and pivotal component.

The recent introduction of a relatively low-cost video phone by AT&T Co. demonstrates how compressed video—even at the lower bit rates—can bring added impact to the delivery of information by telecommunications. The Videophone 2500 operates over existing analog phone lines. Ultimately, when the integrated services digital network (ISDN) and, later, the broadband capabilities of fiber-optic lines become available, multimedia will hit both home and commercial markets in full force, offering a host of

COVER PHOTO AND SCREEN SHOTS COURTESY OF PACIFIC TELESIS, *FIRST BORN* VIDEO. CHIP SHOT AND RAPPORT SOFTWARE COURTESY OF AT&T CO.

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new interactive information services as well as video-phone service.

ISDN is key to multimedia's growth, says Rich Baker, director of research at video-teleconferencing leader PictureTel Corp. in Peabody, Mass. "You need a network before you have a market. We don't think the home market will happen until the [system] price hits well below the $1,000 mark, and until ISDN service is available," Baker says. "About a third of the lines in the U.S. are capable of ISDN, but nowhere in the States has a phone company tariffed ISDN for residential use." ISDN's basic transmission rate of 128 Kbits/s is tailor-made for video, he adds.

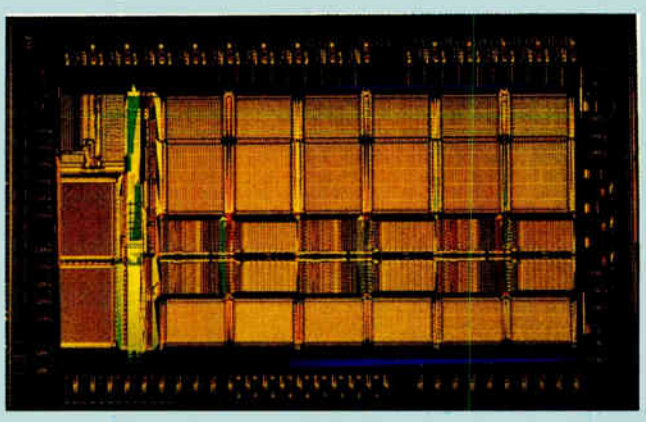
In the meantime, the driver will be the existing telecom network, says Arnold Englander, manager of market development for AT&T Microelectronics in Berkeley Heights, N.J., and manager of AT&T's Video Codec VLSI Program. "Telecommunications-intensive multimedia computing will build upon the digital precursors of ISDN—and it will accelerate ISDN deployment," Englander declares.

The telephone companies may be going head to head in this new market with the cable TV industry, which already has wideband networks in place and will soon switch to compressed digital transmission, thus greatly increasing the number of available channels from 35 or so to well

The advent of ISDN is key to multimedia's growth; its basic rate of 128 Kbits/s is tailor-made for video.

AN INTEGRATED SOLUTION

One obstacle impeding the development of computer-based interactive video and video telephony has been the absence of low-cost audio and video compression and decompression circuits. That has changed this month with the introduction of the AVP1000 Video Codec chip set from AT&T Microelectronics in Berkeley Heights, N.J. The chip set, along with the AT&T 3210 digital signal processor and a selected telecommunications IC, provides all the essential processing functionality needed to build a complete desktop video-teleconferencing system. The solution conforms to three key standards: MPEG (Motion Picture Experts Group), JPEG (Joint Photographic Experts Group), and Px64, the communications specification.



The AT&T solution is the most integrated available on the market today. The chip set includes the AVP-1400D decoder, which performs MPEG and Px64 decoding, and two encoders, the AVP-1300E and the AVP-1400E. The lower-cost 1300E performs MPEG and Px64 compression but without MPEG's motion estimation (which compresses by eliminating redundancies common to successive frames). The 1400E encodes both the Px64 and MPEG specs, and provides high-speed motion-estimation processors. Part of the single-instruction multiple data (SIMD) processor used in the encoder and decoder is shown in the photo.

The three-chip set featuring the 1300E encoder is priced at $376 in OEM quantities. The powerful AVP-1400E encoder will be available separately in the fourth quarter.

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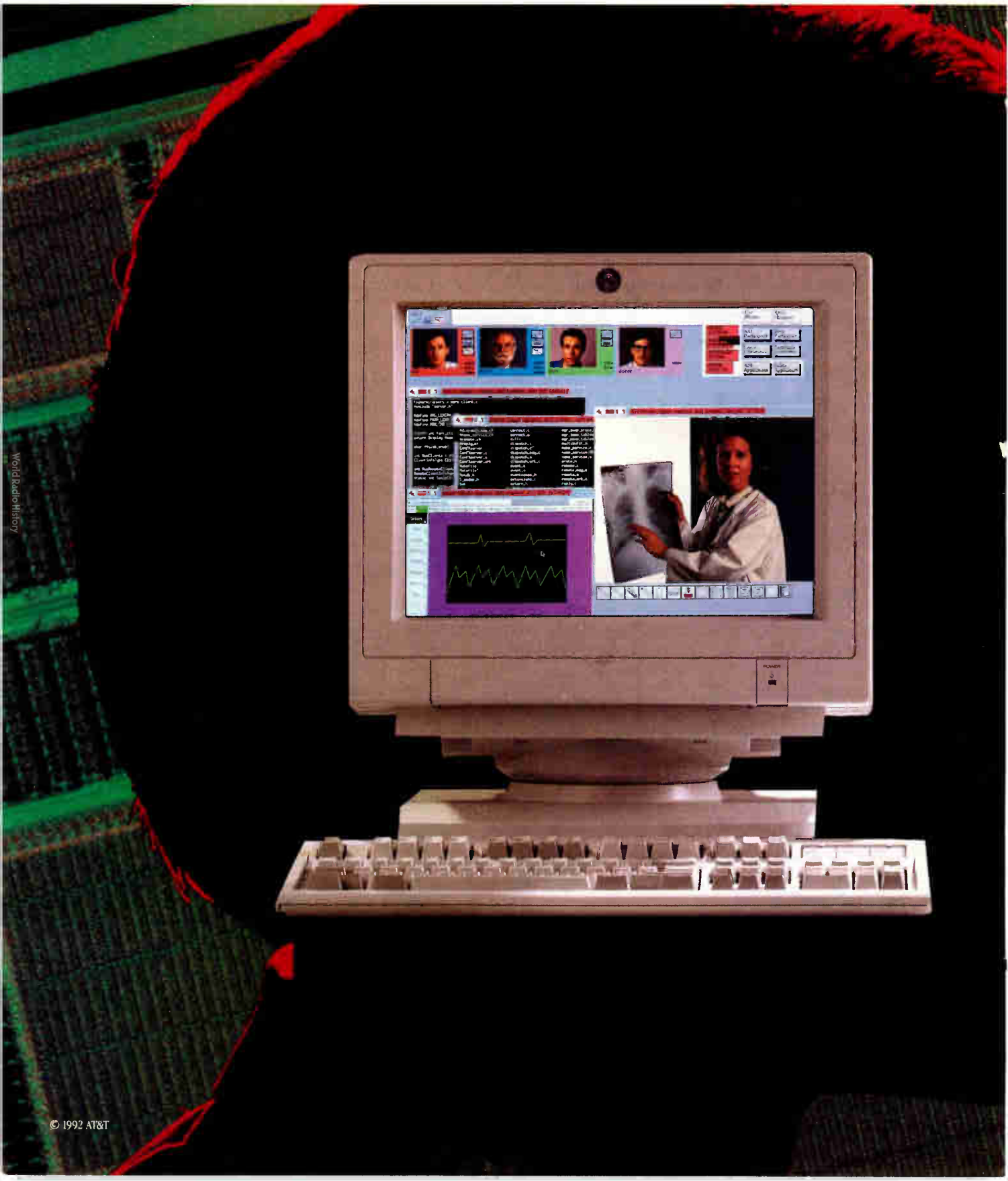
The first DSP-based helps you design a "first"



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operating system that in multimedia.

That's AT&T "Customerizing."

If you'd like to pace the market with a flexible, upgradeable multimedia PC or workstation, we offer you the first cost-effective solution.

A multitasking, realtime operating system ported to a DSP. It utilizes existing system memory—along with full function application libraries to make a broad spectrum of integrated multimedia applications an attainable reality.

New DSP3210

An enhancement of our DSP32C architecture, the floating point DSP3210 operates as a parallel processor to the CPU in PCs and workstations. It offers up to 33 MFLOPS of processing power, so audio, still image, speech processing and communications become an integrated part of the computer.

VCOS™ operating system

AT&T's VCOS Operating System is both open and platform-independent. It integrates the DSP3210 into PCs and workstations without costly DSP SRAMs, and without affecting critical realtime processes. The VCOS operating system enables application developers to create multitasking multimedia applications without requiring DSP expertise.

VCOS library and tools

Our extensive VCOS software library, developed by AT&T Bell Laboratories, offers low bit-rate speech coding and recognition functions; CD-quality audio coding (MPEG Audio, CDXA and others); image compression (JPEG); high speed modems (V.32 Data and V.29 Fax); and telecommunication and graphics, all compliant with industry standards.

Our hardware and software tools enable you to design complete end-user applications to run under VCOS. And both realtime and non-realtime applications can be developed by combining algorithm code blocks.

That's what AT&T means by "Customerizing."

For more about today's most complete multimedia solution, just give AT&T Microelectronics a call at 1 800 372-2447, ext. 640.

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Many firms have installed video-conferencing equipment, and falling prices are fast attracting new users.

In the future, pay phones will provide the same video-conferencing capability as the telephone in the home or the office.

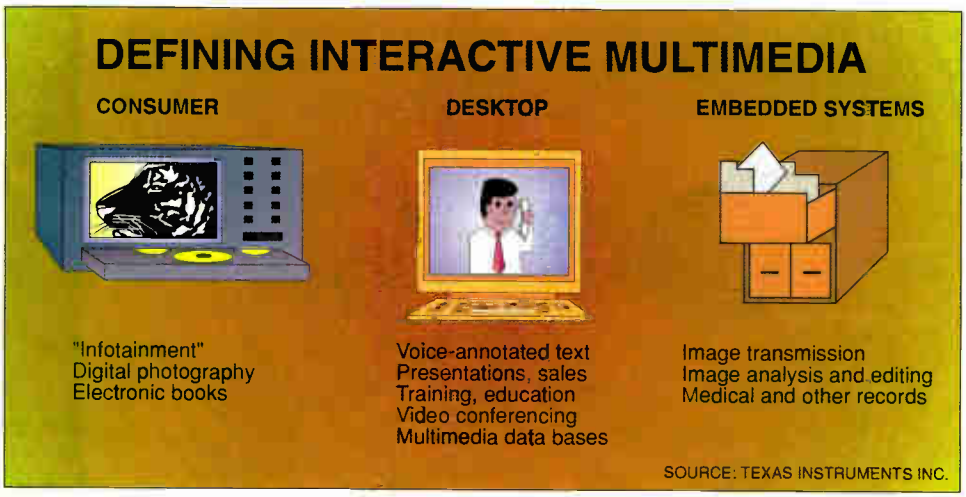
over 100. (Over optical fibers, the number could hit 300.)

Increased channel capacity combined with digital compression will offer opportunities for additional services and additional interactive capabilities. Cable companies are already looking at the educational market.

Almost all high schools have access to local cable TV networks, which could be an effective delivery system for educational programs and "learning at a distance." At the Carrollton High School in Carrollton, Ga., for example, engineers from the Georgia Center for Advanced Telecommunication Technology joined with cable TV companies, which supplied equipment and training, to bring multimedia to the classroom. With personal computers provided by IBM Corp., students proceed at their own pace with their TV coursework, with the help of a teacher who provides individual help.

VIDEO-CONFERENCING EXCITEMENT

The main market excitement right now is in video teleconferencing, one of the fastest-growing segments in the communications arena. Many large companies have already installed video-conferencing equipment in conference rooms, and costs have dropped low enough to attract midsize companies as well. The price tag for systems that operate over switched 56-Kbit/s networks or dedicated links has fallen below $20,000, says Baker of PictureTel. What's more, he says, product quality, flexibility, and portability are up, thanks to digital compression techniques for audio and video, and the availability of better and less expensive video codecs.



Costs are down on the telecommunications-services side, too. The price of a one-hour coast-to-coast video-conferencing call on a digital dial-up network

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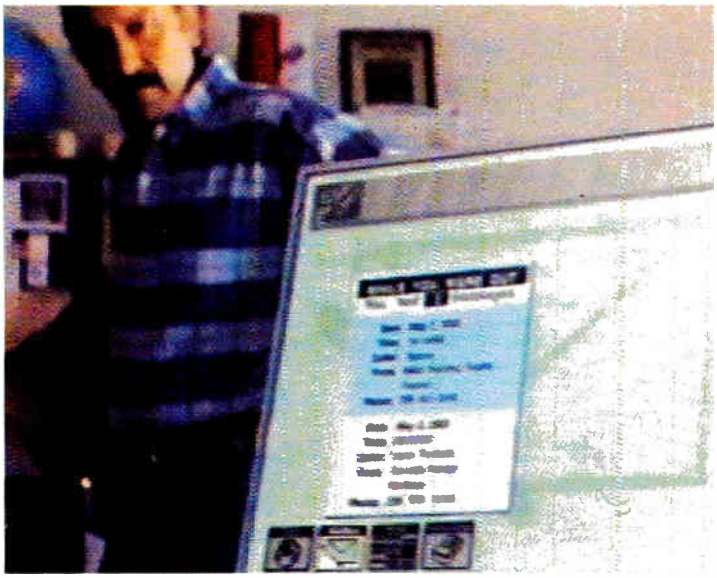


Phones will deliver recorded video mail, complete with time and date stamp.

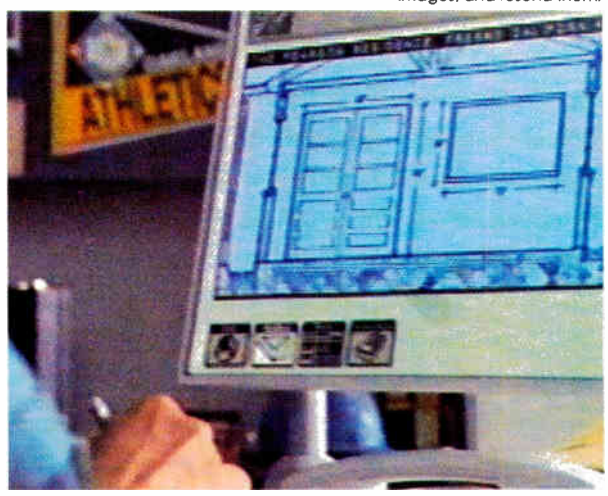
is now less than $20 an hour. Standardization has helped as well. The advent of the International Telegraph and Telephone Consultative Committee's Px64 video-conferencing standard assures interoperability among different vendors' equipment. Baker, like many others, believes video-conferencing will be ubiquitous by the end of the decade.

