

Cabletron Networking Solutions

In this report:

Analysis -102
 Characteristics..... -105
 Architecture -105
 MMAC..... -106
 DNI Cards -108
 Transceivers -109
 Repeaters -109
 Concentrators..... -110
 Software -111
 Pricing -113

Product Summary

Editor's Note

Since our last report on Cabletron, the company has developed a complete line of token-ring products; has introduced products based on FDDI; has announced SPECTRUM, its UNIX-based network management platform; and has developed a series of third-party modules.

Description

Cabletron's product line includes network management software; network interconnection equipment; bridges; repeaters; transceivers; diagnostic test instruments; and transmission media, components, and accessories.

The company bases its products on Integrated Network Architecture (INA), a concept that allows customers to build and manage a global, distributed network of interconnected LANs with products that transparently work together, regardless of the media type or network standard selected.

Strengths

Cabletron is an innovative company, offering an extensive product line and services that start at the design phase and run right through to the cabling. Its network management approach is based on leading edge technology.

Limitations

As yet, Cabletron does not offer routers in its internetworking line, but has entered into a codevelopment agreement with cisco Systems to do so.

Competition

David Systems, Digital Equipment, Hewlett-Packard, IBM, Racal Inter-Lan, SynOptics, 3Com, and Ungermann-Bass.

Vendor

Cabletron Systems Inc.
 35 Industrial Way, P.O. Box 6257
 Rochester, NH 03867
 (603) 332-9400

Price

MRX hub—\$1,400; IRBM for MMAC—\$6,500. See Pricing for more detailed information.

GSA Schedule

Yes.

—By *Barbara Callahan*
Associate Editor

Analysis

Product Strategy

The line along the road from a garage in Ashland, MA, to a 125 square foot facility in Rochester, NH, was formed by cable. The cofounders of Cabletron, Robert Levine and Craig Benson, started their business in the time-honored tradition of true entrepreneurs in Levine's garage in Massachusetts. After selling wire for a short time, the partners started installing networks. In the process, they learned what made networks tick and decided to make them tick better—a quest that resulted in Cabletron's earning second place in both *Business Week's* ranking of "The 100 Best Small Corporations" and *Forbes Magazine's* listing of 200 of the "Best Small Companies in America." Another publication, *Inc.* magazine, acknowledged Levine and Benson's achievements by naming them National Entrepreneurs of the Year in 1990.

Attempting to zero in on the exact reasons for the phenomenal growth of a company such as Cabletron can deteriorate into an exercise in oversimplification. Certainly, the service provided early on by the fledgling company generated goodwill, and certainly the prices set below those of competitors aroused interest, but many other factors in the company's eight-year history have moved it forward.

A clearly defined goal in the company's charter of establishing "network connectivity between any number of computers anywhere in the world" sets high standards of expectations and firmly asserts a global view, but Cabletron has a high energy level that fosters the creativity and drive required to fulfill the charter's mandate. Two years after entering the networking field, Cabletron introduced the first products to verify Ethernet LANs. The following year, the company introduced LANVIEW Diagnostics, featuring the first LED indicators of network performance, and also introduced the first Ethernet transceiver that included on-board diagnostics.

A major breakthrough occurred in 1988 when MMAC debuted as the industry's first modular intelligent device with a central location for transmission media and data. At present, interest in intelligent hubs runs high, but Cabletron enjoys lead time in the industry because of the foresight of developing and marketing this type of product.

During its rapid ascent, and probably contributing quite a bit toward it, Cabletron incorporated management capabilities into its products. In 1988, the company released Remote LANVIEW Network Control Management. Since that time, LANVIEW has followed an interesting evolutionary course that produced MacLANVIEW, LANVIEW SunNet Manager, and LANVIEW Network Analyzer.

Capping Cabletron's advances in network management, the newly released SPECTRUM UNIX-based system is based on a realtime modeling engine, the Virtual Network Machine (VNM). Through SPECTRUM, Cabletron has extended integrated network management into the world of artificial intelligence. The model-based reasoning approach of VNM to network management empowers every entity in the network with its own type of intelligence. Each entity, therefore, can make use of its intelligence to learn its own status, combine or preprocess information, find out configuration information, and propose recommendations to the user.

In little over a year, Cabletron has closed the gaps in its line by releasing a complete set of token-ring products and expanding its FDDI offerings. Its product strategy calls for marketing quality internetworking hardware and software solutions, addressing all current media and preparing for future breakthroughs.

Competitive Position

Cabletron competes in the LAN marketplace on three different levels—a situation somewhat akin to an athlete entering three distinct Olympic events. Its first-tier competitors are the large computer manufacturers, such as Digital Equipment, IBM, and Hewlett-Packard. The second tier includes independent LAN vendors, such as 3Com, Racal InterLan, and Ungermann-Bass, which, like Cabletron, market a comprehensive product line. The third tier features a still rather small lineup of

smart hub vendors, primarily dominated by Syn-Optics, but increasingly challenged by Ungermann-Bass, which has declared its smart-hub eligibility through Access/One and Net/One.

Industry analysts predict that the LAN market will continue to grow, climbing to almost \$21 billion by 1993, creating a very large pie. How that pie will slice in this fast-moving market is anyone's guess. The large computer manufacturers, experiencing the downturns generated by a spasmodic economy, have turned to LANs to help keep the graphs from running amok. During the past two years, IBM has acknowledged the existence of Ethernet and has produced internetworking products that support it. Hewlett-Packard and Digital Equipment rank LANs high on their lists of ways to maintain and regain profitability. Facing these giants on their own turf is quite intimidating, but Cabletron, taking the "David" role in this contest, has the energy and expertise to emulate the achievement of the earlier David.

Unlike major computer companies that instituted layoffs in 1990, Cabletron conducted a career fair in September to attract personnel for its new research and development facility. Cabletron filled approximately 80 positions in quality assurance, finance, hardware/software engineering, sales, and technical customer support.

In the independent LAN-vendor arena, Cabletron faces off mainly against 3Com and Racal InterLan. After a rather difficult period, possibly activated by overextension of resources, 3Com has emerged revitalized and ready to play. 3Com's president, Eric Benhamou, has targeted internetworking products as important assets in the company's comeback. Racal InterLan has refocused its product line and is concentrating now on the INTERNExT Series and Ethernet Network Interface Cards. INTERNExT does include an impressive array of internetworking and management products, but not for token-ring, which gives Cabletron an edge.

Where the contest really heats up is in the smart-hub segment of the market. Formerly, Syn-Optics of Mountain View, CA, and Cabletron squared off principally against each other, but now, Ungermann-Bass has tossed its hat in the ring, setting its sights on recognition as the foremost smart hub vendor. A pioneer in LANs, and lately working hard to regain its former high visibility, U-B will be a strong contender in this market.

A recent development augurs well for the future of Cabletron. The company has penetrated the Japanese networking market, which currently lags behind that of the United States. In Japan, Ethernet dominates networking, and FDDI is slowly emerging. Since the Japanese market has nowhere to go but up, Cabletron stands a good chance of making substantial inroads into a lucrative area. The Networkworld communications company, a joint venture between Mitsubishi, Otsuka, and NEC, acts as Cabletron's sole Japanese distributor. A contract signed March 18, 1991, authorizes Networkworld to distribute Cabletron's full line of Ethernet, token-ring, and FDDI networking products.

