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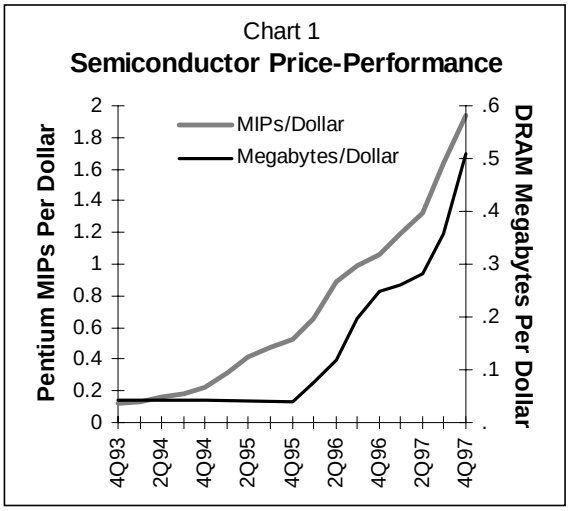
TELECOSM OUTLOOK: 1998

Bandwidth is king in the Telecosm. The top bandwidth show is InterOp, the Comdex of the Telecosm. Nearly everybody who is anybody in networking shows up. The most recent InterOp, in early October, brought together an array of Internet Service Providers (ISPs) demanding more bandwidth, and a constellation of equipment and telco executives promising to respond any day now. Then there was Nayel Shafei of **Qwest** (QWST). So who is he and why is he on a bandwidth high? What is he lighting up anyway? Why does he see himself beset on all sides by dinosaurs? Why does he think InterOp in Atlanta is Jurassic Park? Why is he so rude to Craig Partridge, GTE's gigabit networking guru, who is heading a terabit router project? Why is Shafei claiming that his little startup, worth a mere $6 billion, is rolling out fiber with more bandwidth than **AT&T** (T), **WorldCom** (WCOM), **MCI** (MCIC), and **Sprint** (FON) put together? Is he crazy? Only slightly.

This issue of GTR is mostly a year end update of recent news on paradigm companies and technologies. We will get to them in due course. But first we have to deal with Shafei, an MIT Media Lab PhD who now serves as Executive VP for Product Development at Qwest and Alan Taffel who is VP of Marketing at WorldCom's UUNet. Both of them are pawing and snorting at InterOp.

With talk of bandwidth abundance, Taffel says your humble servant is blowing bandwind. Then he proceeds to confirm all GTR's most hyperbolic claims about the explosion of bandwidth. He's up against the kilofold wall, a thousandfold rise in network traffic every three years. Meanwhile routers and switches are creeping forward at the molasses pace of Moore's Law. Fiber is all lit, so he says. Bandwidth will be scarce and expensive, and WorldCom has most of it. Any ISP who doesn't own his own facilities will crash in the coming bandwidth crunch. Gilder is smoking something.

Chart 1
Semiconductor Price-Performance



Here's where our friend Nayel Shafei comes in. He confronts Partridge, who is heading an InterOp panel on Big Fast Routers and Switches. Caught at the kilofold wall at Qwest, Nayel is totally funked by Partridge's talk of mere millions of packets per second. "We have a revolution going here," says the Qwest VP. "We have 48 fibers running OC-192, that's 10 gigabits per second, and each fiber can carry eight to 16 WDM (wavelength division multiplexing) windows, and we can run four times as many fibers through our conduits. That means close to 30 terabits per second. We have no time for dinosaurs and museums around here."

Heading an Advanced Research Project Agency (ARPA) Terabit Router project for **GTE**'s (GTE) BBN and **Cisco** (CSCO), Partridge is pretty high on bandwidth himself. His prototype equipment can forward packets at a rate of nine million a second, which is reasonably good for government work. An average Internet packet runs at about 2400 bits, which times 9 million adds up to about double OC-192 right there. With Ethernet packets, common or data, it adds up to another order of magnitude. The routers are in the ballpark, he says. Moreover, Shafei is talking backbone speeds here. Individual bitstreams don't need to run nearly as fast.

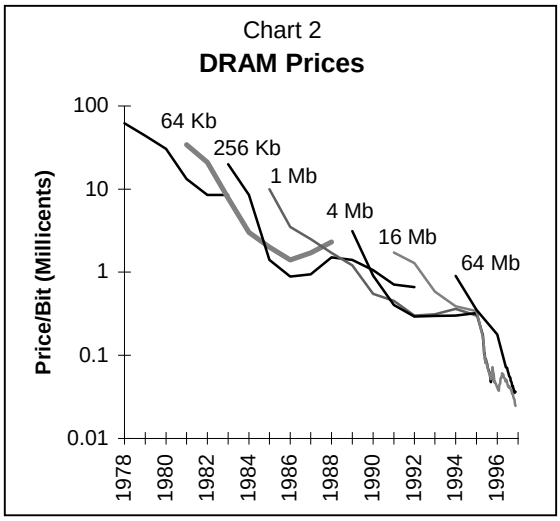
Anyway, Taffel and Shafei agree that bandwidth is growing at least three times Moore's Law. That's the law of the Telecosm right there. QED. With WorldCom, plus Qwest, and the power companies all entering the fray together with **Williams** (WMB) Oil & Gas launching a new fiber net as

large as the one it sold to WorldCom, Taffel is going to be surprised by the bandwidth abundance ahead. But if people like Taffel were not facing the kilofold wall, people like Shafei would not be building their crystal cathedrals of bandwidth abundance. As it all plays out, both sides will prosper.

But first we must go back to the Microcosm where it all starts...