Most video-teleconferencing installations today are dedicated, stand-alone facilities set aside for just that purpose. Meetings must be scheduled in advance with the concerned parties, and users cannot share data files directly. "Video conferencing so far is like two cans on the end of a string," says Fred Dyer, director of the Multimedia Laboratory at the Georgia Institute of Technology.

But corporate interest in the technology is rising so fast that video conferencing may soon impact the workplace in a big way, Dyer says. "We think kiosks, teleconferencing, and learning will be dependent on the network," he says. "We need a switched network so that you can interconnect and make it as seamless and transparent to the user as possible."

Soon the forum will no longer be a preplanned meeting in a conference room. Rather, it will be a casual video chat on the desktop. Multiple workstations that are interconnected locally via LANs will interface with the public switched network, and that change will transform the way companies conduct business. Users of such desktop conferencing systems will be able to access stored video and audio from a central server, hold conferences with remotely based colleagues via the PCs on their desks, and work simultaneously with them on files in a shared electronic workspace. Such a setup promises huge gains in flexibility and productivity as well as reduced corporate travel costs. That's why this merger of video conferenc-

Tomorrow's telephone will allow subscribers to send, receive, electronically modify, or annotate still images, and resend them.



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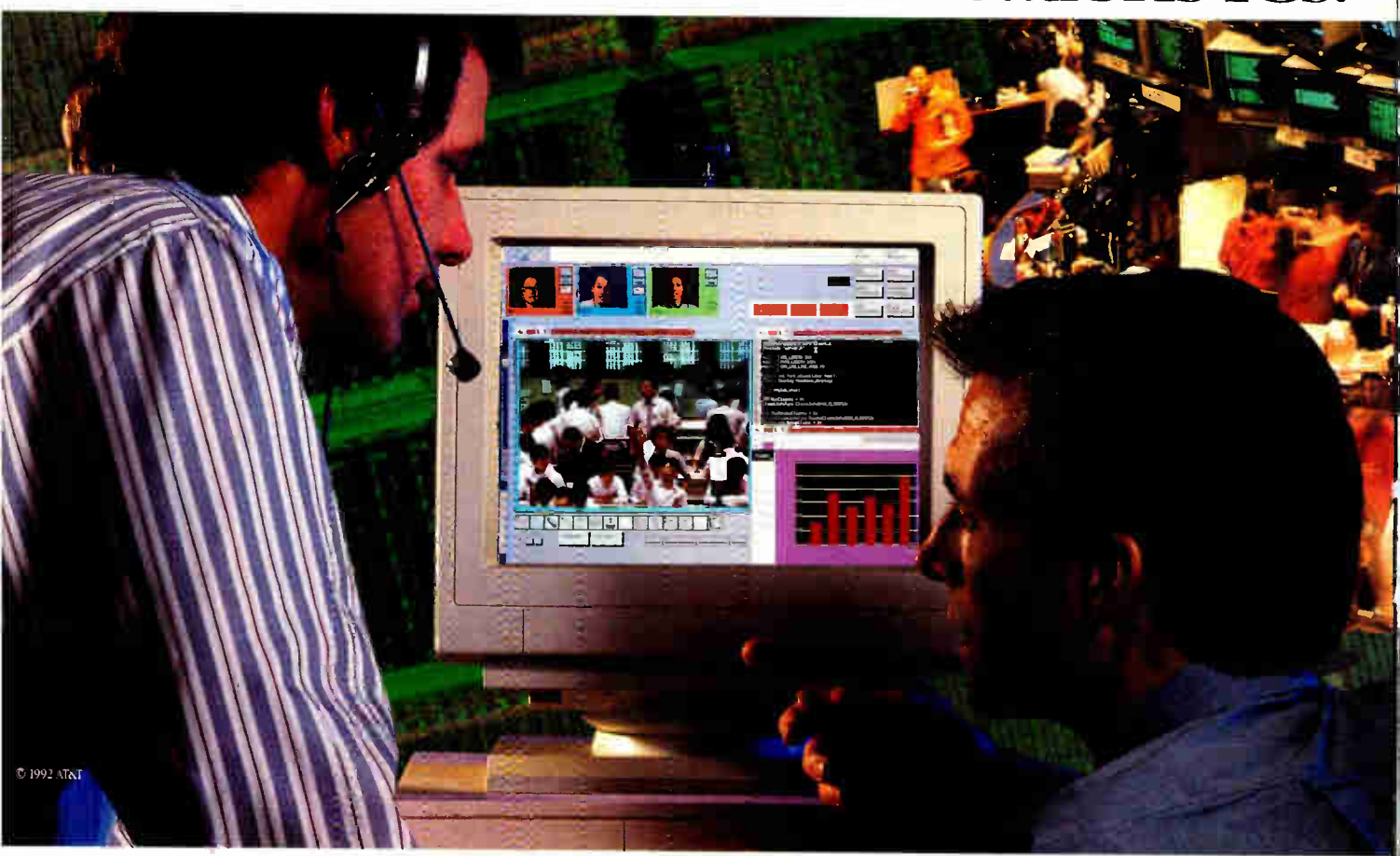
In the future, video phones will verbally announce both the caller and the location he or she is calling from.

ing, personal computing, and multimedia is attracting so much interest from the business world—and why the fledgling market is attracting so many vendors.

The market for video-conferencing systems today is a modest $105 million to $110 million, says Walt Bonneau, manager of multimedia development at Texas Instruments Inc.'s Semiconductor Group in Houston. "We think it will grow to $600 million by 1995—and that's conservative," he says.

Video-conferencing features and functions as we know them today will be moving to RISC-type workstations by late 1994, says Bonneau. "In early '94, you will see some companies offering teleconferencing as an

Multimedia Communications ICs:



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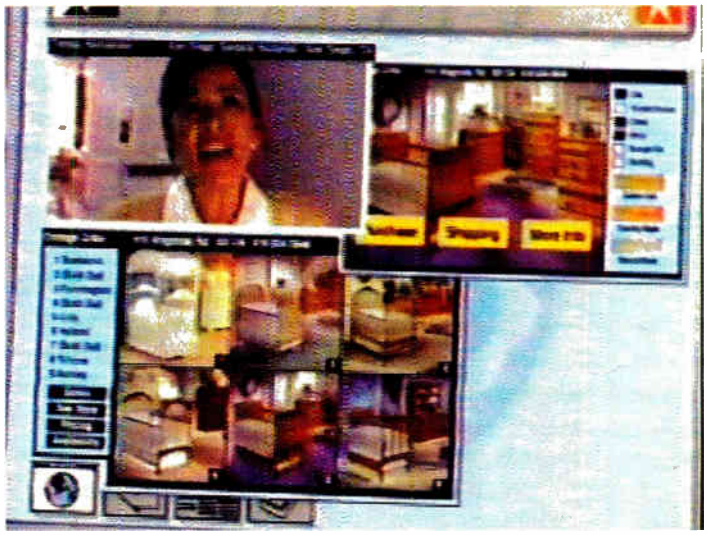
added feature on a workstation." Half the Dataquest survey respondents agree with Bonneau, predicting that videotelephony will be integrated onto computers in the 1993-94 time frame. Half believe it will happen a bit later: between 1995 and 1997.

But major problems—some gaps in technology that are just now being addressed—are perceived as barriers that must be removed before these gains in the marketplace can be realized. For example, the conflict between the synchronous nature of digital video and audio signals, versus the asynchronous burst form of data for which LANs are designed, can produce network delays that frequently cause audio and video data streams to lose synchronization and drop out.



Subscribers will be able to shop together by phone from the same electronic Yellow Pages.

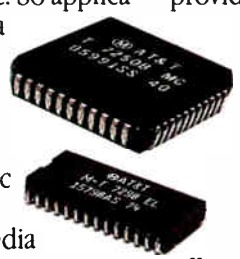
Many LANs, such as Ethernet, have limited bandwidth that varies with network usage and traffic. It can drop below the minimum required

From here to there, or even further.

That's AT&T "Customerizing."

Multimedia PCs and workstations must be able to communicate as well as compute. So applications can be sent across a campus, a city, or around the world.

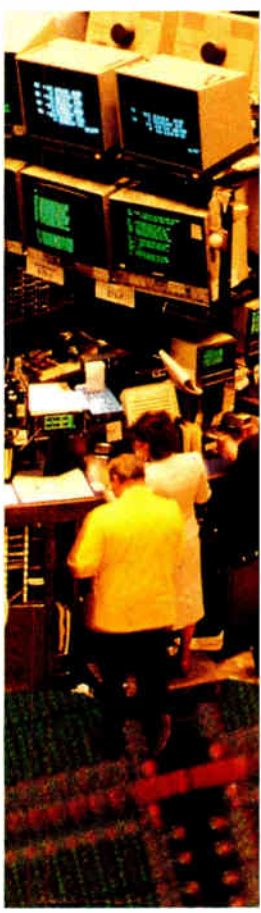
Building on its communications expertise, AT&T offers solutions for multimedia access to the many levels of ISDN and its precursors: Basic Rate ISDN. Switched services and FT1 for low-cost,wide-area multimedia communications. And Primary Rate ISDN and T1 for higher quality, wide-area multimedia communications, with an eye toward FDDI-II for local area multimedia networking.



AT&T's Multimedia Communications ICs include a universal serial bus interface. This provides a glueless connection to audio, video and data ICs without extra interface circuitry, reducing design time and board space. An all-CMOS architecture means lower power, smaller footprint. That's AT&T "Customerizing."

Our Multimedia Communications ICs are designed by AT&T Bell Laboratories, pioneers in networking technology, offering maximum reliability, minimum design risk.

For more information, just call AT&T Microelectronics at 1 800 372-2447, ext. 639. In Canada: 1 800 553-2448, ext. 639.



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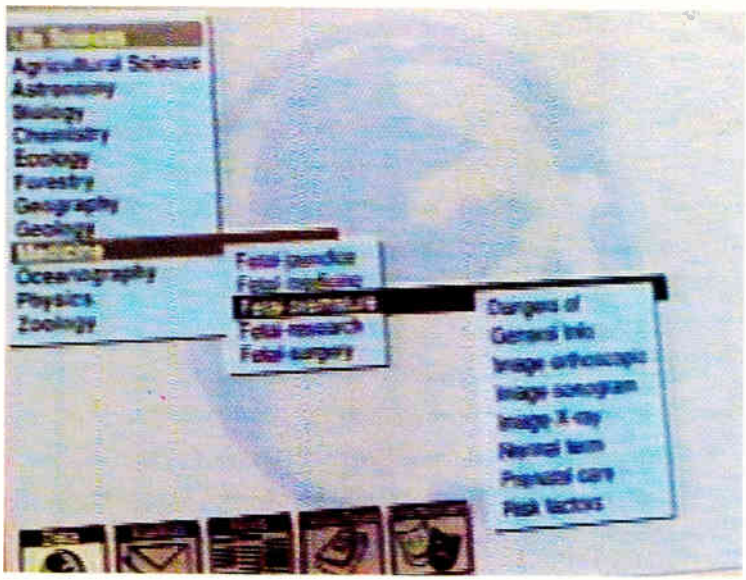


From their intelligent video phones, subscribers will have access to an incredible wealth of text, image, and video information.

by a digital audio and video data stream, resulting in deterioration of sound and image.

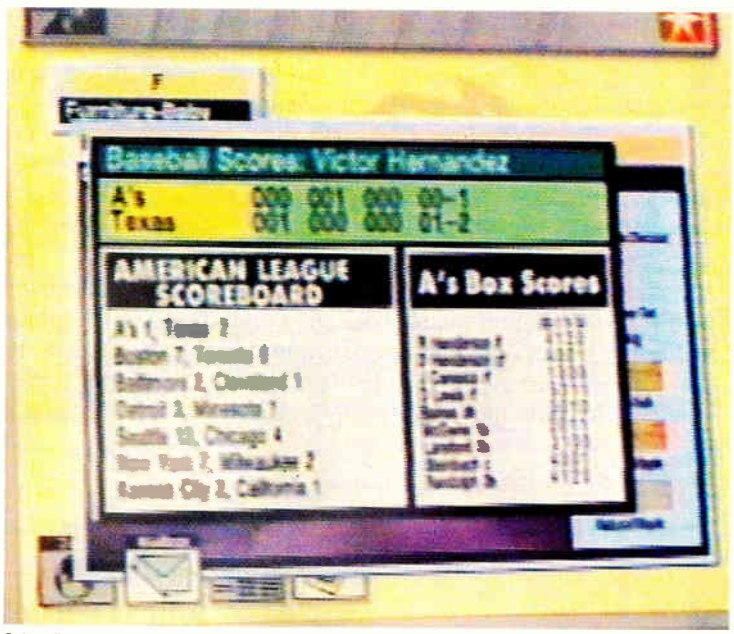
But solutions to these problems are beginning to arrive. For example, Fluent Inc. of Natick, Mass., has developed video-networking software called FluentLinks for managing the flow of video and audio data between a server and multiple clients within LANs and WANs. FluentLinks supports the concept of scalable video—the capability to dynamically adapt video data rates to available network bandwidth, allowing motion video with synchronized audio to be sustained even under heavy load conditions.

PERSON TO PERSON

Another solution comes from IBM, which recently introduced Person to Person for networked PS/2s. Designed for use by two colleagues located across the country or in adjoining offices, Person to Person permits real-time electronic collaboration and the sharing of files. It can be used with IBM ActionMedia II, IBM's plug-in board that displays compressed video on the PC screen, Intel Corp.'s Digital Video Interactive (DVI) hardware, or an IBM M-Motion Adapter/A running on LANs, Token Ring, Ethernet, and ISDN networks.

Protocomm Corp. of Trevose, Pa., meanwhile, has announced a software product that networks DVI audio, video, and still-image files residing in a Novell file server. It supports up to five workstations.

Another significant barrier to the proliferation of multimedia—cost—is also falling. Low-cost video-processing and codec chips and chip sets will soon be



Subscribers can access such timely information as American Baseball League statistics.