Decision Points

Since most installations feature products from many vendors, Cabletron's alliances with significant participants in the networking market is good news for potential buyers. An arrangement with Sun Microsystems delivers a universal approach to integrated management for networks supporting TCP/IP through Cabletron's LANVIEW/SunNet Manager. This product holds the distinction of being the first third-party software package to run on Sun's SunNet Manager network management platform.

In an era in which vendors are promoting customer satisfaction as a primary goal, Cabletron reflects that concern through an agreement with Intel Corp., in which Cabletron serves as the single point of contact for its customers, while Intel offers same-day or next-day service through its international field service operations. As Cabletron goes international, its customer service support follows.

A Cabletron/cisco Systems development agreement calls for cisco to integrate routing technologies into Cabletron's MMAC intelligent hub products. Both companies are working on a module with routing capabilities that feature cisco's router and software technologies. The resulting module will support SNMP management platforms. This agreement will fill in the void created by the lack of routing functionality in Cabletron's product line.

Users of Western Digital and 3Com adapter cards can take advantage of a Cabletron-developed application that transforms the unintelligent cards

Company Profile Cabletron Systems Inc.

Corporate Headquarters

35 Industrial Way, P.O.
Box 6257
Rochester, NH 03867
(603) 332-9400

Officers

*Chief Executive Officer
and President:* Robert S.
Levine

*Chief Operating Officer,
Chairman, and Treasurer:*
Craig Benson

Chief Financial Officer:
David Kirpatrick

Director of Operations:
Robert Monaco

*Director of Engineering
and Manufacturing:* Chris-
topher Oliver

Company Background

No. Employees: 1,350

The cofounders of
Cabletron, Robert S.
Levine and Craig Benson,
started the company in
1983 as a supplier of

Ethernet cable and trans-
ceivers. Since that time,
Cabletron has experi-
enced rapid growth and
now manufactures an ex-
tensive LAN connectivity
line of products.

Cabletron products in-
clude network manage-
ment software; network
interconnection equip-
ment; bridges; repeaters;
transceivers; diagnostic
test instruments; and
transmission media, com-
ponents, and accesso-
ries.

From 1984 to 1989,
Cabletron sustained a 278
percent growth rate. In
May 1989, Cabletron went
public and is represented
on the New York Stock
Exchange. Fiscal year
1990 sales totaled \$104.7
million; fiscal year 1990
net income totaled \$22.3

million. Cabletron has re-
ported 130 percent reve-
nue growth and 255
percent earnings growth
since 1985. Since its
founding in 1983,
Cabletron has sustained
an average annual reve-
nue growth rate of 271
percent. The company
invests approximately 7.4
percent of revenue in re-
search and development.

International sales for fis-
cal 1989 amounted to
\$23.2 million. In August
1989, Cabletron estab-
lished a subsidiary in
Dreieich, Germany. In
February 1990, the com-
pany opened an office in
Sweden and in August
1990, opened another in
Australia. Cabletron main-
tains a direct sales and
technical support office in
Newbury, England.

A 60-person direct sales
organization, backed up
by a 165-person, in-house
technical sales and sup-
port staff, generates 90
percent of Cabletron's
revenue. Sears Business
Centers also sell the com-
pany's products.

Since 1988, the company
has achieved significant
corporate recognition by
national magazines and
organizations. In Decem-
ber 1988, Cabletron was
named the 7th fastest-
growing, privately held
company in America by
Inc. magazine. *Business
Week* magazine named
Cabletron the 2nd "Hot-
test Growth" company in
America out of a field of
100 companies in May
1990. *Money* magazine
reported in May 1990 that
Cabletron's stock was
cited as one of the most
socially responsible
stocks by PAX World, a
\$95 million mutual fund
devoted to ethical invest-
ing.

In November 1990,
Forbes magazine ranked
Cabletron second in the
magazine's annual rank-
ing of "The 200 Best
Small Companies in
America." In January
1991, the company was
rated as the New York
Stock Exchange's num-
ber one performance
stock in 1990. Also, in
January 1991, the co-
founders of the company,

from these two vendors into Simple Network Man-
agement (SNMP) manageable devices. Inexpen-
sively priced, the Western Digital application costs
\$79 per card, and the 3Com application, \$59 per
card.

Fiber optics arrived at the desktop through
Cabletron's Desktop Network Interface (DNI) PC
cards. By means of an onboard fiber optic trans-
ceiver, the cards convey fiber optic networking
technology conforming to IEEE 802.3 FOIRL stan-
dards to IBM's PC XT, PC AT, and PS/2 and Ap-
ple's SE, SE/30, and Mac II systems. In the near
future, Cabletron plans to equip the desktop with
the 100M bps capability of FDDI via low-cost

FDDI PC adapter cards. Since the DNI cards sup-
port SNMP, they can be managed by any SNMP-
compliant management station or by Remote
LANVIEW/Windows software.

Network administrators will be particularly
attracted by the innovative SPECTRUM inte-
grated management system, which operates in an
open environment, independently functioning re-
gardless of protocol, manufacturer, or device type.
Use of the system reduces network downtime, low-
ers personnel costs, eliminates redundant hard-
ware, and simplifies the entire administration
process by making more efficient use of resources
and providing more accurate management data.

Craig Benson and S. Robert Levine, were named National Entrepreneurs of the Year by *Inc.* magazine. In April 1990, *Investor's Daily* ranked the company first in annual growth rate out of 400 computer companies evaluated over the last five years.

In its short history, Cabletron has recorded many firsts, including the following: first products to verify Ethernet LANs; first products with LED indicators of network performance; first Ethernet transceiver with built-in diagnostics; first modular intelligent device for central location of transmission media and data; first 10BASE-T products with management capabilities; first token-ring module for MMAC; first 10BASE-T chip for OEM markets; first hub with integrated analyzing capabilities; and first integrated twisted-pair/FDDI interface.

Recent Agreements

March 1990—Cabletron and Sun Microsystems announced an agreement in which Cabletron's Remote LANVIEW network management software was teamed with Sun's SunNet Manager to create an integrated network management system.

May 1990—Cabletron and Cisco Systems entered into an alliance to integrate Cisco's internet networking routing technology into Cabletron's MMAC intelligent hub products. The agreement calls for Cabletron and Cisco to jointly develop a router module that plugs into the MMAC chassis to endow MMAC with a routing capability.

July 1990—Cabletron signed an agreement with Intel, which allows Cabletron to coordinate worldwide on-site network support. Under terms of the agreement,

Cabletron acts as the point of contact and responsibility for its customers, while Intel provides same-day or next-day service through its international field service operation.

September 1990—Cabletron and National Semiconductor Corp. of Santa Clara, CA, announced an agreement to jointly develop an integrated twisted-pair interface for FDDI networking equipment.