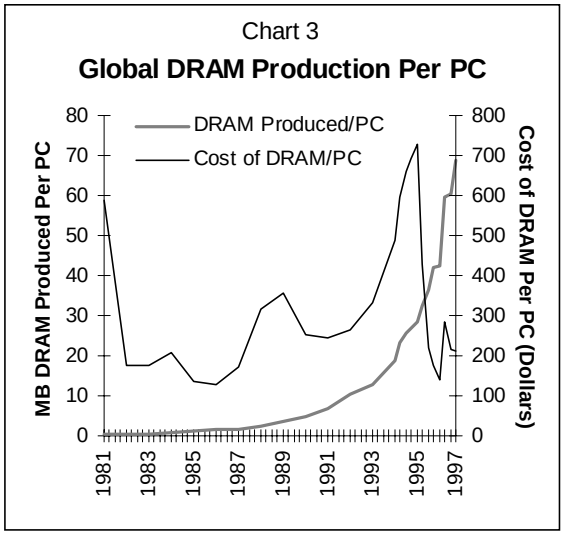
The Good News Bad News DRAM Market

1998 will be a good year for the semiconductor industry. So say the pundits of Semiconductor Industry Association and Dataquest, among others. They cite stable or even rising DRAM (dynamic random access memory) prices as a portent of prosperity. What's wrong with this picture?



Paradigm companies prevail by lowering prices. The PC industry feeds on ever lower prices. Lower prices of commodity components mean higher sales of computers and all their specialized peripherals, replete with microchips. Printers, scanners, cameras, graphics boards, audio devices all now bulge with memory and all are dependent on PC sales. High DRAM prices choke off the golden spiral of price-performance that sustains the microchip industry, including DRAMs.

Both the DRAM price plateau between 1992 and 1995 and the subsequent price collapse in early 1996 were mere incidents in a 30 year Moore's Law tumble down a continuing cliff of costs. Ever since the invention of the DRAM in 1969, its price per bit has plummeted 68 percent per year. Current 64Mbit pricing is nearing per bit parity with 16Mbit chips. Increased 64Mbit production in 1998, added to abundant 16Mbit supply lines, will drive the prices down still further even without currency devaluation in Asia that has brought DRAM spot markets to record lows .



With cheap Asian DRAMs threatening to flood into the US, **Micron Technology** (MU) is pushing to stay ahead. Early this year, when Asian producers attempted to prop up DRAM prices by cutting back on 16Mbit supplies–shifting planned new production to 64Mbit lines–Micron accelerated production of 16Mbit chips on 0.30 micron lines. Together with fewer mask processing steps in manufacture, Micron's 0.30 micron system eclipsed competitors' 0.35 micron products and Micron took the global lead in DRAM market share. Now, Micron is ramping up 64Mbit DRAMs using its 0.25 micron process technology and new process efficiencies. They announced samples of industry leading 125MHz Synchronous DRAMs on November 19, 1997.

The Onrush of Silicon-Germanium

So it goes in the Microcosm. Meanwhile, the Telecosm of high frequency communications uses the microcosmic advances to accelerate communications bandwidth down an even steeper cliff of costs.

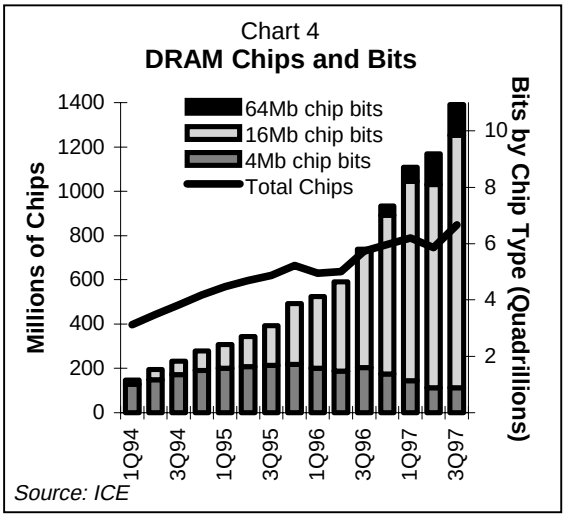
Advanced semiconductor technologies, such as Silicon-Germanium (SiGe), combine with new breakthroughs in digital signal processors (DSPs) and Java software, to drive the industry to new heights. While the press focuses on minor advances such as **Intel**'s (INTC) two bit Flash RAM cells and **IBM**'s move to copper wires on chip, Silicon-Germanium is enabling a real array of new products and capabilities. For example, **Lucent** (LU) reveals a new Silicon-Germanium process that allows its switches to couple directly to OC-192 (10 gigabit per second) fiber optic lines. Germany's Temic Telefunken Microelectronic GmbH, says *EE Times*, "is cutting staff, realigning fabs and phasing out over half of its IC portfolio" to refocus on analog, mixed-signal and RF telecom chips based on SiGe. Temic has already designed SiGe components for digital cordless phones at 1.8GHz and GSM phones at 900GHz, and plans to introduce at least eight more SiGe ICs next year, including low noise and power amplifiers for cordless, GSM and PCS phones.

The July1997, GTR highlighted the cost and manufacturing advantages of SiGe over GaAs (Gallium-Arsenide) chips. With relatively minor modifications of existing CMOS fabrication processes SiGe semiconductors may be produced for near the price of traditional silicon ICs. Yet, SiGe chips will function at higher frequencies (Temic claims 50GHz), competing directly with GaAs chips costing some ten times more.

SiGe Microsystems of Ontario, Canada, is finalizing a patent cross-licensing deal with IBM, including SiGe's UHV-CVD (unique ultra high vacuum/ chemical vapor deposition) process. In 1998, SiGe Microsystems' customers will begin product shipments and SiGe Microsystems will add an 8 inch UHV-CVD tool for fourth quarter production. IBM's SiGe partners are also ramping up production. IBM pioneered SiGe development and is working with **Harris Semiconductor** (HRS), **Hughes**, **Nortel** (NT) and **Tektronix** (TEK) to bring SiGe to commercial markets.

