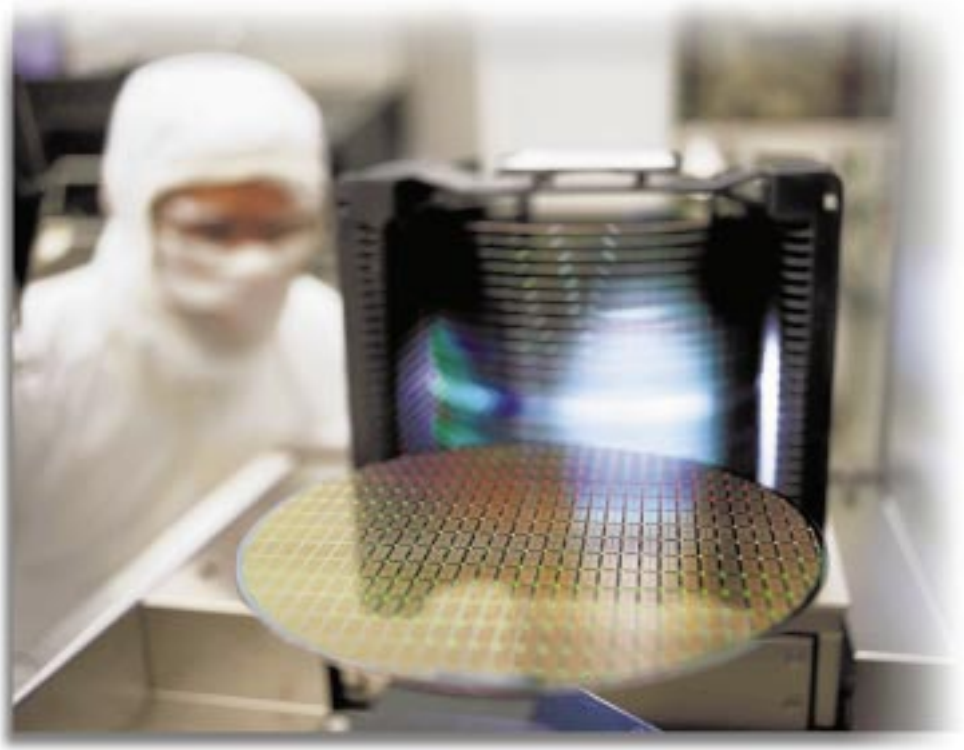
Supplying Chips to Computer and Communications Device Manufacturers Worldwide

Lucent Technologies Microelectronics Group is a world leader in the communications semiconductor industry, powering computer and communications equipment in every application. We are experts in optoelectronic components, analog, digital, wireline, wireless, voice, and digital networking. We focus on providing the best customer service in the industry. We make Bell Labs innovations and expertise available to you.

Technology Trends

The growth of the personal computer market, the worldwide web, and the Internet has generated demand for everything related to communications and PCs. Communications and network service providers must quickly and effectively reinforce or replace their networks, provide new services, and prepare for a fast-moving future. Communications equipment and terminal equipment manufacturers must quickly design and offer products that meet both today's and tomorrow's needs.

Communications system and PC manufacturers need reliable, forward-thinking, and flexible suppliers who can react to the quick changes demanded by today's environment. Lucent Technologies Microelectronics Group is such an ally.



Microelectronics Group Successes

Lucent Technologies Microelectronics Group has been named the world's fastest-growing top-20 OEM semiconductor company in the industry. We became the twentieth largest IC company in the world in 1996, and advanced another six places to the fourteenth position in 1998.*

Our relationships with our customers have grown just as strongly. We focus on our customers' needs and offer products and support in a range of key areas: digital signal processors (DSPs); wireless radio frequency devices; application-specific ICs (ASICs); optoelectronic transmitters, receivers, and transceivers; framers; line drivers and receivers; and many more successful products.