January 1991—Cabletron and Xyplex of Boxborough, MA, a supplier of multiprotocol communication servers, announced the development of an Ethernet Terminal Server Media Interface Module (ETSMIM) for Cabletron's Multi Media Access Center (MMAC) hub series. The agreement between the two companies calls

for ETSMIM to be manufactured by Xyplex and private-labeled by Cabletron.

March 1991—The company signed NetworkWorld as its sole Japanese distributor. The contract calls for NetworkWorld to distribute Cabletron's full line of Ethernet, token-ring, and FDDI networking products, based on the company's Integrated Network Architecture.

March 1991—Cabletron and Cayman Systems of Cambridge, MA, announced a strategic development alliance to integrate Cayman's AppleTalk gateway technology into Cabletron's MMAC intelligent hub wiring series. The agreement calls for Cabletron and Cayman to jointly develop new products that integrate networks of Macintosh users into existing multivendor computer networks.

Characteristics

Installed Base: More than 9,500 customers worldwide; over 1.8 million nodes installed worldwide.

Architecture

The cornerstone of Cabletron's product line is its Integrated Network Architecture (INA), which includes all of the company's standards-based products and services

for creating and managing a global, distributed platform of interconnected LANs. The INA-based products and services work together transparently, regardless of the media standards chosen by the user.

Products based on INA that support all major international networking standards include Multi Media Access Center (MMAC) for Ethernet, token-ring, and FDDI; Desktop Network Interface (DNI) Cards for Ethernet (coax, 10BASE-T, fiber optic) and token-ring; Transceivers for Ethernet (coax, 10BASE-T, fiber optic); Repeaters for Ethernet; Concentrators for token-ring (UTP, STP, fiber optic); Bridges for Ethernet (local and remote), token-ring, and FDDI; Routers; and Remote LANVIEW Network Management Systems (DOS and UNIX versions).

Under INA, groups of disparate networks merge into a single system in which all devices are managed from a remote management workstation. INA also serves as the framework for seamless network evolution as customer needs change and new technologies emerge. INA enables organizations to interconnect local

Table 1. MMAC Specifications

Feature	MMAC-3FNB	MMAC-5FNB	MMAC-8FNB
Number of Ports	Up to 48	Up to 120	Up to 168
Media Interface Module Slots	2	4/5	7
Mgmt./Repeater Slots	1	1	1
Power Supply Slots	Fixed in unit	2 modular supplies	4 modular supplies
Power Rating	150 W	300 W each	150 W each

area and wide area networks into global enterprise networks, equipping personnel with power and access to the organization's information and computer resources through an electronic window on the desktop.

Multi Media Access Center (MMAC)

The MMAC is an advanced network smart hub that integrates LANs and WANs, and Ethernet, token-ring, and FDDI over any type of media. Cabletron's Flexible Network Bus (FNB) allows token-ring, Ethernet, and Fiber Distributed Data Interface (FDDI) technologies to coexist simultaneously in the MMAC intelligent wiring hub. FNB's architecture allows several token-ring boards to automatically form separate rings within the MMAC hub. Users can configure one large ring within the MMAC or up to seven smaller rings within the same MMAC hub. One MMAC hub can support up to 168 devices.

Multi Media Access Center (MMAC) supports LAN and WAN applications. The company offers the MMAC in three card cage sizes: *MMAC-3FNB*, *MMAC-5FNB*, and *MMAC-8FNB*. Table 1 lists the specifications for these products.

The MMAC provides IEEE 802.3 and Ethernet 10M-bit support on a variety of interconnection cabling schemes, such as unshielded twisted pair, IBM data, fiber optic, thin or thick Ethernet, and standard AUI transceiver. MMAC incorporates a combination of software-driven network monitoring and control features, called the Control LANVIEW and Management function, which enable the network administrator to manage the network from any node or from a remote modem. A series of visual indicators assists installation and furnishes fault diagnosis data. MMAC's modular design facilitates network maintenance.

In October 1989, Cabletron announced that MMAC supported Simple Network Management Protocol (SNMP). Support of this protocol allows third-party network management products to manage the MMAC hub.

MMAC Modules

Intelligent Repeater Bridging Module (IRBM): In June 1990, Cabletron introduced IRBM, a combination repeater, bridge, and analyzer module that merges analyzing and network management into the smart hub.

Users can integrate IRBM into the MMAC hub to connect 10-megabit-per-second Ethernet LAN segments. The combination of IRBM and Cabletron's Remote LANVIEW/Windows software performs network management for the entire MMAC line. By combining both functions, the IRBM acts as an integrated, high-performance Ethernet bridge that provides monitoring and control functions to the individual port level. IRBM resides on a card that occupies a single slot in the MMAC-8 or MMAC-3 hub.

IRBM is the first Cabletron product incorporated into the Remote LANVIEW/Windows (Version 1.2) software, which provides a graphical user interface for the IRBM that features strip and bar charts representing realtime network utilization, error rates, and collision rates.

IRM and IRM-2 Intelligent Repeater Module: These modules are IEEE 802.3 repeater boards that are inserted into the first slot of the MMAC. Both IRMs retime and regenerate the data packets entering the MMAC and automatically segment problem ports and reconnect nonproblem segments. The IRMs incorporate Cabletron's Remote LANVIEW network management software. Functionally similar to IRM, IRM-2 includes more sophisticated management capabilities, such as complete port error breakdown, port-to-address matching, and throughput analysis in graphical format.

IRM-2 Intelligent Repeater Module II: Cabletron designed this module specifically for networks that integrate both token-ring MIMs and Ethernet MIMs in the same chassis.

TPMIM-T 10BASE-T: This module supplies 12 Ethernet/IEEE 802.3 connections over unshielded twisted-pair cabling at a 10M bps data rate. Each twisted-pair connection can be up to 150 meters per run from MMAC to host device transceiver. Any Ethernet twisted-pair run can coexist in the same cable bundle with other balanced data or voice signals. Each module supports a maximum of 12 connections over IBM type 1, 2, or 6 data cabling.

Table 2. MMAC Fiber Modules

Model	Features
FOMIM-16	6 FOIRL ports with SMA connectors
FOMIM-26	6 FOIRL ports with ST connectors
FOMIM-12	12 FOIRL ports with SMA connectors
FOMIM-22	12 FOIRL ports with ST connectors
FOMIM-18	18 FOIRL ports with SMA connectors
FOMIM-28	18 FOIRL ports with ST connectors

Table 3. ETSMIM Specifications

Dimensions	11.5 in. (H), 2.0 in. (W), 2.0 lb. (Wgt.)
Software	Xyplex LAT and/or TCP/IP software
Network Interface	Connection through MMAC backplane
Terminal Signals	Transmit, Receive, Transmit Ground, Receive Ground, Data Carrier Detect (DCD), Data Transmit Ready (DTR), Data Set Ready (DSR), and Ring
Terminal Cabling	Modular RJ-45
Serial Line Speed	300 to 38.4K bps
Throughput Performance	26K characters per sec.
Sessions per Port	16
Maximum Sessions per Unit	128 per unit—1,500 max.
Display LEDs	Run, LAN, Console, Port Status for ports 1-16
Controls	Run/Reset push-button switch

TPMIN-24 and *TPMIM-34*: Released in February 1991, the *TPMIM-24* and *TPMIM-34* incorporate silicon technology, which enabled Cabletron to double the number of ports on its modules from 12 to 24. Conforming to 10BASE-T specifications, the modules increase the maximum number of users per MMAC from 84 to 168 on MMAC-8FNB, 60 to 120 on MMAC-5FNB, and 24 to 48 on MMAC-3FNB. The modules come with RJ-45 and RJ-71 connectors and 24 ports for shielded/unshielded twisted-pair connections up to 200 meters in length.