Harris plans to introduce a SiGe RF front end for dual-mode cell phones (800MHz/1.9GHz) in July. Wireless LAN (local area network) chips are due in October, 1998. Rather

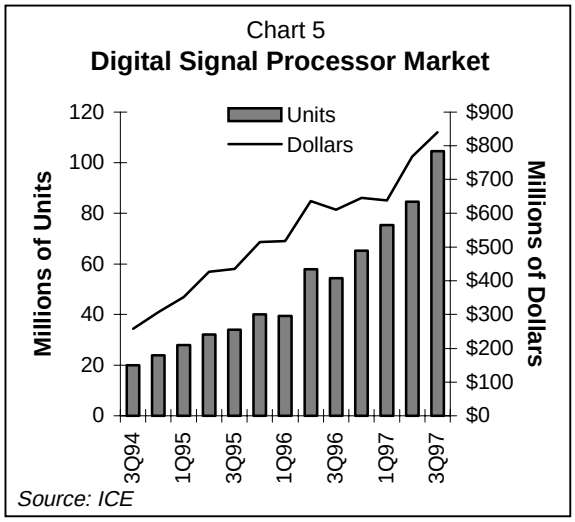
than mixing silicon and GaAs chips, SiGe allows the integration of functions that previously were distinct. Using SiGe to produce 2.4GHz wireless LAN components, Harris is able to reduce the current five chip set to one. This type of integration, shrinking costs and power consumption, is also part of Temic's strategy as they move from low noise and power amps to single chip RF modules. With a strategic focus on the development of single chip systems, including radios-on-a-chip, **National Semiconductor** (NSM) is investing heavily in SiGe. National's Director of Marketing for Wireless Communications, Greg Ravenscroft, sees SiGe as an exciting opportunity, with the technology now "about as good as GaAs."



With SiGe pulling even with GaAs, but at a significant cost advantage, the technology is poised to explode into the RF IC marketplace. We stand by our comments made in the July 1997 GTR that "SiGe has the potential to seriously compromise the future of the three GaAs companies [**Vitesse** (VTSS), **Triquint** (TQNT) and **Anadigics** (ANAD)] that have been cited in various reports." While SiGe will not supplant existing Gallium-Arsenide designs, the single chip systems of the future will move toward the new process.

Digital Signal Processors Take Center Stage

Through nine divestitures and four acquisitions, our basic paradigm leader **TI** (TXN) has refocused its efforts on DSPs (digital signal processors) as the core of its semiconductor business. Since 1988, the market for DSPs has grown at more than 40 percent per year. Today, the DSP solutions market is approximately $5 billion, with TI commanding an industry leading 45 percent market share. TI expects continued DSP growth rates well above that of the semiconductor market, and anticipates the market for DSPs–together with related mixed-signal devices–will reach about $50 billion in ten years.



Since pioneering DSPs in 1982, TI has generated a mass market for general purpose DSPs and now counts a base of over 30,000 customers. DSPs are specialized semiconductors capable of processing a stream of bits–a digital signal–in real-time. With DSPs found in everything from DVD (digital versatile disk) players to anti-lock brakes, TI estimates the average technology consumer touches a DSP-enabled product every ten minutes. Key DSP market areas include mass storage, network access and wireless devices. According to TI, 90% of the high performance disk drives (with capacity in excess of 3 gigabytes) contain TI DSPs. In 1998, TI expects sales of DSPs for LAN (local area network) interconnects to increase by 25 percent and sales to modem manufacturers to rise 40 percent.

TI's programmable DSP has reshaped the modem market. A little more than a year ago, all modems were hardwired. Today, more than half of modems shipped have completely programmable DSPs. Next year, this should climb above 60 percent. This is a paradigm technology that can end by making TI happy that it botched its invention of the microprocessor. The question is, can it make horses fly?

The ADSL Dilemma

Paradigm technologies use bandwidth as a simpler and cheaper replacement for power and switching. ADSL (asymmetric digital subscriber line) uses power, switching, and ingenious, Shannon defying, engineering bravado to stuff megabits of data into twisted copper wires designed for 4 kilohertz voice. Putting full-scale video down your humble telephone line, this technology smacks of a campaign to compete with Federal Express using winged horses. But if you own 43 million tons of embedded phone lines–that is to say, if you are an incumbent local telephone company caught in a copper cage–you are willing to incur the costs of making horses fly.

The great promise of this technology is to break the current Internet bottleneck of some $1,600 per month T-1 lines. These regulated and tariffed 1.536 megabits a second links to offices represent a $10 billion telco monopoly market totally unrelated to costs. Many of these lines are already implemented with a DSL technology called HDSL and could earn profits at $10 per month.

Putting wings on horses is a real time DSP challenge. Call for TI. Expanding their role in the *x*DSL high bandwidth modem market, TI announced November 19, 1997, its acquisition of **Amati Communications Corporation** (AMTX) for $395 million in cash. Amati is one of the most macho engineering companies on the face of the earth. Essentially, it breaks your phone line into some 32 parallel tones or DMT fre-

quencies (discrete multitones) and dynamically tests each one to discover the broadband sweet-spots. It then pushes the bulk of the bits through the most capacious bands. Invented by Stanford professor John Cioffi, the DMT process takes advantage of the highly variable nature of twisted pair copper bandwidth and the increasing real time processing powers of DSP.

The TI agreement cancels Amati's previously announced merger with **Westell** (WSTL). Concurrently, TI and Westell announced a strategic development program that will accelerate the use of TI and Amati's DSP-based technologies in Westell's DSL systems.