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AT&T's new Rapport software allows for collaborative computing. It enables an interactive video conference of several participants, all working simultaneously on the same shared document from remote locations.

found on PC motherboards and cards. Over the next few years, codecs "will support the Px64 and MPEG [Motion Picture Experts Group] standards along with proprietary extensions, over the bit-rate range of 40 Kbits/s through 2 Mbits/s and higher," says AT&T's Englander. The requirements for such processors are extremely stringent, especially if, as many chip makers contend, they must be programmable in order to conform to all the audio and video compression/decompression standards. In addition, they must be able to handle such functions as audio, video, and data multiplexing and demultiplexing; synchronization; bandwidth allocation; and channel management.

Already on the market is LSI Logic Corp.'s three-chip set that is compatible with the Joint Photographic Experts Group's standard for compressing and decompressing still video. Integrated Information Technology Inc.'s programmable single-chip compression device, the Vision Processor, resides on a board from Compression Laboratories Inc. in the new AT&T video phone.

Low-cost video-processing and codec chips will soon be found on the PC motherboard and on cards.

PROGRAMMABLE PROCESSORS

Later this year, Intel will introduce its third-generation i750 programmable chip capable of supporting any or all of the internationally approved standards, including JPEG, MPEG, and Px64. Texas Instruments, too, is working on a programmable processor, according to Bonneau, and AT&T Microelectronics promises to soon introduce a line of VLSI chips and software that provides a complete solution for all of the multimedia functions.

Dataquest survey respondents put cost at the top of the list when asked what they perceived were barriers to multimedia development. But

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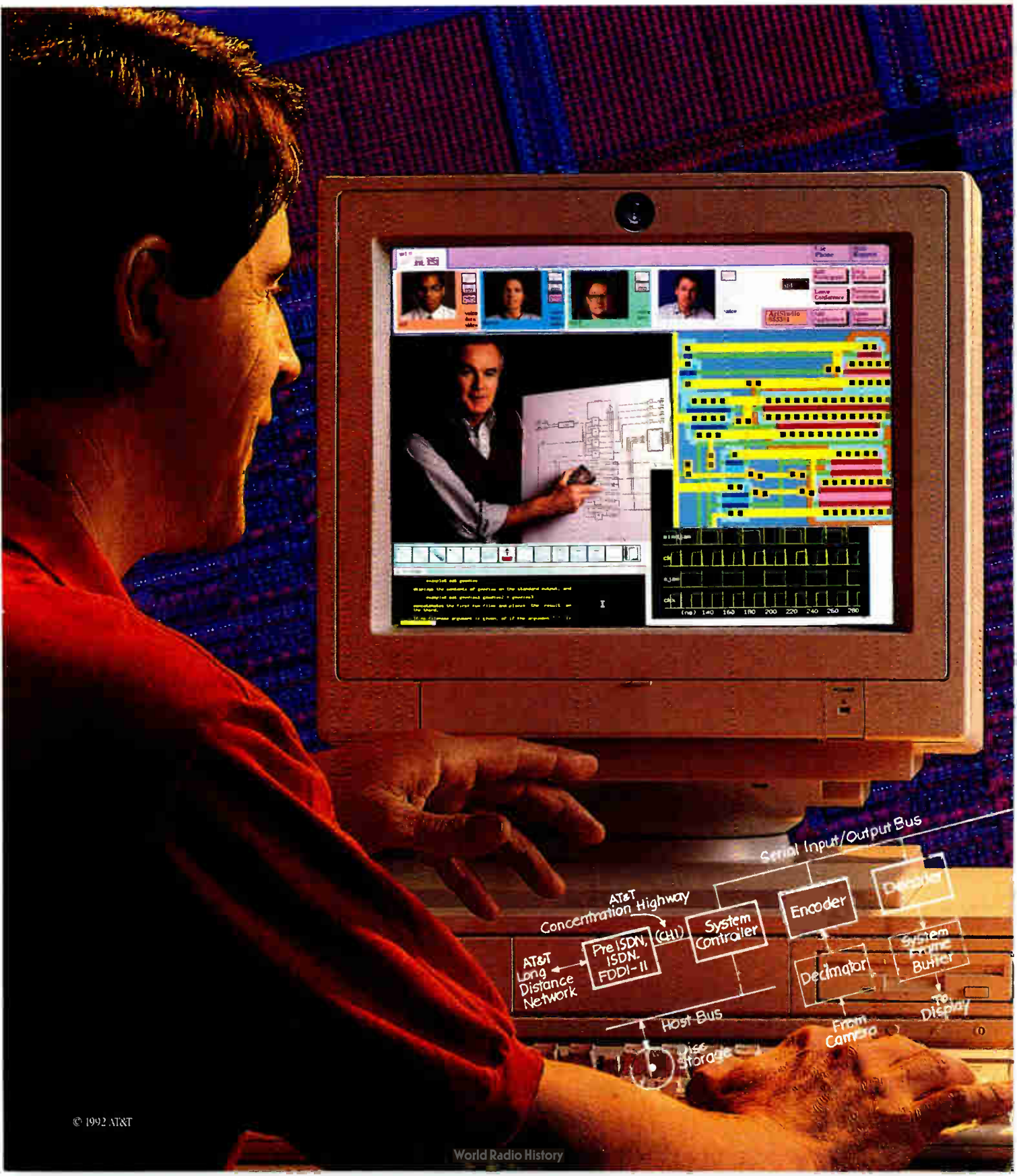
Giving you something in multimedia: A complete



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completely new solution.

That's AT&T "Customerizing."

"Customerizing" means helping you build a complete range of multimedia capabilities into your PC or workstation product lines. Quickly and cost-effectively. By offering you a complete multimedia solution.

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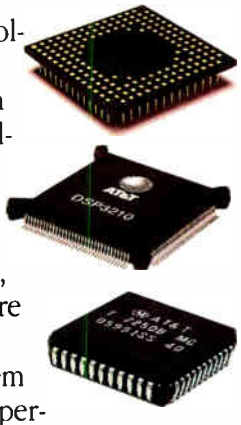
Every chip needed to perform the key multimedia functions. Audio. Video. Data. And Telecomm. Including all interfaces.

Our new Video Codec chip set, a 3-chip encoder, decoder, systems controller solution, operates from 40 Kbits/s through 4 Mbits/s to support full-motion digital video over a wide range of applications.



To simplify design-in, our multimedia DSPs are supported by AT&T's VCOS™ operating system (Visible Caching and Operating System). And by a function library based on AT&T Bell Laboratories' leadership in signal processing algorithms.

Another key feature: Multimedia Communications ICs that support ISDN and its precursors for wide-area multimedia communications, with an eye toward FDDI-II for local area multimedia networking.

Complete Functionality

We can provide every process and interface device needed for multimedia audio and video. For still-image compression and decompression. True color graphics controllers and 24-bit RAMDACs. Audio/video/data multiplexing and demultiplexing. Bandwidth allocation. And channel management.

Complete Compliance

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For more about the industry's most complete multimedia offering, call AT&T Microelectronics at 1 800 372-2447, ext. 630.

AT&T Microelectronics

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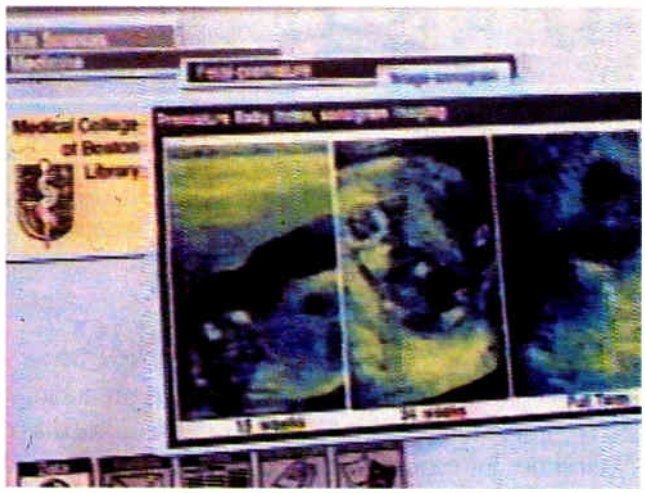

Data accessed by video phone can be as complex as the sonargram of a developing fetus.

More rapidly than expected, the elements that must combine to make multimedia a reality are coming together.

they also thought market education—convincing the population at large that multimedia will be a powerful and easy-to-use adjunct to their home and working lives—is a big hurdle to overcome.

Copyright law is another sensitive issue. "People who own media rights to program material will be in an enviable position," says Dyer of Georgia Tech. "Media guys are buying up rights to all kinds of things. The royalty costs that plague the music business might perpetuate themselves in multimedia. From a user point of view, it is disturbing to have everything locked up behind the copyright window."

For multimedia computing, all the Dataquest survey respondents felt there was still a lot to be done in providing application software, increasing network data rates, providing wideband telecommunication networks, and finalizing standards. But despite these unresolved problems, the multimedia juggernaut rolls on. "To many, this looks like a tidal wave starting to swell," says AT&T's Englander. Certain elements are in place, he says: the readiness of the telecommunications infrastructure; the emergence of critical video-compression and telecom standards; advances in image compression, VLSI technology, and object-oriented programming; and the high costs of travel in a business environment that's ever more global in scope.

The video phone will bring people separated by great distances into one another's living rooms.

More rapidly than expected or imagined, the elements that must combine to make multimedia a reality are coming together. And "the ambitions of diverse businesses competing and cooperating in the convergence of telecommunications, computing, and TV," as Englander puts it, guarantee that the ride will be an interesting one.

World Radio History

HURTLING THE LANGUAGE BARRIER

A consortium of researchers and industry engineers is about to start a project that aims to fulfill one of mankind's oldest dreams: overcoming the language barriers between different peoples. By the year 2000 the group hopes to develop a portable and automatic system that translates languages into spoken English.

The so-called Verbmobil project, sponsored by Germany's Ministry for Research and Technology, aims at a system that translates spontaneously spoken language. The common denominator is English; in other words, it is assumed that two people in conversation—say, a German and a Japanese—have a fair command of English. The Verbmobil translates each partner's spoken words into English. Depending on the two persons' language capabilities, the system will either translate the entire conversation or deliver only the more difficult words and passages.

Under contract to the ministry, two independent teams, one from Stanford University in Palo Alto, Calif., and the other made up of German researchers, have completed feasibility studies for the Verbmobil system. Encouraged by these studies, the research ministry is now outlining an eight-to-10-year research and development project. In the first four-year phase, work on certain project elements will begin.

The ministry will finance this phase to the tune of $9 million a year and expects additional support to come from the project partners. Participating in the effort will be a number of German universities, the German Research Center for Artificial Intelligence, the Institute for Applied Information Technology, and the industry, specifically Siemens AG and IBM Corp. in Germany.

The ministry is also looking for participation from the European Community as well as Japanese and U.S. partners—for example, the Advanced Telecommunications Research Institute in Kyoto and Carnegie Mellon University in Pittsburgh.

One big challenge is the development of suitable processor chips for a system with real-time response capabilities. Experts figure that to accomplish simultaneous speech translation a computing power up to 1.5 billion operations/s would have to be handled at minimum loss and in a minimum of space. In addition, they say, 100 Mbytes of memory would be needed, also housed in a minimum of space. It is expected that by the end of this decade only 0.1 μm^2 will be needed for 1 bit of a cell in a dynamic random-access memory. ❑

NOW JESSI IS PUSHING CHIP DEVELOPMENT FOR HDTV

Now entering its main phase, the Joint European Submicron Silicon Initiative has embarked on one of its ambitious "flagship" projects: high-definition TV. Such projects [*Electronics*, December 1991, p. 37] involve joint developments that, instead of aiming toward esoteric goals in science and technology, lead to products that it is possible to market commercially and thus manage to catch the public's attention.

With that formula in mind, HDTV is a natural—if nothing else, it can't help but garner a great deal of attention. What the people who run Jessi intend to do with their HDTV flagship project is develop advanced, high-performance chips for the TV of the future. But that's not all: the scientists and engineers are also developing methods and procedures for testing such chips.

Participating in the effort are 10 companies from five countries: Belgium, France, Germany, the Netherlands, and the UK. For the project, which is scheduled to run until 1994, Jessi officials have earmarked about $140 million, with roughly 25% of that money to come from Germany.

Jessi officials hope that the high-speed, high-complexity HDTV circuits to be developed will serve as pacesetters in designing ICs for other portions of the consumer electronics market. They are also banking on HDTV to create a huge demand for high-performance consumer chips, a demand considered crucial if Europe is going to manage to develop a stronger base in microelectronics. ❑

GERMANS REPORT 53-GHZ SILICON TRANSISTOR

Experts at the Daimler-Benz Research Laboratories in Ulm, Germany, have developed a silicon-based transistor that can handle frequencies up to 53 GHz. A similar speed performance for a silicon transistor has been achieved so far only at IBM Corp.'s Thomas J. Watson Research Labs in Yorktown Heights, N.Y.

This record has been obtained with a hetero-bipolar transistor (HBT), a technology that not only is faster than conventional silicon technologies but also outdoes them in other aspects: current amplification is higher, and both noise and power consumption are lower.

The heart of the new transistor is a 50-nm silicon-germanium base layer. A high boron doping level makes for a high charge-carrier density and hence for a low resistance, the prerequisite for fast switching. With HBT's opening the high-frequency ranges to silicon technology, high-frequency devices and conventional silicon circuits can be integrated on the same chip.

Unlike conventional silicon transistors, HBT's consist of layers of different semiconducting material. To obtain that structure, germanium is usually added to the silicon. Even though germanium atoms are somewhat bigger than silicon's and wouldn't fit into the silicon crystal lattice, the researchers managed to make the different layers monocrystalline by using molecular-beam epitaxy to grow extremely thin layers on top of each other. So all transistor layers are made in one process step at low process temperatures—typically 550°C. ❑

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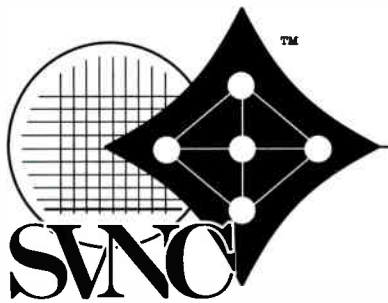

THE SILICON VALLEY NETWORKING CONFERENCE

Location : The Santa Clara Convention Center, Santa Clara, California and the adjacent Westin Hotel

APRIL 27 - 29, 1992

KEYNOTE SPEAKERS:
Eric Benhamou, Chief Executive Officer, 3Com Corp.
Dr. Colin Mick, Technical Director, Network Products, Comdisco Systems Inc.