FOMIM Fiber Optic Modules: These modules come with 6, 12, or 18 ports and SMA or ST connectors. All FOMIMs provide 12 Ethernet/IEEE 802.3 Fiber Optic Inter Repeater Link (FOIRL)-compatible attachments over 50.0, 62.5-, or 100-micron core fiber cabling. Each port can drive fiber optic link segments up to 3 km. in length. For details, see Table 2.

THN-MIM Thin Coax Module: These modules support 12 Ethernet/IEEE 802.3-compliant attachments to thin or thick coaxial cable through a thick-to-thin adapter. The thin coaxial segment can extend to 185 meters in length and can support a maximum of 29 connections. The thick coaxial segment can extend to 500 meters in length and can support a maximum of 99 connections.

MT8-MIM Multiport Transceiver Interface Module: The MT8-MIM consolidates the functions of eight separate transceivers into one unit that can be inserted into the MMAC. The MT8-MIM provides eight IEEE 802.3-compatible medium attachment unit (MAU) ports to support a direct connection to unshielded or shielded twisted-pair, fiber optic, and coaxial cable. In the MMAC, the MT8-MIM performs IEEE 802.3 repeater functions.

PSM-R and *MMAC-5PSM*: Cabletron offers these modules for power supply. They feature automatic load/sharing redundancy when used with the Flexible Network Bus. Incorporated into the design of these units are the LANVIEW diagnostic LEDs.

Ethernet Terminal Server Media Interface Module (ETSMIM): ETSMIM enables network administrators to simultaneously connect dumb terminals and other devices to a LAN. Cabletron and Xyplex of Boxborough, MA, jointly developed this module. For specifications on ETSMIM, see Table 3.

TRMM Token-Ring Management Module: An intelligent media interface module (MIM) for the MMAC, TRMM performs detailed network management for the ring by collecting management statistics and doing port-level monitoring and control. The module can perform in-band and out-of-band management tasks.

TRMBM Token Ring Management Bridging Module: Also a MIM for the MMAC, TRMBM combines the same management capabilities as TRMM, but also bridges two separate rings of different speeds. The integrated bridge management board supports transparent source routing and source routing transparent (SRT) routing schemes. Cabletron provides fiber and copper Ring-in/Ring-Out connections on the front panel.

Ethernet-to-FDDI Bridging Module (EFDMM): An industry-first, the EFDMM is an Ethernet-to-FDDI bridging module for intelligent wiring hubs, which enables an Ethernet network to reach the speed of an FDDI backbone. Installed in MMAC, EFDMM also supports 10BASE-T, thin and thick coax, and FOIRL media types. It filters packets at 15,000 per second and forwards packets at 10,000 per second. EFDMM can hold 8,191 addresses in the source address table.

MMAC Slide-In Connectivity Modules

The *TRMIM-20R*, *TRMIM-22*, *TRMIM-10R*, and *TRMIM-12* operate in conjunction with MMAC. From these modules, network designers can connect to token-ring stations. Cabletron has equipped the TRMIM-10R with Remote LANVIEW and SPECTRUM management support. For details on these modules, see Table 4.

As an option, Cabletron offers the *TRRMIM-16/26* Repeater Interface Module to accommodate the expansion of a token-ring network. The module features a combination of Ring-In/Ring-Out connections and six additional shielded twisted-pair (TRRMIM-16) or unshielded twisted-pair (TRRMIM-26) ports.

LANtern Network Monitoring Module

Cabletron has incorporated Novell's LANtern network monitoring technology into the MMAC as a modular combination of hardware and software that continuously monitors network statistics under SNMP. The module also tracks network usage and traffic patterns. The LANtern module can also function independently of topology or protocol. Based on a Motorola 68020, LANtern has 1M byte of memory, expandable to 2M bytes. The controller used with it is an Intel 82586, running at 10MHz.

Table 4. MMAC Slide-in Modules

Feature	TRMIM-20R	TRMIM-22	TRMIM-10R	TRMIM-12
Type of Module	Ring-in/Ring-Out	Media Interface	Ring-in/Ring-Out Media Interface	Media Interface
Ring Speeds (bps)	4/16M	4/16M	4/16M	4/16M
Number of Ports	10 RJ-45 for 10 Token-Ring stations	12 RJ-45 for 12 Token-Ring stations	10 9-pin ports for 10 Token-Ring stations	12 9-pin ports for 12 Token-Ring stations
Cabling	UTP	UTP	STP	STP

MiniMMAC

For users with smaller networks and users who want to reduce the density of their wiring hubs, Cabletron introduced MiniMMAC, which allows users to configure up to 13 network segments or ports on unshielded/shielded twisted-pair, coaxial, AUI, and/or fiber optic cabling. Cabletron produces Media Interface Modules (MIMs) for the MiniMMAC that support a variety of media and incorporate LANVIEW diagnostic indicators.

MiniMMAC performs IEEE 802.3 repeater functions to sustain the integrity of the data packet over extended distances. Whenever a data packet is received, each port is retimed and regenerated, ensuring the integrity of the data packet as the distance of data connectors increases. Additional features include automatic segmentation of bad ports and conformance to 10BASE-5, 10BASE-T, and Fiber Optic Inter Repeater Link (FOIRL) repeater standards.

The Multiple Port Interface Module (MPIM) supports unshielded/shielded twisted-pair (10BASE-T), fiber optic, and thin coax cabling. Each MPIM contains six media connections, except for the AUI MIM, which has four. The Single Port Interface Module (SPIM) also supports the same multiple media types as MPIM.

Desktop Network Interface (DNI) Cards

Cabletron's IEEE 802.3-compliant DNI cards implement a high-speed Ethernet data connection for IBM PC AT, PC XT, and Micro Channel (PS/2) systems and Apple SE, SE/30, and Macintosh II machines. Any LAN application that supports Apple's Ethertalk standard will run on Cabletron's DNI cards. The cards enable users to connect directly to 10BASE-T twisted-pair, fiber optic, or coaxial cabling via built-in transceivers.

In November 1990, Cabletron announced that Digital Equipment and Banyan Systems, Inc. had certified the Ethernet controller software driver for the company's E1000, E2000, and E3000 Series DNI cards. The driver is compatible with Digital Equipment's Digital LANWORKS for DOS and Banyan's VINES Release 4.00 and 4.00 (1).