Both the American National Standards Institute (ANSI) and the European Telecommunications Standard Institute (ETSI) have selected Amati's DMT as the standard for ADSL equipment. Amati has licensed technology based on its ADSL/DMT patents to **Analog Devices** (ADI), Nortel, **Motorola** (MOT), **NEC** (NIPNY) and **Pairgain Technologies** (PAIR). On September 23, 1997, Amati and **Alcatel** (ALA), the leading supplier of asynchronous transfer mode (ATM) based ADSL access equipment, announced a deal for patent cross-licensing and interoperability testing. Alcatel brings Amati's DMT technology into Europe, a potential marketing sweet-spot, lacking extensive cable TV and paradigm friendly broadband cable modems.

Ironically, as TI pursues its DSP interests through the purchase of Amati, the Palo Alto company is entering into agreement with one of TI's principal DSP competitors, Analog Devices. On September 15, 1997, Amati announced a licensing agreement with Analog. In addition to competing in the wireline communications markets, TI and Analog face each other in the wireless field. Highlighting the importance of the wireless communications markets to TI, is the statistic that more than half of all digital wireless phones sold today use a TI DSP solution. And the market continues to grow. TI expects the manufacture of a total of 86 million digital wireless phones in 1997, blowing past its January estimate of 50 million by some 72%.

In the March 1997, GTR, *The Tetherless Telecosm*, we focused on the importance of software radios in wireless communications. Analog Devices was highlighted as "a paragon of the digital radio paradigm." TI is now indirectly challenging Analog in this emerging market.

Chart 6

DSP Market Share

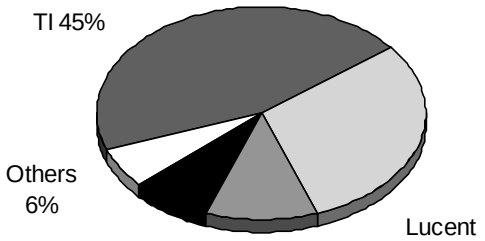
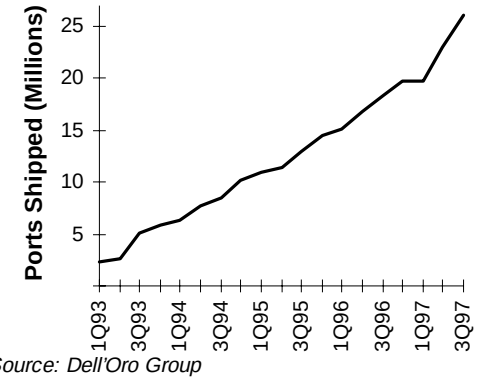


Chart 7

LAN Switch and Hub Market



Source: Dell'Oro Group

Mizar, Inc. (MIZR) is a Texas company that has built a family of products based on TI DSPs. Mizar's new MX3100 VME (Versa Module Eurocard) DSP board combines two TI TMS320C6201 DSPs with on-board memory and high speed I/O interfaces to deliver an industry leading 3,200 MIPS (million instructions per second) performance. This technology responds to the high demands of the military communications, sonar and radar applications which have been the core of Mizar's revenues. But the MX3100 also provides the processing power for the new SoftBand software radio architecture, which was developed by Mizar's recently formed Telecommunications Products Group.

Software radios use high speed processing to perform radio functions in software rather than hardware. This approach enables a single wireless base station unit to process multiple communications protocols including CDMA (code division multiple access) and GSM (Global System for Mobil Communication). Mizar's SoftBand radio system greatly simplifies hardware design, thereby speeding development, lowering manufacturing costs and facilitating future maintenance and upgrades. The company is committed to being at the forefront of the emerging software radio market and cites excellent market response for its SoftBand software radio architecture, which will be the basis for a range of products to be released over the coming months.

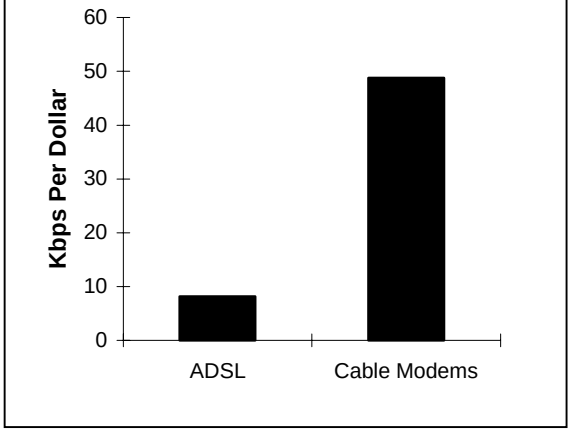
On November 20, 1997, Mizar announced agreement to merge with **Loughborough Sound Images Ltd**., a privately held UK company. Generating revenues approximately twice those of Mizar ($22.45 million for fiscal year ending September 30 vs. $11.5 million for Mizar's year ending June 30), Loughborough Sound Images' develops and sells DSP-based embedded computers for the telecommunications, instrumentation, industrial automation and medical imaging industries. Their broad focus will jump start Mizar's diversification from its previous focus on defense products. The merger will create a truly global embedded DSP company with major operations in the US and UK, sales offices in France and Germany and a worldwide network of distributors. Loughborough Sound Images broad product line includes DSPs from Analog Devices, Motorola and Lucent, in addition to chips from TI.