The Microelectronics Group made a number of key moves in 1998 and 1999, including the following:

- Formed a wafer manufacturing joint venture in Singapore with Chartered Semiconductor Manufacturing.
- Acquired Optimay, a German-based developer of software products and services for GSM cellular phones.
- Installed a new Laser 2000 automated laser packaging operation in Breiningsville, PA, to triple production output.
- Acquired Sybarus Technologies, a semiconductor design company based in Ottawa, Canada, which will specialize in SONET/SDH system-on-a-chip design.
- Acquired the Ethernet local area network (LAN) component business of Enable Semiconductor.
- Created Star*Core with Motorola to jointly develop new DSP architectures.

Microelectronics Key Services and Solutions

Microelectronics Integrated Circuits System Expertise

System Expertise. It takes much more than great technology to be a market leader. If it were simply a matter of integration or technology, most customers would have already solved their problems. What it requires is an in-depth understanding of the systems where the devices will be used, as well as the ability to apply technological advances. We take a systems approach to solving your problems, and we have the support, expertise, and technology to deliver leading-edge solutions.

Core Competencies. We can apply leading semiconductor and optoelectronic technologies and methodologies across a wide range of applications. We offer the products and support you need to achieve system-on-a-chip with our advanced modular process technologies, proven ASIC design, and laser-programmable system

Further Information on the World Wide Web

www.lucent.com/micro/

*Source: Dataquest

chips. We offer DSPs with remarkably high levels of performance, power, and configurability that use our world-renowned algorithms. Our optoelectronic lasers and detectors are world leaders in distance and speed. Our systems expertise and support are also industry leading.

***Silicon Suite*® Solutions** deliver applications support at unmatched levels. These suites are application-based product groups designed to accelerate your time to market. They include elements of our system ASICs and standard products along with system design tools, software, and support services. Hardware design verification can be accomplished in silicon, using our *ORCA*® FPGAs, kit parts, standard products, or laser-programmable system chips.

Wireless Communications. Our comprehensive offering includes solutions in messaging and digital mobile radio applications. It extends across Personal Communications Systems (PCS) and all other major cellular standards worldwide: CDMA, UMTS, TDMA, GSM, and PDC. Cell phone and infrastructure makers, service providers, and network operators rely on us because no other company can match the technological synergy of Microelectronics Group's wireless solutions.

We now have available a GSM communications handset design that enables fast market entry with minimal investment for consumer product manufacturers. The reference design can slash development time by approximately 60 percent. This design is being used to manufacture handsets for use in China.

Switched Networks. The Microelectronics Group can help you design new equipment for switched networks and networking upgrades. We help to design and build equipment that will meet the challenges of connectivity, consistent quality, and standards compliance. We continue to be pioneers and industry leaders in providing T1/E1 solutions, offering a leading-edge product portfolio of line interfaces, analog front ends, framers, and protocol controller devices. For higher-speed DS3/E3 and SONET/SDH solutions, we have the latest technology in mappers, multiplexers, and high-speed line interfaces (operating at 20 times the common industry standard), as well as a complete, highly integrated solution for OC-48/STM-16 at 2.5 Gbits/s. Even higher speeds will soon be available.

Inter Networking Services. Driven by the continuing development at Bell Labs, data networking systems are moving ahead at increasingly high speeds, from 10BaseT to Fast Ethernet to Gigabit Ethernet. Our ICs are vital to the performance of the most popular LAN topologies and Ethernet and ATM switching schemes, and they can be found wherever speed, interoperability, and bandwidth efficiency are the critical concerns.

High-Speed Networking. The *Silicon Suite* for Fast Ethernet provides standard and customized solutions for 10 Mbits/s and 100 Mbits/s networks. We manufacture single-chip NIC solutions with integrated transceivers, a direct result of our mixed-signal expertise. For hubs, we offer low-cost solutions for switches and hex, octal, and the industry's first 12-port transceivers that simplify design and also minimize system costs.