The Silicon Valley Networking Conference is the only networking conference that focuses on the DESIGN side of network-related hardware down to the chip level as well as the development and use of network management and testing software. In addition to technical papers that focus on design issues there will be panel sessions and papers for system planners and strategic MIS executives that focus on future technology trends and network implementation issues.

The SVNC program venue consists of three full-day tutorials on the opening day (Monday, April 27) and more than 70 technical and management-oriented paper and panel presentations arranged in three parallel sessions on the second and third days (Tuesday and Wednesday, April 28 and 29). Table-top product exhibits and demonstrations will supplement the technical paper program on Tuesday and Wednesday. Limited exhibit space is still available; contact Ken Majithia at SysTech Research - (408) 924-3930 - for exhibition details.

The Silicon Valley Networking Conference is a creation of SysTech Research. SVNC is co-sponsored by 3Com Corp., National Semiconductor Corp., and Electronic Design and Electronics Magazines (Penton Publications).

SVNC'92 TECHNICAL PROGRAM OVERVIEW*

Monday, April 27

Tutorial Subjects
(full day seminars)

(T1) FDDI

(T2) INTERNETWORKING

(T3) NETWORK MANAGEMENT

Tuesday, April 28

Keynote Presentation
(morning subjects)
FDDI
Distributed Systems
LAN Foundations
Future Technology Issues
Panel: Technology's Impact on Networking

PRODUCT EXHIBITS** & Lunch

(afternoon subjects)
Internetworking
ISDN and SONET Design
Distributed Systems
LAN Applications and Protocols
LAN Technology Issues
Network Implementation Approaches
Panel: Implementation Issues

PRODUCT EXHIBITS**

Wednesday, April 29

Keynote Presentation
(morning subjects)
Physical Layer Design
Network Management
Internetworking
Wide-Area Networking
Panel: Internetworking Issues

PRODUCT EXHIBITS** & Lunch

(afternoon subjects)
Physical Layer Design
New Architectures and Functions
High-Speed Networking
Network Implementation Approaches
Panel: A Status Report on Global Networking

*tentative; subject to change

** *Product exhibits are open from Noon to 2 pm and from 5:30 to 7:30 pm on Tuesday, April 28, and from Noon to 2 pm on Wednesday, April 29.*

Note: Registration fees for the conference include coffee-break refreshments, lunch, one set of tutorial notes and/or conference proceedings, and one exhibits admission. A $100 handling fee will be charged for registrations cancelled before March 30, 1992; no refunds after March 30.

Make your room reservations directly with the Westin Hotel, 5101 Great America Parkway, Santa Clara, Calif. (408) 986-0700; Ask for the special SVNC room rate.

SVNC'92 REGISTRATION FORM

Please mail in this form with your payment. Make checks payable to SysTech Research and mail to: SysTech Research, 1248 Olive Branch Lane, San Jose, CA 95120. FAX inquiries to (408) 997-8265.

	Payment * postmarked by 3/30/92	Payment * postmarked after 3/30/92	Payment at the door
(A) Tutorial only (one tutorial on 4/27) Select one: T1 --- T2 --- T3	$250	$295	$350
(B) Papers only (includes exhibits entry) (Technical paper sessions on 4/28, 29).	$350	$395	$450
(C) Full conference (includes 1 tutorial, all papers and exhibits); mark tutorial in (A). . .	$450	$495	$550
(D) Exhibits-only admission (Table top exhibits only on 4/28 or 4/29). .	$ 25	$ 25	$ 25
(E) Extra proceedings (For pick-up at the conference); If not attending, add $20/domestic, $40/intnl, for shipping.	$ 85	$ 85	$100

*New extended deadline dates; after 4/16 do not mail, bring for at-door registration

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World Radio History

EXECUTIVE

BRIEFING

THE NATIONAL TECHNOLOGICAL UNIVERSITY BRINGS ENGINEERS UP TO DATE AT WORK

FIGHTING OBSOLESCENCE

BY SAMUEL WEBER

In 1984, Lionel Baldwin left his job as dean of engineering at Colorado State University to head a new kind of school dedicated to the continuing education of engineers. Eight years later, the National Technological University in Fort Collins, Colo., is broadcasting advanced courses via satellite 24 hours a day, seven days a week to thousands of working engineers all over the country.

TRAINING

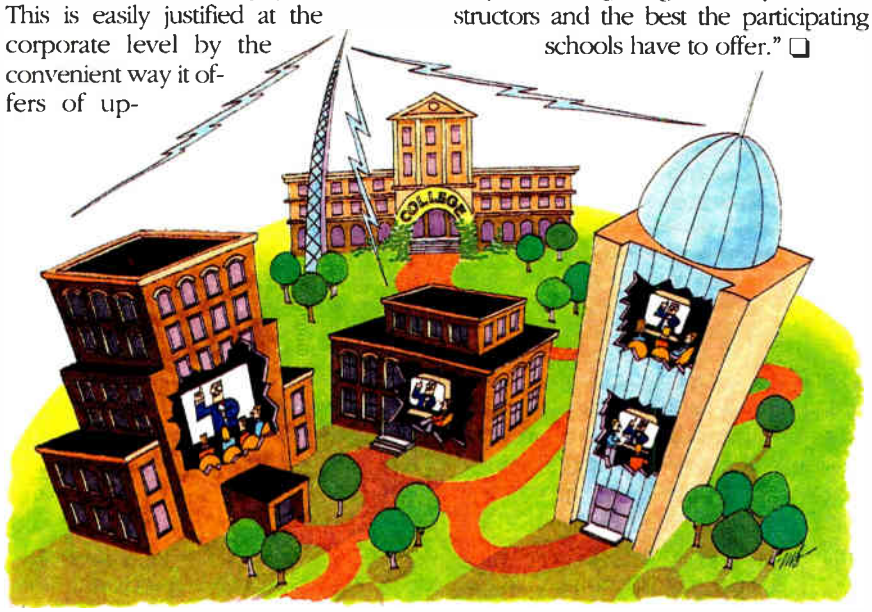
NTU instructors are topflight professors from 42 participating universities and industry experts in technical specialties. Since 1986, 183 engineers have graduated with B.S. degrees, and 1,450 students are currently enrolled in the graduate program, for a total of 4,600 credit enrollments. The school expects to reach 95,000 credit enrollments for noncredit courses this year.

With more than 700 courses to choose from, participants are all earning their degrees or honing their technical skills right at their place of employment, in facilities provided by their employers, who in most cases also pay tuition costs. This is easily justified at the corporate level by the convenient way it offers of upgrading skills and technical know-how.

Last month, NTU completed the installation of digital compressed video equipment at its transmitting station and 385 receiving sites across the U.S., increasing its channel capacity sixfold and providing noise-free, high-quality reception. Digital transmission opens the way toward multimedia instruction, says Baldwin, now NTU's president.

Born of the necessity to keep engineers from technological obsolescence, instructional TV (ITV) is not new. Since the 1960s some engineering colleges have established regional ITV systems linking their campuses with local employers. But NTU, launched in 1984, is the largest, most comprehensive deliverer of live and taped courses in the U.S.

In its graduate program, NTU offers M.S. degrees in computer science, electrical engineering, management, and other specialties. It also broadcasts live interactive noncredit courses, seminars, workshops, and symposia. The main draw, says Baldwin, "is the convenience and flexibility—the fact that [students] don't have to commute. And at NTU we work very hard at getting the very best instructors and the best the participating schools have to offer." ❑



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CIRCLE 206

World Radio History

WIRELESS LANs: WELCOME TO THE VIRTUAL WORKPLACE

TO REALLY CUT THE CORD, ISSUES OF STANDARDS, POWER CONSUMPTION, AND SPECTRUM AVAILABILITY MUST BE RESOLVED

BY JACK SHANDLE

COMMUNICATIONS

The newest vision of desktop computing all but eliminates the desk. Wireless local-area networks are becoming still another holy grail of sorts for leading-edge computer and communications companies. Apple, AT&T, and Compaq all plan to put wireless Ethernet connections in their high-end notebooks. To do it, they are teaming up with companies that own proprietary solutions based on spread-spectrum radio technologies.

The spectrum of choice is the unlicensed 900-MHz band set aside for industrial, scientific, and medical (ISM) applications. And by most accounts, the untethered future looks relatively bright. Shipments of wireless LAN nodes in the U.S. will grow from about 100,000 units this year to around 2 million in 1996, according to BIS Strategic Decisions, a Norwell, Mass., market forecaster.

But the technology has a few problems to solve if the market is to ramp up as sharply as predicted. First, it must move toward a universal standard—much the same success formula followed by Ethernet and Token Ring. The IEEE 802.11 committee on wireless LANs, which has been working quietly for the past year, is likely to deliver a standard by mid-1993, some say.

In the meantime, companies promoting proprietary solutions will be wrestling with real or perceived problems in price, data throughput, spectrum availability, power consumption, interfacing with network operating systems, and packaging. Everyone is optimistic, but "no one is totally convinced the technology is there at the right price," says Curtis Schmidek, product marketing manager for wireless communications at National Semiconductor Corp., Santa Clara, Calif., the world's leading supplier of Ethernet ICs.

Power consumption is right at the top of nearly everybody's problems list, says Schmidek, who doubles as National's representative on the 802.11 committee. It is widely believed that the wireless LAN market will gain its toehold in portable and pen-based computers rather than by replacing wired nodes on desktops. For the sake of battery life, that means the adapter card cannot consume more than 2 W.

Some products now on the market consume on the order of 6 W. These early proprietary solutions tend to use discrete parts, so higher levels of integration in smaller geometries will get the power crusade off to a good start. So will the trend in notebooks toward 3-V operation, but innovative power management will ultimately be the key to gains in battery life, says Rich Bartlett, director of engineering at AT&T Co.'s Safari Systems Division, Lincroft, N.J.

AT&T reduced the power consumption of its Safari notebook from 8 to 4 W with clever tricks such as putting the processor into sleep mode for a brief time after each keystroke, he says. The 802.11 committee can help by writing a Media Access Control (MAC) layer spec that will allow the MAC controller to power down when the transceiver is not needed.

Solving the packaging problem—where do the spread-spectrum radio and antenna go?—requires a joint engineering effort with the computer company. Compaq Computer Corp. of Houston will mold the antenna into a groove on the side of its LTE 386's screen, says Paul Smith, vice president of marketing at Proxim Corp., Mountain View, Calif. Proxim and Compaq have a wide-ranging technology pact, he adds.

With space inside the notebook at a premium, companies are "headed toward PCMCIA format," says Bob Barton, marketing project leader for board and module products at NCR Corp., Fort Collins, Colo. The format, originally conceived for memory expansion, was revised last year to include input/output capability, which opens the door not only to LAN adapters but modem and other cards as well, he says. The electronics of a wireless LAN adapter card can be handled in the PCMCIA Type 2 format, which is twice as thick as the original format, says National's Schmidek. However, the filters and antenna will have to find a home somewhere inside the computer. "One of the big issues for this industry is how to get around custom-designing a solution for everybody's notebook," says AT&T's Bartlett. "In the long term, PCMCIA cards will solve that."

To be untethered, users should be able to roam the LAN's domain without losing their connection to the application they are running on the server. This capability inevitably pulls the network operating-system vendors, such as Novell Inc., into the picture. "Novell could make our life easier," says Proxim's Smith. "It is tough to do roving capability without them. We are working on ways to switch from one server to another without breaking the link—essentially tricking Netware—but obviously there is overhead to doing it that way."

Novell is working on capabilities that address wireless LANs as a subset of "roving nodes," says John Edwards, vice president of marketing for the Provo, Utah, company. The first is support for distributed directories, so every network server will recognize a new plug-in's address. The second is modifying the client side of Netware that acts as an

World Radio History

A HODGEPODGE OF SPECTRUM USE

More than the Summer Olympics and the World Exposition are going on in Spain this year. The World Administrative Radio Conference (WARC) meeting in Torremolinos-Málaga recently took on the intimidating task of coordinating the hodgepodge of national spectrum use worldwide for an increasingly wireless world. How well the 109 nations involved in WARC did so at their February conference will not be known for a while. But some progress was made.

Of great interest to computer and data-communications companies is the hotly contested band between 1.5 and 2.5 GHz. Three applications compete for control of the space: a European concept with the catchall name of Future Public Land Mobile Telecommunications Services (FPLMTS); Aircraft Public Correspondence (APC) systems, which are services that will allow airline passengers to make phone and fax calls; and Low Earth Orbit Satellite (LEO) systems.

The high end of that spectrum—2.4 to 2.5 GHz—is also being eyed by wireless LAN proponents. But that band is allocated worldwide for industrial, scientific, and medical (ISM) purposes, says Adrian Brinkerink, secretary of European Telecommunications Standards Institute's (ETSI) Radio and Equipment Systems technical committee. So it will require spread-spectrum techniques to allow LANs to coexist with existing users. Brinkerink says that regulation will be limited to ensuring that LANs in that band do not interfere with other users, and will be restricted to low power outputs.

For faster office- or building-wide networks with data rates of 256 Kbits/s or higher, the Digital European Cordless Telephone (DECT) standard provides for integrated speech and data with a dynamic bandwidth capability. DECT has been allocated 20 MHz of spectrum in the 19-GHz band, with a further 30 MHz set aside.

For very-high-speed operation over very short distances, ETSI has just started work on HiPerLAN, or high-performance LAN. Two potential frequencies have been identified, Brinkerink says, at 5 and 17 GHz. And some thought is being given to 60-GHz bands, where atmospheric oxygen absorbs radio waves. That creates "an ideal mechanism for use with pico-cellular networks," he says.

One problem with the 17-GHz band is that it is now used for security-sensitive governmental applications. The committee appointed by the European Radio Office has until September to negotiate with the 31 members of the Conference of European Postal and Telecommunications Administrations (CEPT) to find out exactly what those frequencies are used for—they believe it's airborne military radar—and get them released.

While the 17-GHz band looks good technically for in-building wireless LANs, a need for site-wide, high-capacity networks has been promoted. Such nets will need to operate at a lower frequency to get penetration through buildings. So now the committee has to find another block of 150 MHz somewhere between 3 and 7 GHz. Current thinking suggests the answer might be around 5 GHz.