The Horses Take Wings

The commercial launch of DSL service by major telcos began with a grandiose sputter on October 28, with **US West Communications'** (USW) introduction of service in Phoenix. About 500 customers signed

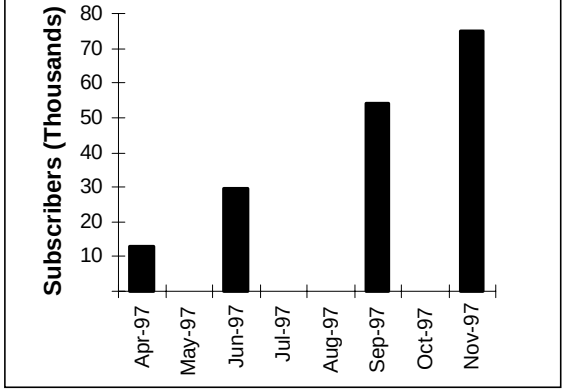
up in the first day and within a week 1,714 had applied for service. Using equipment from Amati licensee PairGain, US West offers 192kbps (thousand bits per second) service for $40 per month, 320kbps for $65, and 704kbps for $125 plus $19.95 additional charge for Internet access. Days later, **SBC Communications** (SBC) announced DSL service by PacBell in Silicon Valley and Southwestern Bell in Austin, Texas. PacBell's offering will be priced at $80 per month for a 384kbps symmetrical connection or $250 for a 1.5Mbps downstream and 384kbps upstream asymmetrical link, plus hardware costs of $435-$660 and installation fee of $125. If you would like Internet access service, **Concentric Network Corporation** (CNCX) will provide it for $95-$495 per month (depending on usage) added onto the PacBell line charges. On November 18, GTE jumped on the bandwagon announcing their Marina Del Ray deployment using Westell equipment. The service will include unlimited Internet access, with pricing set at $125 per month for 680kbps/256kbps asymmetric service or $700 per month for 1.5Mbps/384kbps service.

Chart 8
ADSL Falls Short of Cable Modems



Based on these prices, the US RBOCs (Regional Bell Operating Companies) seem to think they are still a monopoly. And, of course, in many areas, they are. None the less, cable TV coax currently passes some 90 percent of American homes, reaches more than 60 percent, and offers modem ready quality for perhaps 20 percent. Cable modem services come with unlimited always-on Internet access at speeds of 1.5Mbps to over 3Mbps for just $40 to $50 per month. Only in Canada, where **Rogers** (RG) and **Shaw**'s (STV) Wave cable modem service is aggressively providing service in partnership with **@Home** (ATHM), is there a local telco apparently willing to compete. The **Bell Canada** ADSL service supposedly begins in Ottawa/Hull and Quebec during the 1st quarter of 1998 with asymmetrical 2.2Mbps/1Mbps service priced at $69.95 per month. Hey, it's cheaper than T-1.

Chart 9
North American Cable Modems



Bell Canada's planned offering, however, falls well short of the next generation of modems standardized on the specification of the MCNS–Multimedia Cable Network System Partners, L. P., which consists of **Comcast** (CMCSA), **Cox** (COX), **TCI** (TCOMA) and **Time Warner** (TWX) Cable. Offering interoperability, lower prices, and even the possibility for off the shelf retail sales, MCNS compliant cable modems promise to accelerate cable modem deployments. **Bay Networks** (BAY), the industry leader with over 100 thousand modems shipped and an installed base of at least 50 thousand, will begin interoperability and field testing of its MCNS modem early next year. Late 1998 will see them follow up with modems compliant with the next generation of MCNS specifications, known as DOCSIS. (The Data Over Cable Service Interface Specifications; in addition to MCNS partners, Rogers, **MediaOne**, and **CableLabs** have all contributed to the DOCSIS documents as have numerous cable industry, computer and networking vendors).

Terayon also plans a MCNS DOCSIS compliant modem for late 1998. Terayon had resisted MCNS compliance while pushing for inclusion of its proprietary S-CDMA technology. S-CDMA uses the spread spectrum technology favored by GTR to provide robust high rate (symmetrical 30Mbps) data transmissions over even noisy unimproved cable plant. While accepting MCNS compliance as the industry standard, Terayon's modems will continue to support two versions of its S-CDMA technology. And Terayon will push to increase S-CDMA market presence through a licensing program for their outstanding technology.

The first commercial launch of Terayon's modems in North America came on November 20, 1997, in Sudbury, Ontario, by Northern Cable. A subsidiary of **Videotron**–the second largest cable operator in Canada–Northern deployed Terayon equipment–operating at 14Mbps–to link 60 elementary schools, secondary schools and administrative sites in the Sudbury District. Since 1994, Northern Cable has installed some 300 km of fiber in a hybrid fiber coax system and is now positioned to offer broadband services to other organizations and businesses.

Presenting ADSL as an easy consumer entry point for higher rate digital services, on October 8, 1997, Nortel announced the Nortel 1-Meg Modem service. Billed as a simple upgrade to existing Nortel telco central office (CO) switches, the 1-Meg system would separate data traveling at up to 1Mbps (1Mbps downstream/120kbps up) from ordinary voice traffic, allowing each to coexist on subscriber lines. On the user end, the modems would cost no more than a traditional analog modem and be as easy to install. Just weeks later, **Rockwell** (ROK) Semiconductor announced a very similar proposal which they named CDSL (consumer DSL). And on November 17, Nortel and Rockwell agreed to cooperate on a single version of the service combining Nortel's CO network equipment solution with Rockwell's modem chipsets.

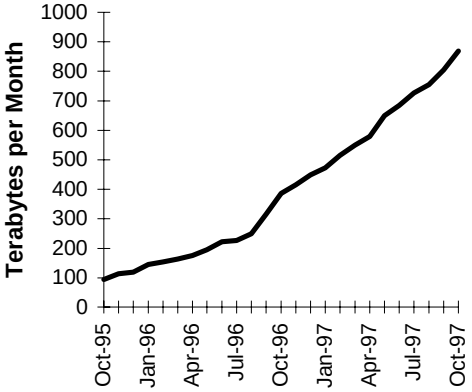
Other breakthrough Nortel technologies will bypass entirely both telco copper and cable coax. On October 8, Nortel

and Norweb Communications (a business unit of **United Utilities PLC**. of Great Britain), announced the joint development of technology allowing data to be transmitted over electric power lines into homes at up to 1Mbps. With ownership of millions of miles of fiber used for maintenance and signaling in their power line trunks, utilities for a decade have been studiously contemplating their potential to be big players in telecommunications. Michael Milken, for one, has long been an enthusiast. Now data can enter homes directly on power cables.