Key features of the DNI cards for Ethernet applications are:

- remote and local management statistics
- support of Simple Network Management Protocol (SNMP) management specifications
- multimedia support of 10BASE-T twisted pair, fiber optic, and coax
- simultaneous running of multiple operating systems
- memory expansion up to 64K of RAM
- LANVIEW onboard diagnostic indicators
- self-diagnostic software
- compliance with IEEE 802.3 standards

DNI cards report "receive and transmit" statistics to an IBM 286 or higher management workstation on the network. Users can also obtain these statistics from an onboard local management program on their PCs. The polling system inherent in the DNI card series enables network managers to designate each device by department, user name, or device type. These fields allow managers to segment statistical information and poll devices. Each DNI card comes with LANVIEW diagnostic indicators.

For details on DNI cards for Ethernet, see Table 5.

Cabletron also offers Token Ring Desktop Network Interface (DNI) cards. Key features of the cards are:

- support of 4M and 16M bps ring speeds
- reports on transmit/receive statistics and errors to the node level
- RJ-45 connector for IBM-type UTP cabling
- LANVIEW diagnostic LED indicators
- ISA and MCA cards using Bus Mastering Technology

Table 5. DNI Cards (Ethernet)

Models	Specifications
E1000/E2000/E3000	Support IBM XT/AT/Micro Channel (PS/2) systems; support twisted-pair (10BASE-T), fiber optic, and coax cabling; include device drivers for Sun NFS, Novell, Nexos 386, SCO UNIX, PCSA, DECnet, PC/TCP, and NDIS; 8, 32, and 64K bytes of memory
E4000/E5000/E6000	Support Apple Macintosh SE, SE/30, and Macintosh II; support twisted-pair (10BASE-T), fiber optic, and coax cabling; device drivers include support for Ethertalk; 16 and 64K bytes of memory

- Drivers for DOS and OS/2-based network operating systems, including Novell NetWare, IBM PC LAN, and Microsoft LAN Manager

The Model T1015-4 supports IBM PC XT; T2015 supports IBM PC AT; T3015 supports IBM PS/2; and T6015 supports Apple Macintosh II. Cabletron's Token Ring DNI cards are compatible with the IEEE 802.5 standard and IBM extensions.

Mac II Token Ring DNI Card: Introduced in January 1991, the Mac II DNI card is a manageable Token Ring Desktop Network Interface (DNI) card. Via STP or UTP cabling, the card connects users of Mac II computers to 4M or 16M bps, IEEE 802.5 token-ring networks. The product's network management and diagnostic capabilities provide network administrators with receive and transmit statistics. The card can be managed by Cabletron's SPECTRUM and Remote LANVIEW/Windows network management platforms.

Transceivers

FOTF-1 and FOTF-2 Fiber Optic Transceivers: These devices conform to the IEEE 802.3 Fiber Optic Inter Repeater Link (FOIRL) specifications and are compatible with Ethernet Version 1.0 and 2.0 specifications. FOT-1 operates at 10M bps and can drive distances of up to 3 km. via 50.0-, 62.5-, or 100-micron core cabling. User-configurable, FOT-1 contains two switches, one controlling the output of the transmitter and the other enabling or disabling the heartbeat (SQE) test.

TPT-T Twisted Pair Transceiver: TPT-T supports the 10M bps Ethernet data rate over shielded or unshielded twisted-pair cable. The device has one RJ-45 jack and one 15-pin AUI port that connects the transceiver to a Cabletron MT-800 Multiport Transceiver or the host system. The product supports 10BASE-T.

ST-500 Ethernet Transceiver: ST-500 assists service managers and LAN managers in the installation and troubleshooting of LANs. Cabletron designed ST-500 as user configurable to allow enabling or disabling of the heartbeat (SQE) test. ST-500 is compatible with Ethernet Versions 1.0 and 2.0, and IEEE 802.3 for 10M bps medium access units.

TMS-3 Thin Ethernet Transceiver: Compactly designed and weighing only 14 ounces, the TMS-3 fits into areas of thin Ethernet that were previously restricted. Users connect the unit to the network by attaching a BNC T-connector to the BNC receptacle on the TMS-3 transceiver. TMS-3 incorporates the use of LED indicators for power and the heartbeat (SQE) test.

MT-800 Multiport Transceiver: The MT-800 provides eight ports for connecting Ethernet/IEEE 802.3 host units, an arrangement that eliminates the need for eight discrete transceivers to be placed on the network, while providing full data rates to each of the attached hosts. The unit also provides one additional port for connection to an external transceiver. In addition to an optional heartbeat (SQE) test, each of the eight ports for

host connections implements transmit, receive, and collision functions. The MT-800 can be cascaded to support a maximum of 64 connections. The MT-800 is compatible with Ethernet Versions 1.0 and 2.0, and the IEEE 802.3 standard for 10M bps medium access units.

CTP100-T Coax to Twisted Pair Transceiver: In 10BASE-T-compatible Ethernet systems, CTP100-T supports connections of up to 200 meters of thin coax. CTP100-T connects up to 10 devices and is useful in environments with thin Ethernet-based controller cards. Additional features include automatic polarity detection, correction, and indication. To prevent noise-induced false collision, CTP100-T filters noise on the receive pair during transmission.

Repeaters

LR-2000 Local Repeater: The LR-2000 interconnects two full-length thick or thin Ethernet coax segments by attaching an external transceiver to each segment. The transceivers are then connected to the two AUI ports on the unit by an AUI cable, up to 50 meters long. The LR-2000 retimes data packets, regenerates preamble, extends collision fragments, automatically partitions problem segments, and automatically reconnects nonproblem segments.

FR-3000 and FR-3000-2 Fiber Optic Repeaters: These devices allow two full-length, thick or thin Ethernet coax segments to be remotely interconnected by fiber optic cable, up to 3,000 meters apart. The units comply with the IEEE 802.3 specifications for repeater performance. The FR-3000 contains one pair of SMA 906-905 connectors for interconnection of fiber cabling and one 15-pin AUI connector to attach to an external transceiver. The FR-3000-2 includes a pair of ST connectors. Users can interconnect both repeaters with 50.0-, 62.5-, and 100-micron fiber cabling. The devices retime data packets, regenerate preamble, extend collision fragments, automatically partition problem segments, and automatically reconnect nonproblem segments.

MR-2000C/MR-5000C/MR-9000C Multiport Repeater Series: Repeaters in the Multiport Series connect from two to eight full-length thick or thin coax IEEE 802.3 Ethernet segments. The MR-2000C has one BNC port; the MR-5000C, four; and the MR-9000C, eight. These repeaters can also function in installations with Digital Equipment Corp.'s DECconnect cabling.

Ethernet Bridges

Cabletron incorporates a user-definable filter database into these products to enable users to enter their own filters, including packet destination address, source address, type, and 16 bytes of data.

NB20E: A high-performance bridge that joins two 10M bps Ethernet segments, the NB20E can bridge a user group or a department into a backbone. The device features a software filtering system that determines the packets that can pass through the bridge and enables

Table 6. Cabletron Bridge Products

	NB20	NB20E	NB25	NB25E	NB30	NB35	IRBM
Filtering Rate (packets per second)	15,000	15,000	28,000	28,000	10,000	10,000	28,000
Forwarding Rate (packets per second)	8,000	11,600	11,600	11,600	Up to 2,900	2,900 (3,800 full duplex)	11,600
Source Table	2,047	2,147	8,191	8,191	8,191	8,191	8,191
AUI Interface Ports (Version 2 and 802.3)	2	2	2	2	1	1	2
Serial Interfaces	NA	NA	NA	NA	RS-422/RS-499 or V.35	DS1	RS-422 RS-449
Management Port (RS-232)	NA	No	Yes	Yes	Yes	Yes	Yes
Link Speeds Supported	NA	NA	NA	NA	56, 64K bps to DS1	1.544M bps	9600-64KB

NA—Not applicable.

the unit to store up to 2,048 addresses. A user-programmable aging feature triggers the removal of inactive addresses from the filter database. In October 1989, the NB20E began supporting Simple Network Management Protocol (SNMP).