The process seems like a bureaucratic nightmare, but the ability to move quickly through the labyrinth has already been shown in the case of low- and medium-capacity radio LANs. In 1991, ETSI declared the European ISM bands between 2.4 and 2.5 GHz as the place for spread-spectrum wireless LANs. It also suggested that higher-performance systems could be implemented using the newly finalized DECT standard, at frequencies straddling the 1.8- and 1.9-GHz boundary.—*Peter Fletcher*

SPECTRUM ALLOCATION

2,500 MHz

N. AMERICA: SPREAD SPECTRUM, 802.11 WLAN?

1,900 MHz

EUROPE: PCN, DECT

N. AMERICA: DATA-PCS?

JAPAN: "PERSONAL HANDY PHONE"

1,500 MHz

JAPAN: JDC

900 MHz

EUROPE: CT-1, CT-2, GSM, ETACS

N. AMERICA: AMPS, IS-54, SPREAD SPECTRUM

JAPAN: JDC

450 MHz

EUROPE: NMT-450

AMPS (ADVANCED MOBILE PHONE SYSTEM, ANALOG CELLULAR IN NORTH AMERICA)

ETACS (EXTENDED TOTAL ACCESS COMMUNICATIONS SYSTEM, CELLULAR IN THE UK)

IS-54 (DIGITAL CELLULAR SPECIFICATION FOR NORTH AMERICA)

GSM (GROUPE SPECIAL MOBILE, PAN-EUROPEAN DIGITAL CELLULAR)

CT-2 (CORDLESS TELEPHONE-SECOND GENERATION, DIGITAL CORDLESS)

DECT (DIGITAL EUROPEAN CORDLESS TELECOMMUNICATIONS, EUROPEAN DIGITAL CORDLESS STANDARD)

JDC (JAPANESE DIGITAL CELLULAR)

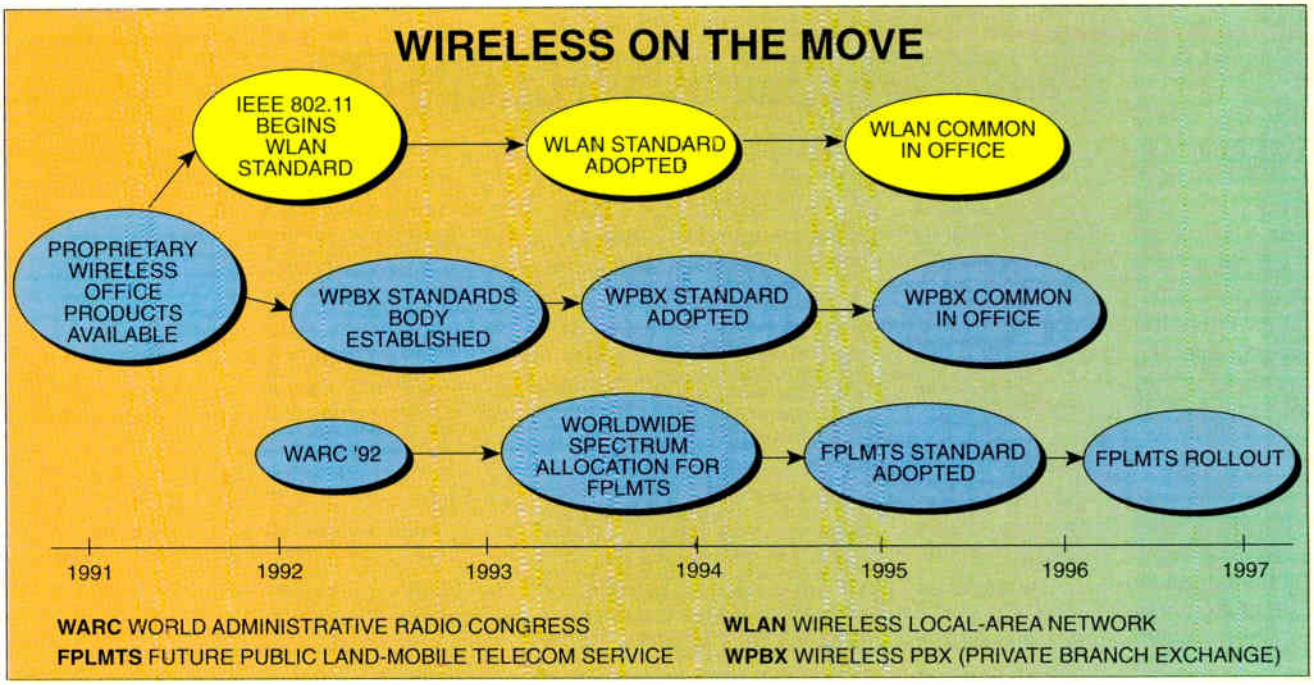
WLAN (WIRELESS LOCAL-AREA NETWORK)

PCN (PERSONAL COMMUNICATIONS NETWORK, PERSONAL HANDSETS IN EUROPE)

PCS (PERSONAL COMMUNICATIONS SERVICE)

NMT (NORDIC MOBILE TELEPHONE, CELLULAR IN NORTHERN EUROPE)

World Radio History



agent, collecting data that will eventually go on the network, such as a fax or e-mail message, and then "emptying the out box" when the user plugs in.

Novell's chief competitor, Microsoft Corp.'s LAN Manager, is somewhat better positioned in its basic architecture. LAN Manager places virtually no limit on the number of servers users can access, says Rich Barth, product manager for LAN Manager and Windows/NT for the Redmond, Wash., company. "When the user logs onto a domain," he says, "every server in the domain includes him in its list of valid nodes." Thus, "the link between the roving notebook and an application is not broken."

Spectrum issues for wireless LANs begin with the current band of choice: the 900-MHz ISM band, which "is not available in Europe," says NCR's Barton. Not being able to sell a product in the global marketplace clearly limits its chances for success. The Federal Communications Commission has designated bands at 2.4 and 5.5 GHz for unlicensed spread-spectrum applications. "The 2.4-GHz band may be more appropriate," says Barton. "and NCR is well into the product-development cycle for a 5.5-GHz, spread-spectrum, wireless LAN. Higher frequencies mean higher bit-transfer rates."

In light of recent developments at the World Administrative Radio Conference (see p. 27), it appears that 2.2 GHz may be available in Europe and Asia, says National's Schmidek. He adds that moving beyond 2.5 GHz could mean a cost crunch, because it would require gallium arsenide technology.

Understanding the spectrum issue of wireless LANs requires knowledge of worldwide spectrum issues for other wireless technologies. Cellular radio, the most widely used of them, operates in about the same range as 900-MHz ISM applications. Spread-spectrum technology avoids interference by parsing the signal, transmitting at low power, and reassembling it at the receiver. In the U.S., the Cellular Telecommunications Industry Association is in the process of locking down a standard for dual-mode (analog or digital) transmissions that will allow a transition from analog systems to digital schemes carrying four times the traffic in the same bandwidth.

Dual-mode cellular phones should be available in early 1993, and a digital standard should be ready in 1994. Europe's GSM (Groupe Speciale Mobile) digital standard will be operational well before that, and Japan is moving right along with its Japan Digital Cellular standard; prototypes are expected by midyear. And the WARC conference started the ball rolling on a worldwide FPLMTS (Future Land-Mobile Telecom Service) standard, which might be deployed as early as 1996.

In the U.S., the FCC is pushing for a Personal Communications Service, probably in the 1.9-GHz range, to be deployed by 1995. Three new bands totaling 220 MHz will be made available, one most likely for data, another for voice (wireless PBX), and the third an extension of wireless phones. Wireless LANs could use the PCS data bandwidth, which would utilize conventional narrowband transmission, but "the 802.11 committee will probably not wait for that allocation," says Schmidek. It will proceed with spread spectrum in mind, but keep the spec open enough to accommodate narrowband or infrared transmissions as well.

As with any technology, pricing is a critical issue. National has pegged $300 per node as the future price point for wireless LANs, which must compete with $120/node wired solutions. Proxim's basic RangeLAN system is $500 per node, but it delivers only 242 Kbits/s. The technology supports three channels, however, so added bandwidth can be obtained by putting three adapter cards in each server—one per channel. NCR's WaveLAN is $1,000 per node but it delivers 2 Mbits/s.

Some observers—including Microsoft's Barth—think limited bandwidth could stunt wireless LAN growth, but NCR's Barton points out that wired Ethernet delivers only about 2 Mbits/s because of system overhead. And speed, says AT&T's Bartlett, is a nonissue. "People pushing 10 or 16 Mbits are saying it mostly because it sounds like it must be better," he says. "We have operated 100 nodes on a 1-Mbit/s network without any trouble." ❑

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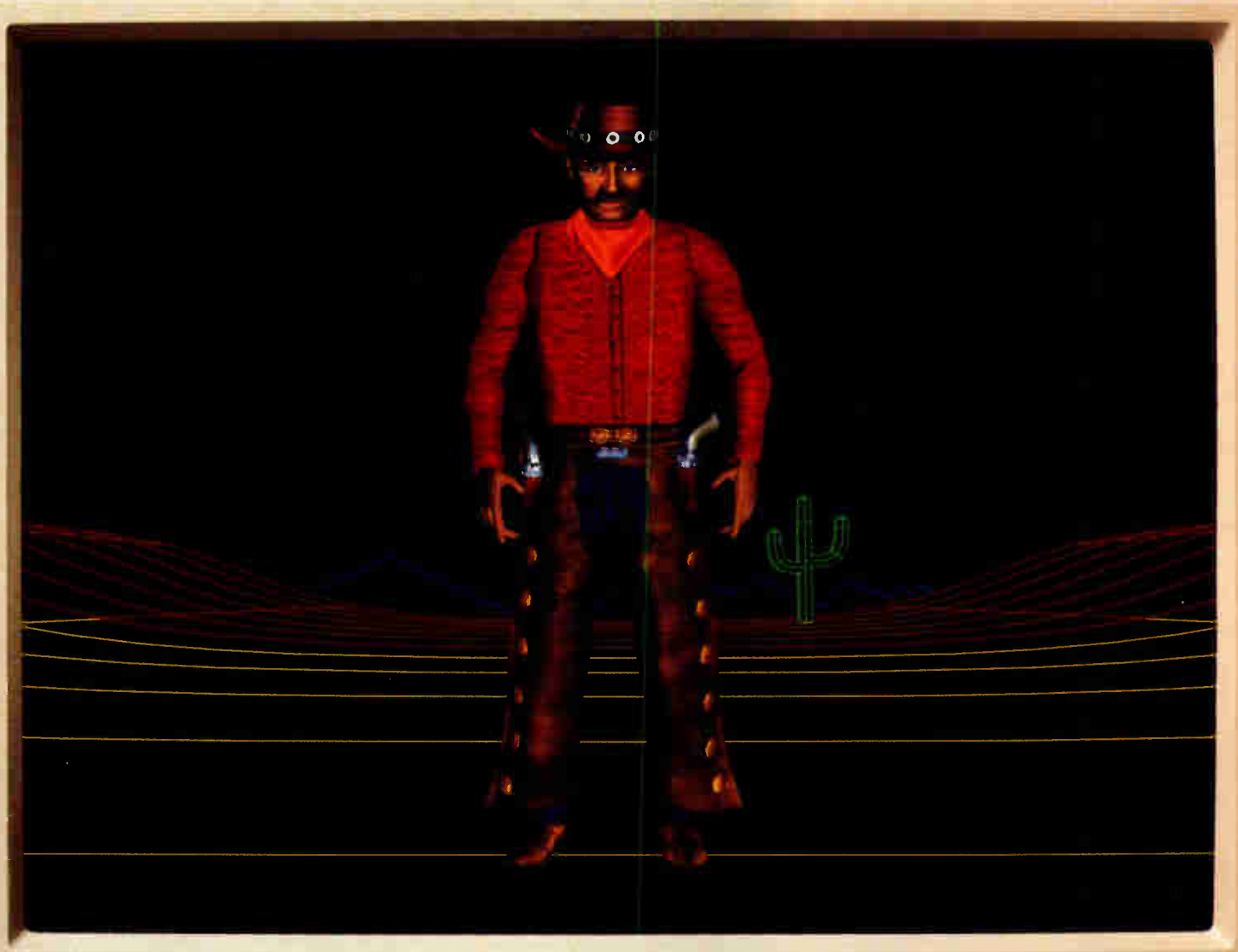

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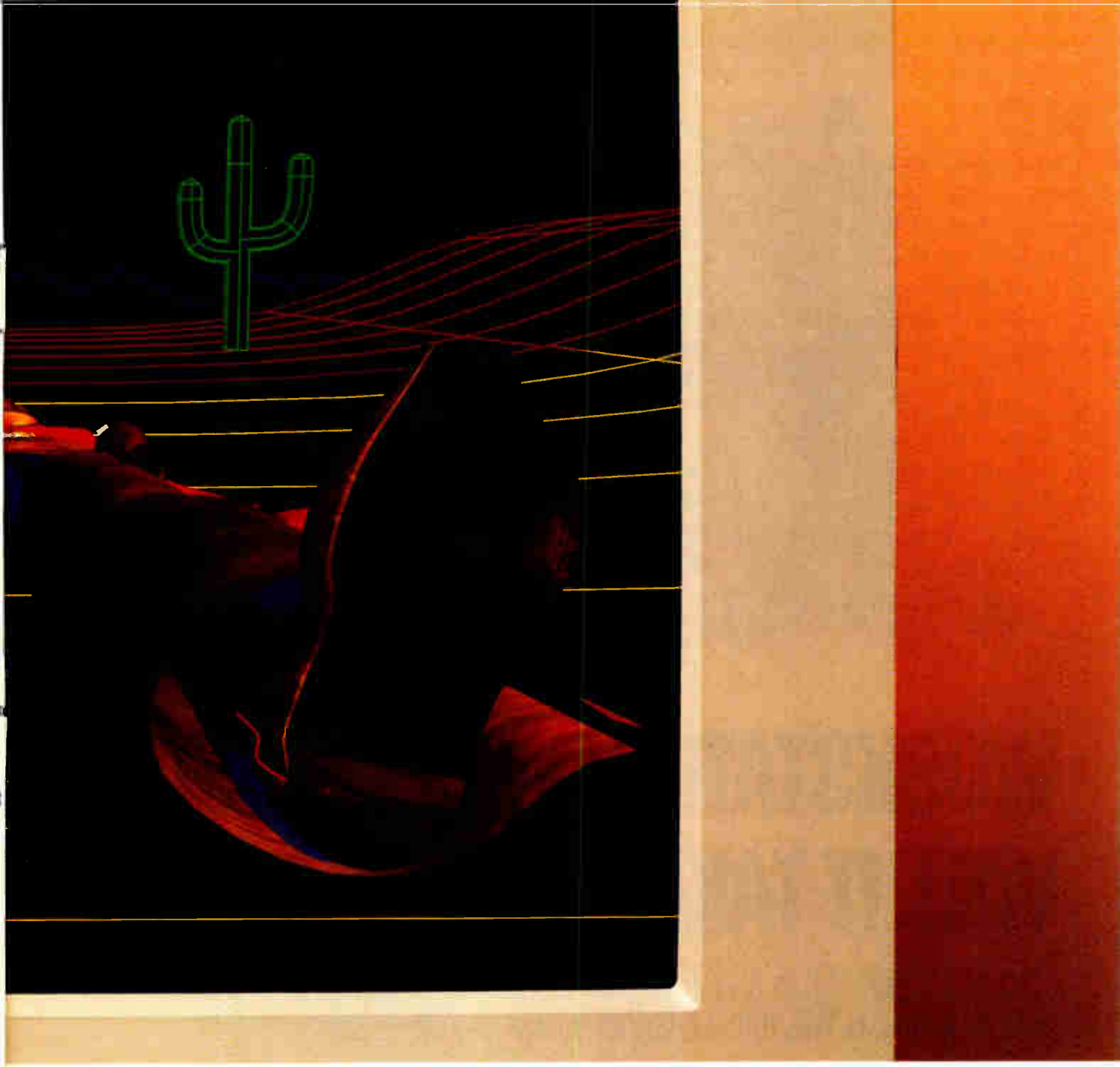

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WORKSTATION WARS: WHAT WILL IT TAKE TO SURVIVE?