Widerhighway Optoelectronic Solutions

Our advanced research capabilities in optoelectronics technologies, deep understanding of system needs, and product leadership enable us to provide leading-edge solutions that continue to expand the fiber bandwidth in all areas of communications. We back up our products with excellent technical support. It is a complete package to help our customers lead their markets by enabling them to break through speed barriers in a wide range of networking applications, including long-haul telecommunications, interoffice access, undersea telecommunications, cable TV, and networked computing. Optoelectronics components include: modulators; photodetectors; laser subsystems, including laser modules, transmitters, receivers, transceivers, optical amplifiers, and pump lasers; as well as passive optical components, such as isolators and WDM couplers.

Ultra-High Speeds and Long Distances. Optoelectronic transceivers, which integrate both the transmitting and receiving functions into a single package, are fully compliant with ATM applications at speeds higher than 600 Mbits/s. For ultra-high-speed data transmission over fiber, Microelectronics Group provides a complete solution all the way up to 2.5 Gbits/s, OC-48/STM 16 applications.

We offer laser transmitters for 2.5 Gbits/s that can go more than 600 km without regenerators. Our 10 Gbits/s transmitter with an integrated electroabsorptive modulator offers a compact, cost-effective, high-speed, long-reach solution where the transmission distance is 100+ km.

Hybrid Fiber Coax. Our advanced capabilities in communications, modem ICs, and optoelectronic devices have enabled customers to design and build next-generations HFC networks. We offer uncooled lasers for CATV return-path applications, as well as a wide range of optoelectronic components that are currently supporting video network needs throughout the world. Using our optoelectronics and broadband ICs, we deliver the core capabilities and the design and manufacturing experience to offer stand-alone or integrated functions for Optical Network Units, Optical Subscriber Units, and terminals for data, video, and telephony.

Home Networking

Lucent's *Home Wire* products will allow consumers to simultaneously access computer files and the Internet, print and FAX documents and play video games, from any home PC – using one Internet connection, one modem, and one phone line. There will be no more vying to use the same modem and Internet connection simultaneously, no more family feuding to use the only printer in the house, and no more drilling holes in home walls to install new wires.

Capable on in-home data transmission rates of up to 1 megabit per second (Mbits/s) *Home Wire* helps create inexpensive in-home LANs by tapping into ordinary copper phone wire and using bandwidth that was unused until now. Lucent's initial *Home Wire* solutions will be compliant with the specification being developed by the Home Phone Line Networking Alliance (HomePNA). Later, in 1999, Home Wire will provide home networking capability for data transfer rates up to 10 Mbits/s — more than 175 times the speed of 56 kbits/s modems. Such high-speed capabilities will quicken the transport of high-bandwidth files, such as graphics and video, while allowing more devices to be added to home networks.

Digital Signal Processors (DSPs)

DSPs are chips that perform speech coding, channel coding, filtering, error correction and other functions in digital cellular phones, pagers, base stations, and other wireless products. Our product lines encompass floating-point DSPs; fixed-point DSPs for wireless microelectronics, consumer microelectronics, and enhanced telephone answering devices; DSP16xx and DSP32C development tools; consumer microelectronics development tools; and codecs.

Modem DSPs. To keep pace with the demand for higher modem data rates, our modem DSPs have doubled the available data rate every few years, culminating in today's 56 Kbps V.90 modem chip sets. In addition, we have horizontally integrated other features such as fax, videoconferencing, DSVD, full-duplex speakerphones, telephone answering devices, cellular phone connectivity, and PC audio functions into our modem chip sets. At the same time, silicon has been vertically integrated to include more modem hardware so that modem manufacturers require minimal hardware in addition to the modem chip sets.