NB25E: This unit is a high-speed, hardware-filtered bridge that joins two 10M-bit Ethernet segments. With hardware filtering, the CPU does not determine if a packet gets forwarded, thereby increasing the speed of the bridge and allowing the NB25E to have an address table that holds up to 8,191 addresses. In October 1989, the NB25E began supporting Simple Network Management Protocol (SNMP).

NB30 Ethernet-to-Fractional T1 and NB35 Ethernet-to-T1 Remote Bridges: The NB30 and NB35 connect two geographically dispersed LANs through a T1 link. Sold as pairs, both bridges support a transparent connection between two physically remote Ethernet networks. This function occurs when the NB30 and NB35 are linked to a Channel Service Unit (CSU) and a dedicated T1 link, which is subsequently connected to a local network via a transceiver. The NB30 uses a fraction of the T1 link, and the NB35 uses the entire bandwidth of the T1 link.

For additional details on Cabletron's bridges, see Table 6.

Gateways to NetView

In February 1991, Cabletron introduced gateways to IBM's NetView mainframe-based management system for its Remote LANVIEW and SPECTRUM network management platforms. The gateways enable NetView users to make use of Cabletron's SNMP-based network management capabilities to monitor local area network performance.

SPECTRUM, Cabletron's UNIX-based network management software, links directly to NetView through a built-in SNA gateway, allowing network administrators to integrate SPECTRUM-controlled devices into IBM-based environments. Cabletron's gateway communicates with the NetView interface via SNA interface software provided by Brixton Systems of Cambridge, MA. The interface provides access to NetView facilities to generate alarm and network activity statistics that are transmitted to a NetView console for increased enterprise-wide network monitoring. The gateway for Remote LANVIEW/Windows ties into the SNA environment through IBM's NetView PC.

Concentrators

TRC-800 Passive Ring-In/Ring-Out Concentrator: A standalone device, the TRC-800 is designed for token-ring LANs with low-connectivity requirements. The unit supports 4M and 16M bps ring speeds. It supports eight MIC station connectors with Ring-In/Ring-Out ports. LANVIEW diagnostic LEDs assist in detecting network problems.

10BASE-T Hubs

For information on MRX, MRX1, MRX2, and MRX12 hubs, see Table 7.

Network Management

For network management, Cabletron offers LANVIEW, a combination of software and hardware tools to control, manage and troubleshoot all Ethernet segments connected to the MMAC, including twisted-pair, fiber optic, coaxial, and IBM data cabling. LANVIEW consists of LANVIEW Control and Management software and the

Table 7. 10BASE-T Hubs

Models	Specifications
MRX	12 ports with built-in 10BASE-T transceivers and 2 optional ports for AUI, thin coax, UTP/STP, or fiber optic; IEEE 802.3 conformance; wall or rack mount
MRXI	12 ports with built-in 10BASE-T transceivers and 2 optional ports for AUI, thin coax, UTP/STP, or fiber optic; IEEE 802.3 conformance; wall or rack mount; built-in microprocessor and Ethernet interface; redundant backbone port; RS-232 port
MRX-2	14-port wiring concentrator; 12 RJ-45 10BASE-T ports and 2 user-configurable ports (AUI, coax, UTP/STP, fiber optic) for PCs and workstation connection in LAN; wall or rack mount
MRXI-2	14-port wiring concentrator; 12 RJ-45 10BASE-T ports and 2 user-configurable ports (AUI, coax, UTP/STP, fiber optic) for PCs and workstation connection in LAN; wall or rackmount; intelligent hub with SNMP management capabilities; redundant backbone port; direct Ethernet connection; RS-232 port

standard LANVIEW LEDs incorporated into the Intelligent Repeater Module (IRM) and into each Media Interface Module (MIM), as well as into all Cabletron products.

The *Physical Layer Diagnosis* feature of Cabletron's network management system resides in the LANVIEW LEDs. All MIMs have LEDs to indicate that a segment linked to a port is connected to the network (POK) and to indicate that a packet is being received on that segment (RCV). The POK LEDs on the twisted-pair and fiber optic MIMs work with Cabletron's TPT-T twisted-pair and FOT-1 fiber optic transceivers. The MIMs and both transceivers generate signals to indicate that a good connection has been made between the two devices.

In October 1990, Cabletron announced applications that upgraded adapter cards from 3Com and Western Digital by endowing them with network management capabilities. In essence, Cabletron transformed the unintelligent cards into SNMP manageable devices. Through the incorporation of Cabletron's Remote LANVIEW or SPECTRUM network management

software packages and a local traffic SNMP Management Information Base (MIB) program written specifically for 3Com and Western Digital cards, managers and users can identify and solve network traffic or workstation access problems.

Software

LANVIEW

LANVIEW is an optional, menu-driven software feature accessible by users from the IRM's console port (terminal version) or by a disk (PC version) from any MS-DOS or UNIX Ethernet workstation on the network. The PC version enables up to 40 MMACs to be controlled and monitored from one network station.

Using a three-tiered approach, LANVIEW focuses on *Network Control*, *Network Monitoring*, and *Physical Layer Diagnosis*.

The *Network Control* function eliminates the need for the network manager to observe network activity constantly. After setting user-defined threshold values, called Alarm Limits, the manager is alerted when certain conditions arise. The manager can set the Alarm Limits to trigger if excessive accurate or error packets pass through a port, board, or the entire MMAC. Managers can set the Alarm Limits to simply advise that an alarm limit exists or to automatically turn off the port or board on which the alarm occurred. In the latter case, the Redundancy Feature of LANVIEW reroutes traffic to another port or board. LANVIEW stores the date and time each Alarm Limit occurred.

The *Network Monitoring* function identifies potential bottlenecks and marginal segments. This feature also creates an historical database to assist network capacity planning and to facilitate expansion. Information appears on-screen about the overall network, MIMs, and ports. Users can define the time intervals for receipt of monitoring information, or the information can be based on the number of good packets processed by the MMAC.

The *Physical Layer Diagnosis* is covered under the Network Management section of this report.

MacLANVIEW

MacLANVIEW is an analysis program for the Macintosh on Ethernet or on Apple LocalTalk networks.

LANVIEW/SunNet Manager

In July 1990, Cabletron introduced LANVIEW/SunNet Manager, which is the first third-party software package to run on Sun Microsystems' SunNet Manager. LANVIEW/SunNet Manager is a UNIX-based SNMP software package that provides users of SunNet Manager with the physical and media access control management and monitoring capabilities of Cabletron's manageable devices, including MMAC, bridges, and DNI cards. The resulting product provides physical and data-link layer management capabilities for Ethernet, token-ring, FDDI, and fractional T1 networks.