CUSTOMER SERVICE IS AS IMPORTANT AS PRICE AND PERFORMANCE IN DETERMINING THE 1995 LEADERS

BY LAWRENCE CURRAN

COMPUTERS

There's no end in sight to the incessant price-performance leapfrogging that has characterized the leading vendors of workstations and workstation servers. That's good news for budget-bound buyers, who will benefit from higher performance and fierce price competition. But that same competition dictates that only the strongest will survive into the mid-1990s. At the head of the pack in unit shipments will be the current market leader, Sun Microsystems Inc., predicts International Data Corp., the Framingham, Mass., market research firm.

Following Sun in 1995, says IDC, will be IBM, Hewlett-Packard, and Digital Equipment, with Silicon Graphics Computer Systems and Next Computer Inc. thrashing it out for the No. 5 spot.

That top four is also today's top four, but in a different order. According to IDC, Sun topped the list in unit shipments for 1991 for a 41% share of the market, followed by Hewlett-Packard (17%), Digital (14%), IBM (6%), Next (5.5%), Sony and Intergraph (3.4% each), and Silicon Graphics (3%).

In a 1990-95 forecast issued last December, IDC predicts that "the workstation leaders [will be] shipping RISC systems almost exclusively. Our expectation is that Sun will lead in units in 1995, with IBM second, followed by HP third and DEC fourth."

At Dataquest Inc., the San Jose, Calif., market research firm, Laura Segervall says Dataquest policy precludes public predictions of vendor rankings, but she doesn't suggest that any of the IDC top four shouldn't be there. She's quite articulate, however, about what attributes the successful workstation vendors need, based on a quarterly Dataquest survey of selection criteria used by buyers. The leading criteria, in descending order, are quality, commitment to and

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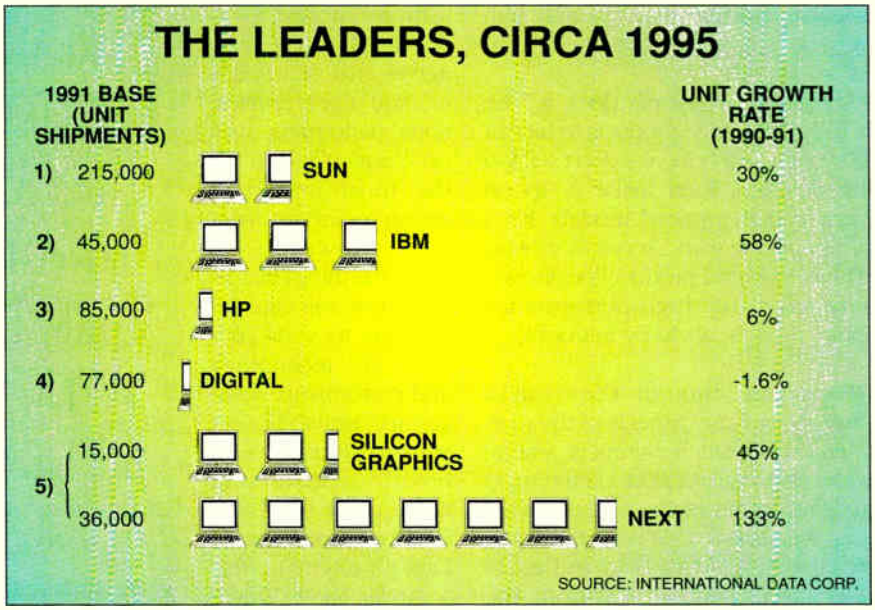
service to customers, value for price, ease of connectivity in a network, and perfomance and upgrade potential.

Some vendors may quarrel with the rankings. Sources at both Digital Equipment Corp. and IBM Corp., for example, argue that their own companies will top the '95 list. But almost everyone agrees that there won't be any slackening in technology advancement.

Brian Croll, product line manager for desktop workstations at Sun, Mountain View, Calif., cites a conversation with an "old-timer" in technology, who said that the logarithmic straight line of boosts in computing performance at decreasing prices was plotted in the late 1950s, "and has come true. I think the same thing will continue to happen," Croll says. "People have had to hit price-point targets for years; it happens as a self-fulfilling prophecy."

For her part, Dataquest's Segervall expects the workstation performance-price spiral to accelerate as more personal computer vendors adopt RISC microprocessors, which continue to escalate in performance. "There's no question that the rate of change of technology is moving at a faster pace than in the 1980s," says Mark Perry, executive vice president at Silicon Graphics, Mountain View. "And I don't see that stopping by 1995."



IBM, Silicon Graphics, and Next are growing fast, but from a small base. Market leader Sun will stay on top for the foreseeable future, IDC says.

There's a never-ending demand for increased performance, says Mike Gallup, worldwide marketing manager for the Workstation Systems Division of Hewlett-Packard Co. in Chelmsford, Mass. "There's more demand for higher performance [in workstations] than most people think. The software has been able to absorb all the mips we've thrown at it."

But while performance continues to soar, some question how long prices can erode before profits are seriously affected. "I don't see how the vendors can continue that spiral because they can't continue to be profitable," says IDC analyst Nancy Battey. "There has to be a price floor." She thinks $5,000 is a floor that may hold for a while. Below that, "the boxes aren't fully configured workstations," Battey says. They have only monochrome displays and limited if any ability for memory expansion.

Battey points out that Sun, Digital, and HP each has a workstation at about $5,000, a price point that was inspired in part by the need to appeal to potential users running commercial rather than technical applications. "I don't think they can go much lower. Instead of lower prices, we'll probably see these boxes grow in functionality," she says.

Sun's Croll hasn't seen any true workstations yet that are much below that floor. "We keep hearing that the hardware has become a commodity, which then leads to price wars, but we're beginning to question that assumption. Components are a commodity, but assembling them into a workstation isn't a trivial function; these aren't PCs," Croll asserts. He adds that CRT displays, especially color, will long remain a barrier to getting workstation prices down much lower than $5,000.

Digital's Matt Kochan, however, is quick to question the $5,000 floor. He's group manager of marketing for Unix-based software and systems—including all workstations—in Maynard, Mass. Digital has two workstations, at $3,450 and $3,995, which can be expanded and upgraded, Kochan says. "You can't do much with those [$5,000] machines; you can't expand them. We're in there looking at the low end, but with upgradeability in mind."

Most vendors say there's no such thing as a "loss-leader" concept in workstation marketing—a strategy to sell with minimal profit margins at the low end but price higher-performance machines high enough to compensate for those thin margins.

IDC's Battey says the vendors can't afford loss leaders because most of the volume is in the low and midranges—up to $20,000. "Vendors need to offer a full boat of products, including servers to work in a network," Battey maintains. "But they don't want to drop prices at the low end, because that's where a lot of the action is; there's limited volume at the high end."

IBM's Dave Cassano believes there's a price floor below which a product would be unprofitable, but says there's no loss-leader strategy at IBM. "Each of our products has to maintain profitability," he says. "The lower-end products are usually the best sellers, and we must have profits there because we can't expect to make it up at the high end."

At Silicon Graphics, which specializes in high-performance color graphics workstations, Perry promises the company will be price-competitive in its specialty. "Our entry-level system is at about $8,000 now, and while I don't expect us to have monochrome-only products, we'll have [color-graphics] products at $5,000 or less by 1995 without any compromise in performance."

But having such a low-end system in no way implies a loss-leader strategy, Perry adds: "Our philosophy is that our entire product line should generate margins that are at or over the target."

HP's Gallup takes a markedly different and candid tack. While he agrees with other workstation vendors that today's effective floor is about $5,000 for a low-end workstation—a diskless computer with monochrome display—he's one of the few who acknowledges a

World Radio History

loss-leader pricing strategy, although there's no suggestion that the $5,000 units are unprofitable.

"Absolutely everyone does it," he says flatly. "We price products to hit that $5,000 point and hope we don't sell too many of them, then make it up on servers or higher-priced models. It's a portfolio-pricing game, so vendors who don't have a broad product line, including servers and high-performance graphics models, could be in trouble."

Disagree though they might about many aspects of the market, there's not much argument among vendors and analysts alike on the main ingredients in the recipe for success in selling workstations. Where the three most important elements in real estate are location, location, location, the things customers look for in a workstation are applications, applications, applications—availability of the right software on the vendor's platform.

That's what topped the list in a recent survey of 200 workstation users IDC conducted, asking what factors influenced their choice of the products they bought. The answers provide good guidelines to the attributes required for survival—along with some surprises about price and performance.

The next most important reason was a need for post-sales service and support, which tells IDC analyst Battey that workstations "still aren't as easy to use as PCs." The price-performance factor had dropped to No. 3, from first place in earlier IDC surveys, indicating that it's still an issue, but not the paramount concern. Reason No. 4 for selecting a given machine was the vendor's commitment to open standards, while the computer's performance in a multivendor network placed fifth. "Raw performance dropped to No. 9 from somewhere in the top five," Battey reports.

"If you're selling to the traditional technical market for electronic design automation, the first question customers ask is 'Whose software will I run?'" says HP's Gallup. "Then they decide whose platform to run it on, and if the vendor can't offer that software on his platform, he doesn't even get a phone call."

Dataquest's Segervall also underscores the importance of application software: "HP is the price-performance leader, but there's been no big migration away from Sun," she says, because Sun's Sparc architecture has strong third-party software support.

At IBM, Cassano agrees that availability of "the right applications performing well on your platform" is the most important selling point for vendors. However, he says, "the things that attract those software developers to your platform are technology and performance leadership, scalability of your products across a broad price-point range, and high volume or market share." Digital's Kochan offers a similar view. Where "applications are the key," third-party software developers are also looking to back the hottest-selling platforms. For that reason, he believes Digital's recently announced Alpha RISC architecture will attract developers because of its promise of high performance [*Electronics*, February 1992, p. 38].

IN REAL ESTATE, IT'S LOCATION, LOCATION, LOCATION. IN WORKSTATIONS, APPLICATIONS, APPLICATIONS, APPLICATIONS.

Sun Microsystems was one of the earliest advocates of open systems, backing the Unix operating system at the company's inception. Sun's Croll takes the open-systems idea a little further in offering his list of selection criteria customers should apply.

The list starts with commitment to the "right" computing model for the future. "That's critical," Croll stresses, "and we have a total commitment to Unix and the client-server model." Ability to change quickly is another important attribute, Croll maintains. Besides committing to Unix, Sun was also an early adopter of the reduced-instruction-set-computing architecture, having quickly recognized its inherent performance advantage. "RISC was just a gleam in people's eyes five years ago, but now it's a standard," he says.

As the Dataquest survey indicates, the explosive growth of workstations dictates that the ability to service them is a concern high on customer lists. Gallup of HP maintains that the ability "to service and support large worldwide networks consisting of thousands of nodes of hardware and software from multiple vendors" is a critical tool for vendors to offer. Digital's Kochan adds that service will become even more pivotal as workstations proliferate beyond their traditional technical turf into commercial applications in the office—a trend that has begun.

After digesting all these required vendor attributes, how well will the leading manufacturers stack up against them as the workstation wars rage on between now and 1995? The IDC leader list three years hence is probably as good as any, although it doesn't take into account Digital's Alpha RISC architecture—a major commitment the company will surely apply early to workstations.

Both IBM and Digital say they'll displace Sun as No. 1, and IDC says that could happen for IBM in revenues as early as next year. "IDC expects IBM to have incredible growth rates for shipments but not to outpace Sun in unit market share by 1995," Brown and Battey write in their December forecast. "We do see IBM as the market leader in revenues in the 1994-95 time frame, possibly 1993 due to higher [workstation] average selling prices as well as greater service/support revenues."

IBM's Cassano won't go out on a limb to rank the top five vendors for 1995. He says the leaders now "are all strong competitors and I don't see any of them dropping out." For his part, Sun's Croll predicts that the top three companies will be Sun, IBM, and HP, followed "probably by a Japanese company, although I don't know which one it will be. There will be a fast trail-off after that. I could say DEC will be on the list, but I can't tell where they're headed. I haven't heard them say they're truly committed to the volume workstation business," Croll says.

Digital's Kochan has a quick retort: "Sun shows a lot of arrogance. That will catch up with them and they'll begin to fall out of favor. Some of our customers are replacing Suns because they're fed up with Sun's service." Not surprisingly, Kochan says Digital will top the list by '95, followed by IBM, HP, Sun, and Silicon Graphics, in that order. ❑

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PENTON CONTINUES COMMITMENT TO RECYCLING

Penton Publishing's Camera Department started recycling chemicals from film wastewater 25 years ago... long before the ecologically-smart idea was widely recognized.

For almost as many years, the Penton Press Division has been recycling scrap paper, obsolete inventory, and printing press waste materials. In 1991, Penton Press will recycle some 5500 tons of paper, 9 tons of aluminum plates, and 3 tons of scrap film negatives. Furthermore, the Press Division has invested $500,000 in air pollution control equipment.

Company-wide, the recycling spirit has spread from Cleveland headquarters to offices throughout the country. Penton employees are enthusiastic participants in expanding programs to re-use paper, aluminum cans, and other waste materials.