Nortel is also bypassing copper and coax through the airways. To strengthen its position in the fixed broadband wireless market (see November 1997 GTR), Nortel announced November 2, 1997, an offer to purchase **Broadband Networks**. Both companies had supplied equipment to **Teligent** (TGNT)–for testing in their early deployment of their advanced wireless telco bypass network–and on November 4, Teligent announced the signing of a letter of intent naming Nortel the preferred supplier and principal integrator of its network. Holding 24GHz radio spectrum in more than 700 cities and towns across the US, Teligent is scheduled to begin offering commercial local exchange, long distance and Internet access services in early 1998. Endorsed as a Telecosm leader before its IPO on November 20 at $21.50 per share (GTR, November), Teligent commands the spectrum, the technology, and the resources to become a major player in the local loop for businesses.

Chart 10

Internet Traffic



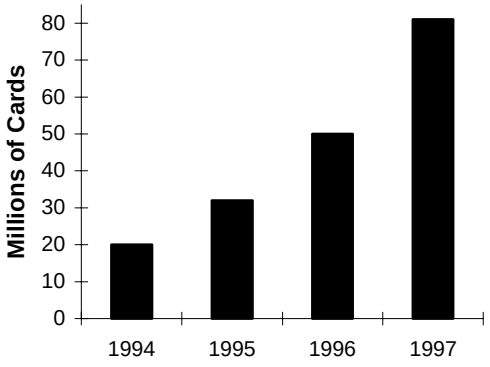
The Java "Religion" Spreads

While the wiseguys of the industry are betting on **Microsoft** (MFST) to take over the cosmos–following in the imperial tread of IBM in the 1980s–a suicidal band of some 750 thousand developers are lining up to sip special Java Kool Aid under the demonic spell of **Sun** (SUNW) cult leader Scott McNealy. Latest to imbibe the telecosmic brew is Texas Instruments.

Bored perhaps with their DSP challenge to Intel in processors, TI has licensed EmbeddedJava and PersonalJava, which are subsets of Sun's Java programming language designed for real time operating systems (RTOS). Typical real time applications are transactional processes such as Internet commerce and audio and video for consumer devices. PersonalJava serves small form-factor devices such as smart phones, while EmbeddedJava is useful in pagers, with simple character-based displays, or other embedded functions. Companies licensing PersonalJava and EmbeddedJava represent more than 50% of the total market for commercial real-time operating systems, for set-top boxes, web phones, pagers and other appliances.

Chart 11

Smart Cards in Banking



Sources: Meridien Research, GemPlus, Orga

Focusing on still simpler systems, Sun has also launched Java into the smart card market. The first licensee for this purpose was **Schlumberger** (SLB). One year ago the company began a campaign for Java now claiming over 90 percent of the global smart card manufacturing market, including **Siemens AG,** which plans smart card Java chips, TI, and **SGS Thomson** (STM). On September 25, 1997, Schlumberger announced that demand was exceeding all expectations for its Cyberflex Java card development kits, with hundreds sold to smart card customers in the banking, telecommunications, health care and information technology industries.

Last February, **GemPlus**, the largest manufacturer of smart cards, was the second to license Java for these devices. GemPlus then joined Schlumberger–the two collectively accounting for 70 percent of global smart card output–in founding the Java Card Forum. So far this group has enlisted **Bull**, **De La Rue**, **Giesecke & Devrint**, **Hitachi** (HIT), IBM, **Keycorp** (KEY) and **Toshiba**.

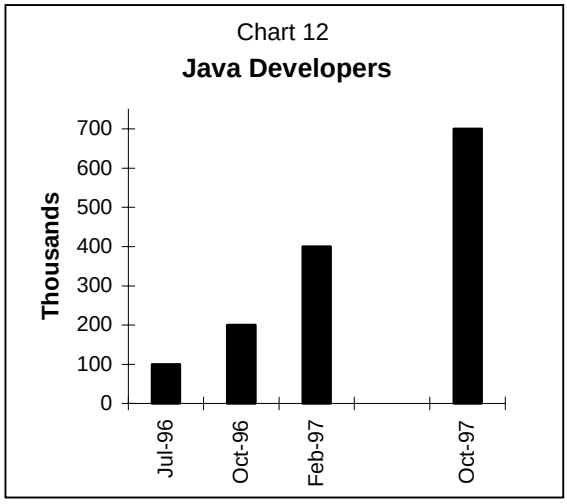
Marc Lassus, chairman and CEO of GemPlus announced on August 22, 1997, the sale of its majority stake in **Integrity Arts** to Sun. With GemPlus' standardization on Sun's Java technology, Integrity Art's specialized skills in smart card operating systems, virtual machines and applications became more of an asset to Sun than to GemPlus. Freed from the standards conflicts found in computer software markets, GemPlus has been able to focus on advancing its Java card offerings. On October 17, it announced the availability of GemXpresso, the first Java Card 2.0-based smart card implementation on a 32-bit RISC processor and the GemXpresso Rapid Applet Development environment.

On August 4, just ten months after Sun's release of the first Java smart card specification, *ComputerWorld* reported that **VISA**'s 21,000 member banks approved the move to Java-based smart cards. VISA's plans call for the circulation of 2 to 3 million Java-based smart cards in the US by the end of next year, and 200 million smart cards worldwide by 2001–compared to some 600 million regular cards now issued. Trials of smart cards incorporating VISA Cash stored value technology are underway in New York City.