Lucent Technologies Microelectronics Group offers three families of modem chip sets:

- The **Apollo** host-based controller chip set uses a Pentium® CPU to implement its controller subsystem in order to minimize system cost. The Apollo modem chip sets are ideal for the PC-OEM market. The Apollo chip family includes Apollo (integrated ISA interface DSP1643/42), **Mars**™ (integrated PCI interface DSP1645), and Luna (low-cost data/fax only DSP1641).
- The **Venus**® embedded controller chip set uses an integrated microprocessor to implement the controller subsystem for maximum flexibility. This chip set is ideal for the retail market and the central site market, such as in a Remote Access Server (RAS). The Venus chip set family includes DSP1670/73/75 for retail modems and DSP1674/75 for central-site modems.
- The **WildWire**™ ADSL "Lite" solution can download data at up to 1.5 megabits per second (Mbits/s) and allows simultaneous transmission of voice (POTS) and data (ADSL) services to a subscriber loop. The 16270 chip is designed for central office and digital loop carrier line cards. The 1690 chip set is designed for use in PC equipment and also provides V.90 interoperability.

Wireless RF Products

Lucent Technologies RF products serve the needs of the wireless terminal market, and form the basis for the radio system transceiver. The W30xx family of RF products is developed specifically to support all digital cellular/PCS standards in the global market. The primary applications are:

- GSM (GSM 900, DCS1800, PCS1900)
- Personal Digital Cellular (PDC900, PDC1500)
- IS136 (TDMA)
- S95 (CDMA)
- G3 Wideband (CDMA)

USB and 1394 Integrated Circuits

Silicon Suite® for Universal Serial Bus (USB) is a comprehensive ensemble of IC products and support that helps you to achieve a powerful, flexible, and cost-effective solution for USB. The Silicon Suite for USB offers standard products as well as custom solutions. For fast and low-risk system integration, the Silicon Suite includes USB controller macros for host, hub, and peripheral device applications that can deliver a direct connection to USB in a single-chip solution. With our standard USB products, we can help you make a rapid transition to USB with the highest level of confidence. The following standard products are available:

- USS-720 Instant *USB*® USB-to-IEEE™ 1284 Bridge
- USS-820 USB Device Controller
- USS-302 PCI-to-USB OpenHCI Host Controller

1394 IC Products, designed to meet the IEEE 1394-1995 and 394A specifications, are nearing market readiness. Samples of Lucent's 400 Mbits/s PHY and Link devices are available for evaluation. Planned products include additional 400 Mbits/s PHYs in multiple port configurations for a full range of applications including host motherboard, add-in cards, and peripherals. Lucent also plans to offer a PCI-OHC1 400 Mbits/s host controller device for host motherboard and add-in card applications.

Networking and Communications Integrated Circuits

Over sixty percent of Enterprise LAN traffic passes through Lucent Ethernet Switching ICs. This ensures interoperability from the Network Interface Card through the desktop, workgroup, and backbone. Lucent's PHY technology coincident with switching technology increases bandwidth to enable nonblocking switching architectures to twenty-four 10/100 ports and beyond. Our ePHY solution breaks the price/port barrier by giving you Layer 3 features at Layer 2 pricing. Indeed, workgroup capability at the desktop price. Our expertise, product portfolio, in-house fabrication and supply-chain management, with first-pass integration success rates, ensure a rapid time to market and ramp to production.

High-Speed Interface Products

The **Quad Differential Line Driver** IC transmits digital data over balanced transmission lines. These devices are pin-equivalent to the general trade 26LS31

device but offer increased speed, decreased power consumption, and significantly lower levels of electromagnetic interference. They translate input TTL levels to differential, pseudo-ECL output levels. These line drivers are compatible with many receivers, including the Lucent 41 Series receivers and transceivers.

The **Quad Differential Line Receiver** IC receives digital data over balanced transmission lines. They translate differential input logic levels to TTL output logic levels. These devices are pin-equivalent to the general trade 26LS32 device; however, they offer increased speed and decreased power consumption. These receivers are compatible with the Lucent 41 Series line drivers and transceivers.