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RING IN THE NEW: HDTV BECOMES A REALITY

LARGE-SCALE TRIALS AT THE OLYMPICS ARE DRESS REHEARSALS FOR A 1994 COMMERCIAL DEBUT IN EUROPE

BY JOHN GOSCH

In Europe, 1992 is ringing in a new era in television—that of high-definition TV. It's the year that's seeing the first large-scale trial transmissions of programs in the 1,250-line/50-Hz HDTV standard the industry has been pursuing since 1986, a standard that presents pictures with the clarity of 35-mm film on wide-area screens with a 16:9 aspect ratio. Predictions are that Europe will have regular HDTV services by 1994.

HDTV transmissions had their first dress rehearsals in ice and snow earlier this year—at the Winter Olympics in February in Albertville, France. There, scores of outside broadcast vans, cameras, and recorders, all built to Europe's HDTV norms, were put through their paces, processing and broadcasting up to 11 hours of programs a day to 60 viewing sites (at banks, hotels, and other public places) throughout Europe, from Lisbon in the west to Moscow in the east.

As may be expected, the trials at Albertville will be upstaged by those at the Summer Olympics, July 25 to Aug. 9 in Barcelona, Spain. During that event, programs will be shown at up to 700 viewing sites around the continent. The sites will be equipped with 36-in. 16:9 receivers as well as projection-TV systems with 56-to-200-in. diagonals in the 16:9 format.

Watching the Summer Games will be sports fans not only at the viewing sites but also at home on conventional sets fitted with appropriate decoders. There are about 250,000 such sets now installed in Europe.

To make 1992 a banner TV year of even greater proportions, there will also be HDTV trial broadcasts from Seville, Spain, site of the World Exposition that starts this month and runs through October; from Stockholm, where the European Soccer Championship Games will be held; and from Wimbledon, near London, during the tennis matches. What's more, independent of these sports events, broadcasters in some countries will send up to four hours of HDTV programs, also on a trial basis, daily.

HDTV

The programs will be distributed by satellites—up to six of them during the Summer Games—and transmissions will be in the HD-MAC (for high-definition multiplexed analog components) standard. This standard ensures compatibility with Europe's MAC standard and, through a decoder, with the existing PAL and Secam color transmission norms used in Europe. Sound is transmitted digitally; video signals are broadcast in analog channels.

The HD-MAC system effectively transmits the 1,250 HDTV lines in a D2-MAC-compatible 625-line format together with information for reconstructing the 1,250-line picture. Existing 625-line sets can receive the signals and display pictures with improved definition. HDTV sets, however, show the full 1,250 lines with double the resolution. (D2-MAC is an interim standard on the road to the final HD-MAC European norm).

For all the activity in analog HDTV, the Europeans haven't lost sight of what's ahead: digitally transmitted HDTV. Aware of U.S. developments and tests in that field, European communication experts have formed national groups and consortia that are working out the techniques needed to implement digital HDTV. It may not be long before this work becomes a pan-European effort.

The series of large-scale trials this year culminates a development effort that is the biggest Europe has ever undertaken in consumer electronics. It started in 1986 when Philips of the Netherlands, France's Thomson, and Germany's Robert Bosch initiated the Eureka HDTV project EU95. In 1989, Finland's Nokia Corp. joined. The latest EU95 members are consortia representing Italy and Spain. In addition to these six so-called "A" participants, there are more than 60 B-participant companies and groups active in the project. They include systems producers, chip makers, research institutes, and broadcasters from nine European nations.

World Radio History

The EU95 project has come a long way since its inception. Within a year of its start, the companies demonstrated working HDTV cameras and monitors, and displayed pictures on prototype 16:9 receivers.

By 1989, they had a working HDTV chain, from program production to satellite transmission, reception and replay, and had built fully equipped outside broadcast vans complete with editing, recording, and mixing facilities. At last year's International Radio and TV Show in Berlin the first live HD-MAC transmissions took place as part of Germany's regular public broadcasts.

The EU95 project is also Europe's most costly effort in consumer electronics. By the end of 1992 the project's precompetitive phases 1 and 2 will have clocked 5,000 man-years and consumed $800 million, says Peter Bögels, president of the Eureka HDTV Directorate and director of the Philips Consumer Electronics Division in Eindhoven, the Netherlands. About 40% of that sum is government money.

During the third phase, to start in 1993, public funding will go down as industry expenditures rise sharply. It's during this phase that firms will gear up for volume production of equipment now existing as prototypes or preproduction models. A case in point is an HDTV 1.2-Gbit/s digital video cassette recorder from Germany's Broadcast Television Systems GmbH. It will be ready as a prototype for the Summer Olympics and will enter production next year.

Europe may also see the development of a tiny liquid-crystal-display HDTV set for personal use. "Everyone thinks HDTV means big pictures," Bögels notes. But the same technology, he says, can be applied to building small personal sets with a screen about the size of a standard sheet of paper (8.5 by 11 in.). "It will provide what I like to think of as a moving photograph in the viewer's hand."

In development, too, will be many nonbroadcasting applications such as computing, public displays, and large-screen systems for use in museums and classrooms. In medicine, there will be equipment for recording operations and displaying HDTV endoscope camera pictures for training purposes.

And then the industry may press ahead with the use of the new technology in multimedia applications by developing the interfaces between HDTV and workstation environments. Options for combining HDTV and CD-ROM/CD-I (compact disk-ROM/CD-interactive) are under study, and preparations are being made for a new generation of HD-MAC laser disks. Also, the cooperation between Eastman Kodak Co., Rochester, N.Y., and Philips may result in a photo-CD system that will give still pictures an HDTV quality.

How does Europe's HDTV system compare with Japan's MUSE, introduced as a regular service last November? "While Japan is ahead in transmitting HDTV, we think our standard provides higher picture quality," Bögels says. "Furthermore, our HDTV infrastructure is bigger." About the only problem Europe has is getting enough HDTV program material.

"The industry will be ready to deliver all HDTV components and play its part in introducing the service by 1994," Bögels insists. But the actual start hinges on the readiness of the TV studios and program producers to supply sufficient software. TV watchers don't care about new technologies, says Karl Tetzner, a German author and electronic media observer. "They are interested mainly in what's on the screen."

Given the big sums they must invest in new production equipment, the financially strapped studios and broadcasters in major European countries could drag their heels in spending the money for implementing a new standard. That could delay HDTV introduction. But hardware makers are banking on Europe's aggressive and trend-setting private broadcasters to forge ahead in program production, leaving the others little choice but to follow their lead.

UP AND RUNNING

This HDTV outside-broadcast van, built by the German firm BTS Broadcast Television Systems GmbH, will be used at the Summer Olympics in Barcelona, Spain. At left, HDTV vision control inside the van.

World Radio History

TOM CAMPBELL

SPEAKS OUT

EIGHT STEPS TO ECONOMIC RECOVERY

Millions of men and women are out of jobs. Families can't get loans. Businesses are struggling. But America can do better. We need to take strong action to bring the U.S. economy back to life. Here are eight steps America should take.

1. **Get banks lending again.**

A 1991 survey of California banks found that 43% of them were refusing loans to good credit risks, solely because of the government bank regulators' tougher attitude.

We must make sure that federal regulators protect the soundness of our banking system while at the same time ensuring it can continue to make loans that provide economic growth. Legislation of mine that recently became law will help. It makes clear that regulators cannot discriminate against loans and investments that banks hold in real estate. Regulatory overkill has stifled real estate lending, a crucial sector of the economy that has helped lead us out of prior recessions.

2. **Cut the capital gains tax.**

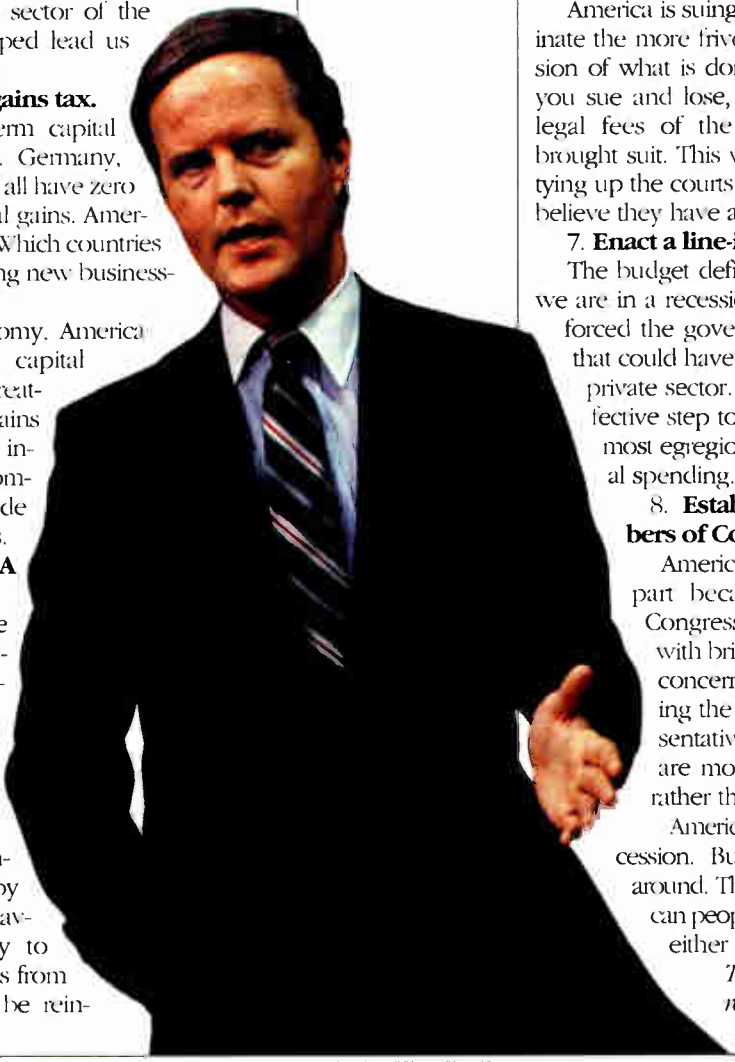
Japan taxes long-term capital gains 5% on average. Germany, Taiwan, and Singapore all have zero tax on long-term capital gains. America takes them at 28%. Which countries are going to be attracting new businesses in the 1990s?

To boost the economy, America should cut the basic capital gains tax as well as creating a special capital gains incentive that rewards investment in startup companies. Startups provide the economy with jobs.

3. **Restore full IRA deductibility.**

Before they were curtailed in 1986, Individual Retirement Accounts allowed scores of American workers to put money away, tax free, for their retirement years. In doing so, the IRAs benefited society as well by increasing the U.S. savings rate. The ability to deduct IRA investments from taxable income must be reinstated now.

THE BUDGET DEFICIT IS THE SINGLE BIGGEST REASON WE ARE IN A RECESSION.



4. **Complete a free-trade agreement with Mexico.**

A free-trade zone with our neighbor to the south will allow U.S. businesses to expand into new markets and produce more and better jobs for our workers. It is estimated that over the next decade, a free-trade agreement will result in a net increase of 44,000 to 64,000 U.S. jobs.

5. **Insist on equal treatment for the U.S. overseas.**

America is far more open to foreign goods and investment than virtually all our major trading partners. We should apply a simple rule: let's be open to investments and goods from other nations to exactly the same extent they are open to our investments and goods. This concept, reciprocity, will give our trading partners a powerful incentive to welcome our goods and investments.

6. **Reduce the number of frivolous lawsuits.**

America is suing itself to death. We could eliminate the more frivolous cases by adopting a version of what is done in English courts, where, if you sue and lose, you are obligated to pay the legal fees of the person against whom you brought suit. This would discourage people from tying up the courts with lawsuits unless they truly believe they have a solid case.

7. **Enact a line-item veto.**

The budget deficit is the single biggest reason we are in a recession. Unnecessary spending has forced the government to borrow $3.5 trillion that could have been spent more wisely in the private sector. A line-item veto will be an effective step to allow the President to cut the most egregious examples of wasteful federal spending.

8. **Establish term limits for members of Congress.**

America is in this recession in large part because individual members of Congress have been too concerned with bringing home the bacon and not concerned enough with strengethening the economy. Senators and representatives who are in their last term are more free to vote in the national rather than parochial interest.

Americans are feeling the pain of the recession. But we *can* turn this recession around. The U.S. economy and the American people are ready; Washington should either help or get out of the way.

TOM CAMPBELL, a Republican, represents California's 12th District, including the Silicon Valley.

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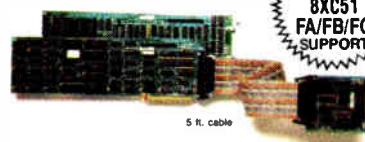

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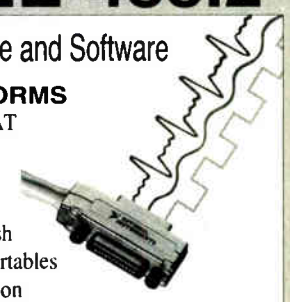

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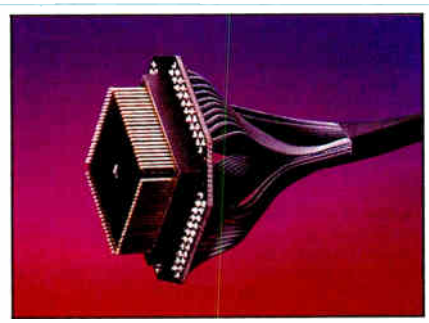

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Advertiser's Index

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Cypress Semiconductor	C IV
Emulation Technology	41
Fide	13
Graphica Computer Co	22E
Harris Semiconductor (Military Div.)	8,9
Harting Elektronik GMBH	C III
Hewlett-Packard M&T Div.	11
IBM	COV II,1
Intel	29-31
Mesago,Messe&Kongress	22H,I
National Golf	22
National Instruments	41
Nohau Corporation	41
Pearson Electronics	16
Philips Semiconductors	22A-C
Pico	17,25
Recruitment/Classified	42
Samsung Electronics	22F,G
Sonnenschein Lithium GMBH	22L
Systech Research	24
Teledyne Relays	3
White Technology	5

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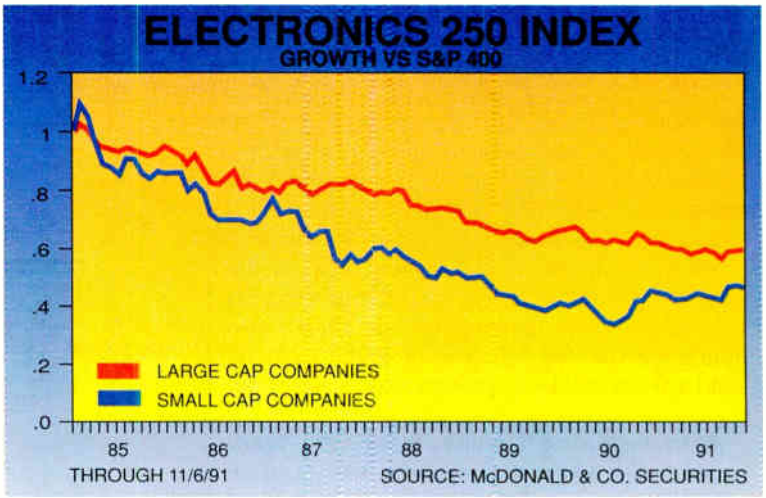
World Radio History

IS IT A RECOVERY? PROBABLY, BUT HOLD THE CHEERS

A traditional economic recovery appears to be under way despite tax increases and lower than usual fiscal stimulus. European and Japanese trends remain weak, lagging normally behind domestic patterns. Domestic demand for electronic capital goods should be helped by these patterns, but the growth potential remains limited by excess industry capacity and intense price competition. The constrained improvement in the early phase of the recovery provides further evidence of the maturation demand for electronic capital goods.