Remote LANVIEW Network Management

Cabletron offers several layers of Remote LANVIEW network management. Through standards-based SNMP connectivity, Cabletron assigns token-ring management capabilities to the port level, where they are displayed locally in a text form and remotely through a Remote LANVIEW/Windows (see next paragraph) graphical user interface (GUI). This feature enables administrators to monitor and control entire token-ring networks and to isolate faulty stations or boards.

Remote LANVIEW/Windows

Remote LANVIEW/Windows is graphical, user-interface software that runs on the management station of the network and allows the network manager to poll all manageable devices from one central location to collect statistics and to control data routings. The devices polled include Multi Media Access Center (MMAC), bridges, and Desktop Network Interface (DNI) PC cards.

Cabletron takes a distributed approach to network management by spreading network management responsibilities among different network devices. This arrangement enables the network manager to gather management statistics about the entire network, subsets of the networks, and connections to the network. The statistics include all error categories broken out individually by port and address, including CRC, alignment, runtime, oversize, and late collisions. The system also maintains information about multicasts, percent utilization, and overall network statistics.

From a remote workstation located anywhere on the network, the manager can route or reroute data paths, establish redundant network connections, and set alarm limits within the managed devices. This setup enables a network manager to troubleshoot and model the network down to the individual network user.

In February 1991, Cabletron enhanced Remote LANVIEW/Windows with management, security, and graphics capabilities. The software uses Microsoft Windows 3.0 to create a graphical window into the physical layer of the network. The latest release of Remote LANVIEW/Windows enables network administrators to receive performance statistics from any SNMP-compliant device on the network, including MMAC intelligent wiring hubs, remote bridges, and DNI adapter cards. A Port Locking feature addresses network security concerns. An additional management function, Port Addressing, allows network administrators to access a complete list of ports and the device addresses connected to them. Port Addressing handles fault isolation, network troubleshooting, and cable management and maintenance.

LANVIEW Network Analyzer

A network monitoring and troubleshooting tool, LANVIEW Network Analyzer runs on IBM PCs and IBM-compatibles in Ethernet or 802.3 networks. The system continuously performs network monitoring, issues audible and visible alarms for network malfunctions, decodes major protocols, performs time domain

reflectometer testing, and performs filtered packet analysis. Protocols and operating systems supported by LANVIEW Network Analyzer include ISO/OSI, DECnet, TCP/IP, XNS, NetWare, VINES, AppleTalk on Ethernet, Spanning Tree Bridge, and ENET (Intel proprietary).

Inductive Modeling Technology

Resulting from a two-year, \$12 million research and development effort, Inductive Modeling Technology, a core software product, provides an adaptive and automatic method of modeling and controlling complex entities with software. This reasoning-capable technology allows developers to build adaptive systems.

Inductive Modeling makes use of model-based reasoning, a form of artificial intelligence, to create programmatic models of each subfunction of a larger entity. Each of these molecular subfunction models understands the attributes and behavior of its real-world counterpart, essentially defining its intelligence. The molecular models are context-aware, interacting with each other to self-adjust their behavior as other subfunction models change status, appear, or disappear. This adaptive integration is similar to some synaptic processes that occur in the human brain. Through these adaptive subfunction responses, large entity system models exhibit inductive reasoning, turning symptoms and effects into conclusions and actions.

Cabletron has no plans to create a commercial development product for the technology alone. The company intends to offer limited licensing arrangements to selected third-party developers.

SPECTRUM

SPECTRUM is Cabletron's UNIX-based advanced management system for multivendor enterprise networks. It is constructed around a realtime modeling entity, Virtual Network Machine (VNM), which uses an artificial intelligence technique known as model-based reasoning. VNM contains a model of the network, which includes the devices, cables, LANs, subnets, rooms, buildings, applications, and protocols. VNM also shows the ways in which all the network and physical components interact. Through this intensive modeling, users receive a cohesive view of the network. The VNM intelligence provides the user with automatic isolation of hard failures and soft error sources, automatic topology discovery, and intelligent alarm filtering.

SPECTRUM directly links to IBM's NetView through a built-in Systems Network Architecture (SNA) gateway to increase enterprise-wide network monitoring capabilities while simultaneously allowing network administrators to access SNMP devices.

Protocol independent, SPECTRUM can manage over 40 types of network devices, including proprietary ones. The product uses the X Windows graphical environment to equip network administrators with a flexible method of managing each network device, including nonintelligent equipment.

SPECTRUM comprises three major components: an object-oriented database, artificial intelligence, and a

client/server database model. The object-oriented database models the components in the network, transforming every device into a combination of data and intelligence.

SPECTRUM can manage standards-based networks, such as departmental LANs running Ethernet or token-ring over twisted-pair wiring. The platform can manage campus networks based on FDDI backbones and corporate networks of a global scale that run multiple protocols over WANs. Additional features of SPECTRUM are:

- support of coax cable, fiber optics, and shielded and unshielded twisted-pair wiring
- open framework that integrates with IBM's NetView, AT&T's Unified Network Management Architecture (UNMA), and Digital's Enterprise Management Architecture (EMA)
- support of Simple Network Management Protocol (SNMP) and Common Management Information Protocol (CMIP)
- integration with SunNet Manager from Sun Microsystems

Pricing and Support

Maintenance: A team of field engineers troubleshoots, repairs, and/or certifies any existing network. A support hot line, staffed from 8 a.m. to 7 p.m. (EST), Monday through Friday, provides immediate response and assistance. Maintenance contracts are available. In July 1990, Cabletron entered into an agreement with Intel to offer worldwide, on-site maintenance and support.

Customer Training: To provide in-house network maintenance and fault analysis, Cabletron offers programs with hands-on training. The training gives customers' staffs access to Cabletron's testing capabilities. Cabletron will also customize training programs to meet individual requirements.

The following prices are for purchase only.

Equipment Prices

	Purchase Price (\$)
MRX hub	1,400
MRX1 hub	2,200
MRX-2 hub	1,395
MRX1-2 hub	2,195
LANtern module for MMAC	3,995
MMAC-5FNB chassis	1,550
MMAC-5PSM-R redundant power supply module	1,380
ETSMIM Ethernet terminal server media interface module for MMAC with multi-protocols (LAT, TCP/IP)	3,995
ETSMIM Ethernet terminal server media interface module for MMAC with single protocol (LAT or TCP/IP)	3,595
Intelligent Repeater Bridging Module for MMAC (IRBM)	6,500
TPMIM-24 media interface module	3,795
EFDMIM Ethernet-to-FDDI Bridging Module for MMAC	19,995
TPMIM-34 media interface module	3,795
TRMIM-10R token ring media interface module	1,295
TRMIM-12 token ring media interface module	1,295
TRMIM-20PR token ring media interface module	1,295
TRMIM-22P token ring media interface module	1,295
TRRMIM-16 token ring repeater media interface module	3,495
TRMM token ring management module	4,995
TRMBM token ring management bridging module	6,995
TRC800 token ring concentrator	595
DNI-T2010 cards for for IBM PC/XT and PC/AT	995
DNI-T3010 cards for IBM MicroChannel	1,295
DNI-T6010 cards for Macintosh	1,295
Mac II Token Ring DNI card	1,295
Remote LANVIEW/Windows (enhanced)	4,995
Remote LANVIEW/Windows gateway	5,995
LANVIEW/SunNet Manager	3,495
LANVIEW Network Analyzer	11,995
SPECTRUM gateway	11,995

Chipcom Networking Products

In this report:

Analysis	-102
Characteristics.....	-104
Pricing.....	-107

Product Summary

Editor's Note

Chipcom is riding high with its ON-line concentrator product line and a first stock offering that Wall Street eyed quite favorably. The unique architecture of the system chassis and the company's responsiveness to the important technical trends of the day are the chief reasons.