While Java has become the de facto standard for smart card development, the computer front is erupting with conflict and controversy. The ISO (International Standards Organization) has granted tentative approval of Sun's application to become the "recognized submitter" of Java, but only after Sun addresses comments made by 13 of the 20 countries (out of 27) voting to approve its application. If all goes well, Sun will control both

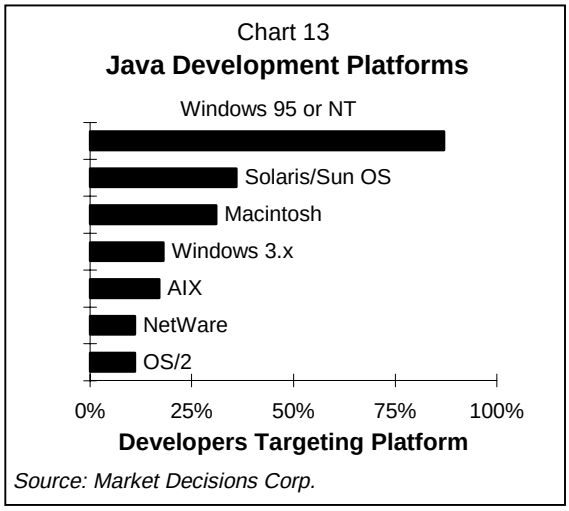
the Java standard and the Java trademark. While Microsoft dismisses the ISO as a rubber stamp for Sun, a more influential Java force is IBM, which dominates key ISO committees.

Also a key Java player is **Netscape** (NSCP), which enhanced its influence on Java for PCs and NCs on November 19 by announcing a suite of tools for building and deploying Java applications. The new tools, together with the November 24 acquisition of **Kiva Software Corporation**, brings a welcome expansion to Netscape's Java product line. Kiva sells award-winning application server software that employs Java for developing, deploying and managing business-critical applications over the Internet, corporate intranets, and extranets. The Kiva kit already complements Netscape's offerings in companies such as **E-Trade** (EGRP) and Pacific Bell.



None the less, the Java scene has grown increasingly murky as the language undergoes predictable growing pains. Microsoft's allegation of double standards in Sun's lawsuit over Java compatibility struck an ironic chord at Netscape on November 13. The leading popularizer of the language from the outset, Netscape removed the Java logo from its Communicator 4 browser, admitting they were not in compliance with JDK 1.1 (Java Development Kit). The time frame for meeting contractual obligations for Netscape's compatibility have already passed according to JavaSoft's Lisa Poulson and Netscape is not likely to be fully compliant until Communicator 5.0 is released in 1998.

The Netscape imbroglio closely followed a startling but controversial survey of 151 Java developers by Market Decisions Corporation. Some 56 percent of the Java developers cited Sun's incompatible versions as an "issue of concern," while 67 percent cited cross-platform compatibility problems and 47 percent objected to Sun's proprietary control. According to critics, the "write once, run anywhere" promise of Java is transpiring into a "write once, test everywhere" reality. Standards and compatibility issues all ranked higher as concerns than Java performance (cited by 45 percent). Despite Sun's 100% Pure Java campaign and the original promise of Java, only 30 percent viewed Java as a robust cross-platform development language. Over 87 percent said they were targeting applications for Windows 95 or NT, where a Microsoft implementation of Java would suffice. Yet six other operating systems are being targeted by 11 percent to 36 percent of the developers.



While *ComputerWorld*, IBM and others now estimate some 700 to 750 thousand Java developers, the Market Decisions sample found only 9 percent of effort spent on development was using Java; 39 percent were merely experimenting with Java or in the early planning stages of a Java project. *Newsbytes'* report of the survey brought an avalanche of critical mail from satisfied Java users. But, even discounting for the small sample and high margin of error, the survey indicates Java is at a critical phase as the Sun-Microsoft litigation gets underway.

An important milestone for Java is the successful development of Lotus' eSuite of Java applets to be shipped in January of 1998. Lending support to eSuite is a conglomeration of Microsoft competitors: Lotus's parent company IBM, Sun, **Oracle** (ORCL), **America Online** (AOL), Netscape and **Novell** (NOVL). Playing both sides of the great divide is Intel, which is working with Lotus to be certain eSuite runs optimally on Intel PCs. Another surprise is that in committing to deliver eSuite to their Java-based network computer (NC) customers, Oracle and Sun appear to be conceding lackluster support for their own previously announced Java applet suites. In this market only **Applix** (APLX) has demonstrated some success in the face of some 20 million licenses for Microsoft's Office 97 in less than a year.

IBM/Lotus, Oracle and Sun have also united in the development of a unified network computing desktop. The Webtop Specification will offer developers a consistent environment and set of APIs to build and deploy Java based programs for both NCs and PCs. With Netscape participation and support for the Webtop Specification, there presumably will be a Communicator based Webtop running on Windows platforms. Thus, the cross platform concerns of Java developers may be met by developer adoption of the Webtop Specification. Alternately, the Webtop may be seen as a competing platform to the dominant Microsoft desktop and its APIs.

Emphasizing the threat of an alternative to Windows is the news that next year IBM will introduce a new Java based operating system that will run on both PCs and NCs, as well as in embedded chips in telephones, smart cards, office equipment and peripherals, such as printers. The new focus on separating software from dependence on the underlying hardware is reflected in the renaming of the IBM PC Company as the IBM Personal Systems Group and the combining of IBM Personal Software, Networking Software, and E-Business divisions to form the Network Computing Software Division. Yet, Donn Atkins, Vice President of Marketing for IBM Personal Software Products, buffers the obvious threat to Microsoft's customer base by saying, "We think we have a set of capabilities attractive to another customer" than Microsoft's.