The **Dual Differential Line Transceiver** IC transmits and receives digital data over balanced transmission lines. The dual drivers translate differential input TTL logic levels to differential, pseudo-ECL output levels. The dual receivers convert differential logic levels to TTL output levels. Each driver pair and receiver pair has a common enable control as in the general trade DS8923 device.

ISDN/Digital Telephony Products

As the customer demand for applications such as Internet access, telecommuting, and videoconferencing increases, ISDN is the only affordable digital phone technology available today that offers a proven solution. Our ISDN and digital telephony offerings include digital line cards, external and internal Network Termination Type 1 (NT1) for Terminal Adapter (TA) support, external TA/routers, internal (passive) TAs, the T8011 time slot interchanger for computer telephony integration (CTI), and general-purpose ISDN ICs. Also available is Silicon Suite for ISDN, including standard products, such as transceivers and NT1, system integration macrocells, and support products.

Analog Line Cards

Line Card Access Switch products replace up to three 2 Form C electromechanical relays, require no zero-cross circuitry to minimize impulse noise, offer solid-state reliability, and their small-outline surface-mount packages require minimal space. The L7581 card provides ringing access, the L7582 provides ringing plus line access, and the L7583 provides ringing plus test-in/test-out access.

Codec T75xx products are available in 1-channel, 2-channel, 4-channel, and 16-channel chip sets, all offering surface-mount packaging, operating on a 5.0 V supply and operating in a temperature range from -40° to +85° C.

Subscriber Line Interface Circuit (SLIC) products are available for short-loop lengths (L7597 resistive and L8576 electronic), long-loop lengths (L7556, L7557, L7585, L8551 electronic and L8574 and L8575 resistive), or any loop length (L7554, L8560, and L8567 electronic). All offer surface-mount packaging, use the on-hook transmission standard, and operate in a temperature range from -40° to +85° C.

Short-Loop Line Card Solutions are available for ISDN and POTS, fixed wireless local loop, terminal adapters, and set-top boxes. All are available with a variety of integration schemes to minimize component count, lower total costs, meet a power budget, and achieve robust reliability.

Long-Loop Line Card Solutions can be used to create a fully programmable, high-density 16-channel central office solution offering worldwide compatibility in one design. It includes a full-featured SLIC, built-in ring access, test-in switches, a 16-channel codec, and either solid-state switches or electromechanical relays. A long-loop line card solution, optimized for central offices, is also available.

PDH/SDH Transmission Integrated Circuits

The Microelectronics Group designs, manufactures, and supports standard and custom IC solutions for low- to high-speed transmission in the range of 1.544 Mbits/s to 2.5 Gbits/s. Our product family targets PDH (T1/E1) SDH/SONET, and System Core applications such as multiplexers, digital access cross-connect systems (DACS), and channel service unit (CSU)/digital service unit (DSU) equipment.

PDH (T1/E1) Products are the interface providing high-speed connectivity to the circuit network. Our solutions in this classification include analog front ends (AFEs), line interface units (LIUs), framers, and line terminators.

SDH/SONET Products address the broadband interface requirements for optical networks. We offer a family of SDH/SONET products ranging from STS-1 (155.52 Mbps) through 2.5 Gbits/s. The products in this family consist of high-speed transmitters and receivers, mappers to bridge the T1/E1 network to the SDH/SONET network, and multiplexers to combine multiple signals to higher line rates and perform the complete section and line termination function.

High-Speed Switching
Lucent switching devices, transmission devices, and protocol devices create interoperable systems. These solutions help protect your investment by future-proofing your need to support higher speeds while preserving your lower-speed line cards. Your initial investment is lessened through highly integrated solutions that reduce the number of devices, which, in turn, improves performance and reliability.

System Core Products offer three different functional elements: protocol control for support of such Layer 2 protocol functions as LAPD, LAPB, HDLC, and primary-rate ISDN; time-slot interchange for rearranging in space and time the constituent DS0s; and echo cancellation for eliminating speech signal reflections in the digital network.