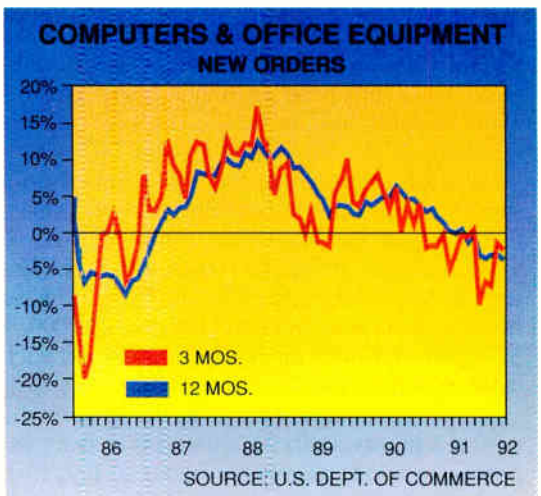
Things are getting better, but growth seems to be limited by excessive industry capacity and intense price competition.

It's no surprise that housing and automotive are driving the improvement seen thus far. The likelihood of a smaller lag than usual between the durable goods and capital goods cycle is well above average because of inventory productivity gains achieved throughout the recession by most manufacturers of electronic capital goods.

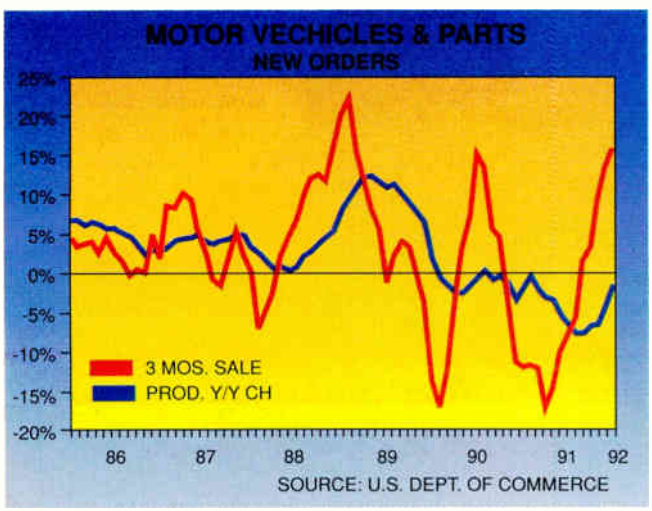
The question is whether domestic momentum can be maintained in the face of a weaker than usual increase in activity. Also, there is some concern over potential liquidity issues in the Japanese economy if demand does not begin to improve by the end of the year. The partial rollback of excise taxes on new autos in the UK, new foreign investment in eastern Europe, and modestly improving liquidity could help Europe begin to recover before the year is up. However, the intermediate picture is clouded by the cost of improving the worldwide competitiveness of European manufacturers.

Company reports for February and March indicate a modest recovery. The stock market is also providing an excellent opportunity for small- and medium-size companies to raise capital, which also supports economic growth potential. And the death of the tax bill is probably also a positive. ❑

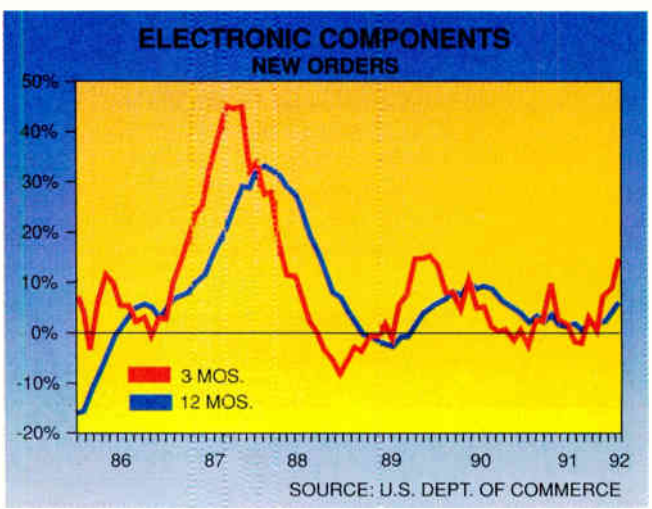
By Mark Parr of McDonald Securities Inc., Cleveland (216-443-2379)



Demand for electronic capital goods has matured, hence the slow recovery pace.



One of the leading sectors in the infant recovery is automobiles. Productivity gains are helping.



Component orders continue to climb despite questions about the length and strength of the comeback.

World Radio History

MIKE EVANS

LAST WORD

AN ECONOMY MIRED IN NO MAN'S LAND

Last June I wrote that the recovery had started. At the time, housing starts had risen 23%, new-home sales had climbed 26%, and the index of leading indicators had risen at a 7.4% annual rate during the previous five months.

Of course, there was no recovery, although the second dip of the recession failed to materialize as well, as real gross domestic product (GDP) rose during the last three quarters of 1991. No Man's Land was more like it; growth was positive, but not enough to reduce the unemployment rate.

Now the leading indicators are up 0.9%, housing starts 6%, and new-home sales 13%. So once again the question is whether this is finally the start of the long-awaited upturn.

Last spring, at the time I said the recession had ended, I predicted that real GNP (that was before the switch to GDP) would rise at a 2.3% annual rate for the last three quarters of the year. The current actual figure, pending further data revisions, is 1.3%. My latest forecast for the last three quarters of 1992 is...2.3%.

Most of the optimism for 1992 is based on a strong rebound in the housing sector. However, that was not enough last year. In 1991, new-home sales rose from an annual rate of 406,000 in January to 542,000 in December, a 33% gain, while housing starts rose from 844,000 to 1,106,000, a 31% gain. Not even raving optimists expect such large gains this year.

Capital spending continues to decline, and the most recent surveys show further cuts in store. Export growth will certainly be weaker in 1992 than in 1991. Defense spending continues to be slashed. And state and local governments face another round of higher taxes or spending cuts.

Thus, if 1992 is to be anything other than a carbon copy of 1991, consumer spending must rise. Furthermore, that will not stem from a bigger rise in disposable income. Employment is still declining, wage rates are barely keeping pace with inflation, and it now looks as though there will be no cuts in personal income tax in 1992. That means consumer spending must rise faster than disposable income. Last year the opposite occurred, as the personal-savings rate rose from 5.1% to 5.4%, confirming that consumers tried to reduce debt instead of spending all their income.

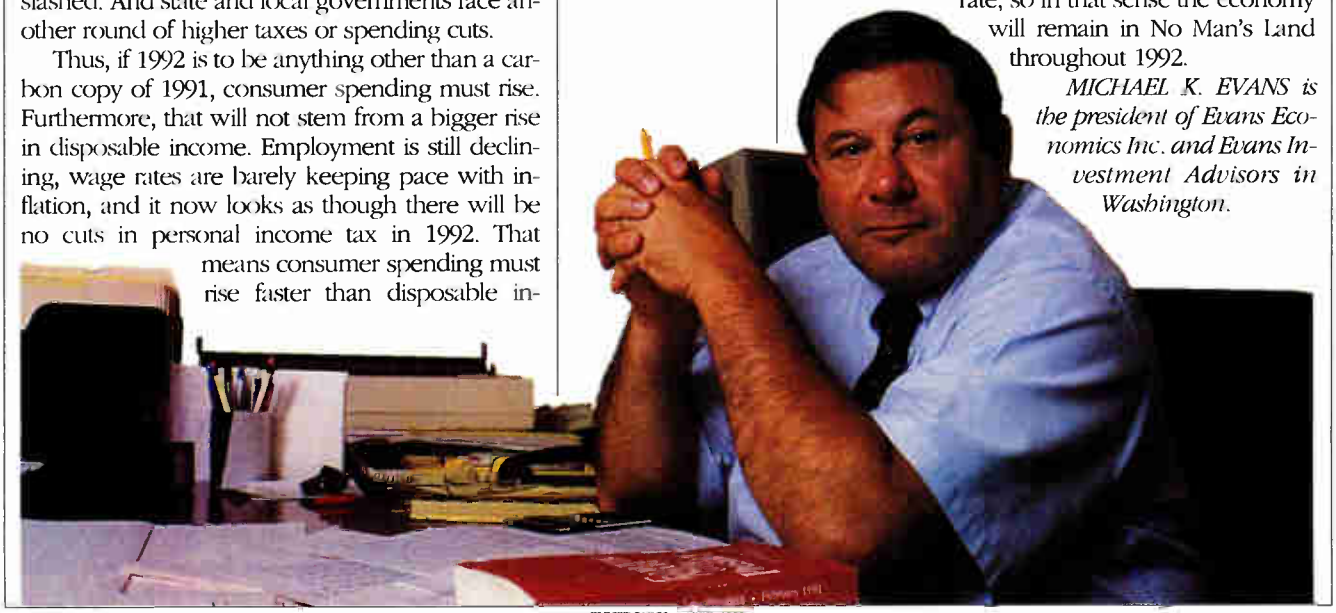
A RECOVERY, AND THAT'S NO LOCK, IS LIKELY TO BE THE MOST ANEMIC ONE ON RECORD.

After a dismal holiday shopping season, consumers have started to open their pocketbooks again. So far these gains have occurred in two major areas. First, among items for which interest costs represent the bulk of the purchase price—obviously housing, but also major repair and remodeling projects and such big-ticket items as boats and airplanes—orders and sales have improved significantly in recent months. Second, small-ticket discretionary items—restaurant sales, airline travel, and attendance at movies and live entertainment—have all risen sharply.

Last year all the key relevant indicators were stronger than is the case so far this year. The recovery stalled primarily because the initial surges in housing and consumption could not generate significant gains in employment.

Even if a recovery does start by midyear, it will be the most anemic on record, with real GDP rising only 2.5% to 3% in the first four quarters of recovery, compared with the historical average growth of 6.5%. Furthermore, the recent gains in the housing sector and leading indicators no more guarantee a recovery this year than they did last year. Nonetheless, the fact that easier monetary policy is finally starting to have some modest positive effects, plus evidence that consumers are starting to spend, does boost the odds of a modest upturn this year above 50%. However, growth will be insufficient to reduce the unemployment rate, so in that sense the economy will remain in No Man's Land throughout 1992.

MICHAEL K. EVANS is the president of Evans Economics Inc. and Evans Investment Advisors in Washington.



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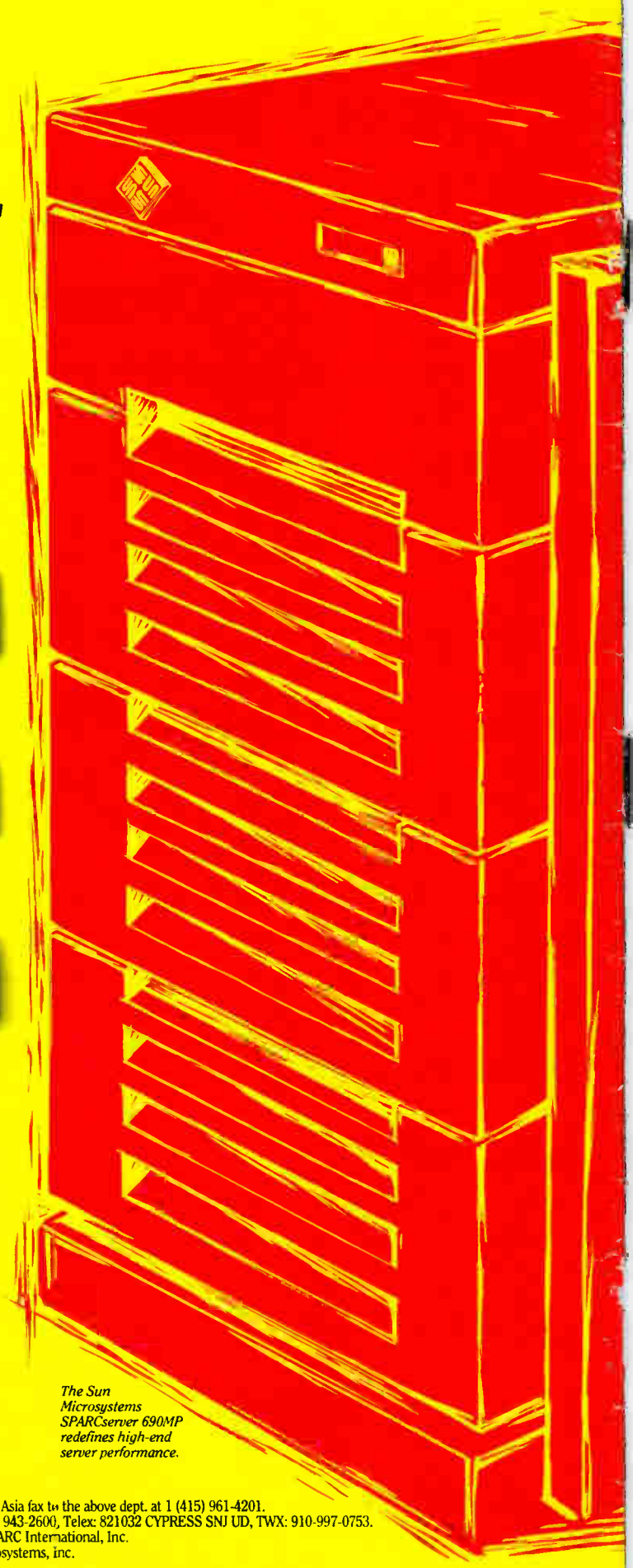

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