Even if IBM does not outwardly admit to gunning for Microsoft, **Fujitsu** and Toshiba are launching NCs running Sun's JavaOS. Meanwhile, Toshiba Information Systems of Japan has developed its own Java based OS. Named Jeve OS, the new OS will incorporate word processing and email

TELECOSM TECHNOLOGIES

ASCENDANT TECHNOLOGY	REPORT(S) Volume: No.	COMPANY (SYMBOL)	Reference Price	Price as of 12/1/97
Cable Modem Service	I: 2, 3 II: 7, 8, 9, 11, 12	*@Home* (ATHM)	19 1/2	22 1/4
Analog to Digital Converters (ADC), Digital Signal Processors (DSP)	II: 3, 7, 12	*Analog Devices* (ADI)	22 3/8	33 5/16
Java Thin Client Office Suite, Rapid Application Development (RAD)	II: 6, 7, 12	*Applix* (APLX)	4 1/2	5 3/4
Digital Video Codecs	II: 5	*C-Cube* (CUBE)	23	20 15/16
Erbium Doped Fiber Amplifiers, Wave Division Multiplexing (WDM)	II: 2, 7, 9, 10, 11	*Ciena* (CIEN)	23 *	56 1/8
Low Earth Orbit Satellites (LEOS)	I: 2 II: 1, 3, 4, 8, 10	*Globalstar* (GSTRF)	21 3/4	51 1/2
Single Chip ASIC Systems, CDMA Chip Sets	II: 8	*LSI Logic* (LSI)	31 1/2	25 1/8
Telecommunications Equipment, Wave Division Multiplexing (WDM)	II: 1, 2, 7, 9, 10, 11, 12	*Lucent Technologies* (LU)	47 1/8	82 5/8
Single Chip Systems	II: 8, 12	*National Semiconductor* (NSM)	31 1/2	34 3/4
Internet Software	I: 1, 3, 4 II: 1, 4, 6, 7, 8, 10, 12	*Netscape Communications* (NSCP)	53	28 7/8
Telecommunications Equipment, Wave Division Multiplexing (WDM), Code Division Multiple Access (CDMA), Silicon Germanium (SiGe)	II: 1, 7, 9, 11, 12	*Northern Telecom* (NT)	92	96
Wave Division Multiplexing (WDM), Satellite and Wireless Systems, Code Division Multiple Access (CDMA)	II: 10	*Ortel* (ORTL)	20 3/4	17 1/2
Point to Multipoint System for 7-50 Ghz, Spread Spectrum Broadband Radios	II: 10, 11	*P-COM* (PCMS)	22 3/8	19
Code Division Multiple Access (CDMA)	I: 1, 2 II: 1, 3, 4, 7, 8, 9, 10, 11	*Qualcomm* (QCOM)	38 3/4	70 7/8
Nationwide Fiber Network	II: 9, 10, 11	*Qwest Communications* (QWST)	40 3/4	54 1/8
Java Programming Language, Internet Servers	I: 1, 2, 3, 4 II: 1, 5, 6, 7, 8, 10, 12	*Sun Microsystems* (SUNW)	27 1/2	38 3/8
Optical Equipment, Smart Radios, Telecommunications Infrastructures	I: 1 II: 1, 2, 3, 9	*Tellabs* (TLAB)	29 1/8	54 1/4
Broadband Wireless Services	II: 9, 10, 11, 12	*Teligent* (TGNT) +	21 1/2 *	25
Digital Signal Processors (DSP), DRAM	I: 2, 3, 4 II: 5, 8, 11, 12	*Texas Instruments* (TXN)	23 3/4	51 15/16
Wave Division Multiplexing (WDM) Modulators	II: 7, 9, 10	*Uniphase (UNPH)*	29 3/8	40
Code Division Multiple Access (CDMA) Testing Gear	II: 1, 2, 7	*Wireless Telecom Group* (WTT)	10 3/8	7 1/8
Telecommunications, Fiber, Internet Access	II: 9, 10, 11, 12	*WorldCom* (WCOM)	29 15/16	32 3/8
Field Programmable Logic Chip	I: 3	*Xilinx* (XLNX)	32 7/8	40 7/16

\+ New Addition * Initial Public Offering

Note: This table lists technologies in the Gilder Paradigm, and representative companies that possess the ascendant technologies. But by no means are the technologies exclusive to these companies. In keeping with our objective of providing a technology strategy report, companies appear on this list only for these core competencies, without any judgement of market price or timing.

functions and is ambitiously aiming for a 15 percent share of the OS market by 2000.

Perhaps competing more directly with the IBM/Oracle/Sun Webtop than Microsoft's desktop, is **Novera**'s Epic (Enterprise Platform for Internet Computing). Running on top of Windows, Unix and other OSs, Epic does not seek to replace the functionality of a full OS, but instead adds a consistent environment for running Java applets while adding file, print, directory and other services that can be accessed consistently across various OSs. In addition Epic focuses on the management tasks required in Enterprise computing. While Novera's collaboration with **Corel** (COSFF) on their office suite did not bear fruit, **Bear, Stearns & Company** is among the adopters of Epic.

As software companies embrace Java and the concept of network computers as an alternative to the Microsoft dominated PC platform, semiconductor companies are attempting to bypass Intel. On November 17, 1997, **LG Semicon** announced its development of a Java processor. Designed to bring the Internet to network computers, Internet TVs, set-top boxes and kiosks, the processor will speed the execution of Java programs by implementing the interpreter part of the Java Virtual Machine on silicon. LG Semicon will manufacture the chips, with their strategic partner Sun receiving the first supplies in December.

So WDM, SiGe, Java, CDMA, Cable Modems, smart radios, microwave local loops, and NCs. There's a millennial soup for the Telecosm.

But keep an eye on Nayel and Craig, our InterOp men of the year.

George Gilder and Ken Ehrhart, December 2, 1997

After much consideration, we have decided to allow ForbesASAP exclusive rights to publish an occasional adapted text from the reports some six to eight weeks following receipt by GTR subscribers. In practice this will mean there is a possibility of a second wave of impact after initial publication.

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Editor: George Gilder; Associate Editors: Charles Frank and David Minor;
Director of Research: Kenneth Ehrhart.
Monument Mills P.O. Box 660 Housatonic, MA 01236 USA
Tel: (413) 274-0211 Toll Free: (888) 484-2727 Fax: (413) 274-0213
Email: gtg@gilder.com