Gallium Arsenide (GaAs) ICs are designed for SONET/SDH compatibility at the O-48 or STM-16 data rate of 2.5 Gbits/s.

Silicon Suite for Wide Area Networking provides exceptional value by integrating our standard products with our ASIC standard-cell and macro-cell capabilities. Whether you choose our standard products or work with us to fashion a custom solution, we help turn your design concepts into a systems solution.

Broadband Access Integrated Circuits

The **Broadband Access ICs** product family includes Fiber-to-the-Curb (FTTC), xDSL, and Passive Optical Network devices. Lucent's Multipoint Broadband Access (MBA) chip set creates the communications link between an Optical Network Unit (ONU) and a resident set-top terminal in FTTC system architecture. It supports simultaneous delivery of switched digital video ATM services, telephony, and broadcast video services.

Broadband Video RF Components

Video RF components are broadband RF communication interface ICs for voice/data/video transmission over coax and UTP. Products include the following:

- **LUCV4910 RF Transmitter** is an upstream line driver for HFC cable modem or cable telephony network interface.
- **LUCV4911 and LUCV4914 Transmitters** are high-speed, linear cable modem transmitter amplifiers for upstream data communications.
- **LUCV5002 Dual Video Cable Driver** is a 150 mA, 240 MHz, unity gain stable, dual operational amplifier designed specifically for applications where stable, high-speed, large current driving capabilities are essential. The LUCV5006 Dual Video Cable Driver is similar but operates at 340 MHz.

Bipolar Custom Products

The Lucent Bipolar Custom organization is one in which customer input can be anything from an idea to ready masks. Our Foundry is a recognized supplier of high-performance bipolar technologies that span a broad analog/mixed-signal application base, including products designed for interface circuitry, network computing, telecommunications, instrumentation, and video/RF. The proven manufacturability of our technologies is complemented by a full range of development and manufacturing services. Bipolar development services include customer training, IC electrical design, test development, IC layout and mask tooling, prototype wafer fabrication, prototype packaging and test, and prototype evaluation. Bipolar production services include wafer fabrication, wafer probe, product packaging and test, and product engineering.

Field-Programmable System Chips and Gate Arrays

ORCA® Series 2 FPGAs

For leading-edge 5 V and 3.3 V solutions of up to 40,000 gates, ORCA Series 2 FPGAs offer a proven SRAM-based architecture to provide high-density logic and superior routing resources.

ORCA Series 3 FPGAs

ORCA Series 3 FPGAs deliver new levels of convenience and performance with a new architecture offering speeds up to 160 MHz, higher gate counts up to 340,000, and greater flexibility in logic and I/O. New system-level features include a built-in microprocessor interface to i960® and PowerPC® microprocessors, a programmable clock manager, and lightning-fast single- or dual-ported RAM.

Available in 2.5 V, 3.3 V, and 5 V versions, Series 3 FPGAs can significantly simplify programming and speed the development process.

ORCA Series 3+ FPSCs

Field-programmable system chips bring a new dimension to programmable logic. They combine the flexibility of FPGA programmability with the high-density and performance of an embedded hardwired core, like a 64-bit 66 MHz PCI Bus Master. This powerful combination opens up new possibilities in achieving system-level solutions with more powerful capabilities than were previously possible with programmable logic. And it simplifies design and speeds time to market.

ORCA Core Alliance

The ORCA Core Alliance brings together leading independent IP vendors and Lucent to provide high-quality, cutting-edge IP core technology. Lucent has long worked with third-party vendors to support telecommunications and data communications applications; the Alliance continues to broaden the base of core functions available for ORCA devices.

ORCA Foundry Development System

Offering ASIC-quality software, ORCA Foundry offers an easy-to-use development system that's powerful enough to meet tight time-to-market demands. ORCA Foundry is not only compatible with standard EDA tools, it offers a macrocell compiler, mapper, timing-driven place-and-route tools, interactive editor, and static timing analysis—all optimized for ORCA FPGAs.