Description

A comprehensive networking product line centered on an innovative modular concentrator. Modules for Ethernet on unshielded twisted-pair and fiber optic media, token-ring, network management, and local bridging are offered.

Strengths

Chipcom offers a variety of interface cards for the ONline chassis that fully exploit the modular design of the system. Cards are available for fiber optic, unshielded twisted-pair (10BASE-T), and token-ring connections, as well as bridging and network management.

Limitations

No significant limitations.

Competition

SynOptics, Cabletron, BICC.

Vendor

Chipcom Corp.
Southborough Office Park
118 Turnpike Road
Southborough, MA 01772-1886
(508) 460-8950

Price

ONline System Concentrator:
\$4,950.
ONline 8-port UTP Module: \$1,600.
ONline Network Management Module: \$2,950.

GSA Schedule

Yes.

—By *John Krick*
Associate Editor

Analysis

Product Strategy

On Friday, May 3, 1991, Chipcom made an Initial Public Offering (IPO) of its common stock. It listed on the NASDAQ exchange at \$12 per share. By the following Friday, the price per share was up to \$16.25. This rapid and respectable rise in its first week speaks volumes about the market's confidence in Chipcom. In its ONline System Concentrator product line, Chipcom has managed to produce a forward-looking product line that combines in one chassis several of the hottest technologies in the industry today—fiber optic LAN cabling, 10BASE-T unshielded twisted pair (UTP), 16M bps token-ring, internetworking, and network management hardware.

Chipcom debuted the ONline system in early 1990 with fiber optic and 10BASE-T Ethernet hardware, and has since expanded the capabilities of the modular box by bringing out cards for other popular networking schemes. Chipcom's solution is a high-end one, aimed at what the company calls facility networks—large, interdepartmental installations.

The most recent addition to the ONline system is a UNIX-based network management software package. The ONline Network Control System (NCS) is a state-of-the-art management system that takes advantage of the redundant power and cabling features of the ONline concentrator to provide automatic reconfiguration of a network in the event of equipment failure.

Competitive Position

Despite the fact that the hub/concentrator market is experiencing a boom, there are not many companies that offer the range of functionality that Chipcom does. The ONline product line really is a unique system, as Chipcom is fond of saying in its

product literature. Its TriChannel architecture allows a high degree of fault tolerance and interconnectivity between various network types in one platform.

While other vendors offer large concentrator chassis, most depend on a single bus architecture, so that attaching Ethernet, token-ring, and FDDI segments to one box is not an option. It should be noted that connecting any of the three channels in the ONline concentrator requires a bridge, just as connecting two single bus concentrators would. The difference is that with the recently announced ONline Ethernet Bridge Module, the bridge is contained in the same chassis with both of the channels being bridged. Until the ONline bridge module was announced, the separate channels in the ONline concentrator had to be bridged with an external bridge, such as Chipcom's Midnight Bridge. The ONline system should be popular among integrators of large-scale networks.

The older Chipcom product lines are quickly approaching obsolescence—not because of design failings of the products themselves, but rather, because the market has changed so drastically since these products were introduced in the mid- and late-1980s. The ORnet fiber optic Ethernet equipment is still a viable solution for small networks running fiber, but this is a small market segment.

Chipcom's other product line, Ethermodem broadband equipment, while seemingly well engineered, is being sold into a market that is diminishing rapidly. The demand for broadband equipment is virtually negligible today. Hardly anyone is building new broadband networks, and many existing broadband campus backbone systems are being replaced by fiber optic token-ring systems, with the expectation of upgrading to FDDI when it becomes widely available. In environments where data traffic must share a backbone with voice and video, broadband installations will continue to operate, but the cost of maintaining broadband, which requires tuning by RF-knowledgeable technicians, is almost prohibitively high.

Chipcom's executives like to point out that the fortunes of the company are riding on the ONline system. That they have chosen a very robust platform for those fortunes to ride seems abundantly clear. The ONline products accounted for more than one third of the company's revenue in 1990 and they only became available that spring.

Company Profile Chipcom Corp.

Corporate Headquarters

Chipcom Corp.
Southborough Office Park
118 Turnpike Road
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01772-1886
(508) 460-8950

Officers

Chairman of the Board:
Yoseph Linde
President/CEO: Rob Held
VP of Engineering: Men-
achem Abraham

Company Background

Year Founded: 1983
No. Employees: 200
Installed Base: 1,600 ON-
line System Concentra-
tors.

Business Overview

1990 was a year of rapid
growth for Chipcom, and

the media took notice. *Inc. Magazine* ranked Chipcom number 12 in its list of the 500 fastest-growing, private companies in America. The company also captured the number one spot in *New England Business Magazine's* ranking of the 100 fastest-growing companies—public or private—in the region.

In early May 1991, Chipcom made an initial public offering of 1,550,000 shares traded on the NASDAQ National Market. Its stock symbol is CHPM. Proceeds from the sale of the stock are to be used for working capital and product development.

The company manufactures three distinct product lines: Broadband Ethernet hardware, the ORnet Fiber Optic Ethernet system, and the ONline System Concentrator. Introduced in the spring of 1990, the ONline concentrator has been met with an enthusiastic reception in the facility network market, and Chipcom is basing its hopes for the future on this product. The industry's high regard for the ONline system is best indicated by the fact that ONline sales accounted for over one third of Chipcom's total revenue for fiscal 1990.

Financial Profile

Chipcom's 1990 total revenues amounted to \$28.4 million, which represents an increase of over 60 percent compared to 1989's \$17.1 million. Major investment came from a number of the

country's top venture capital firms. Seed money was provided by Boston-based Charles River Ventures, which was soon joined by the Aegis Fund. In 1985, a second round of financing brought together Southwest Venture Partnerships, Advent International, Sigma Partners, and Menlo Ventures in support of Chipcom.

Management Statement

"We have experienced tremendous growth during the last five years," Chipcom President Rob Held remarked, on the occasion of the *Inc. Magazine* ranking. "This outstanding achievement and honor reflects the market's strong belief in our products, the loyalty and support of our customers, and the hard work of our employees."

Decision Points

Chipcom is one of the strongest contenders in the intelligent, multifunction hub arena. Those who require the broad functionality and flexible, forward-looking design of a system of this sort will find few competitors that can match Chipcom's offerings.

The ONline system is clearly a high-end solution that offers advantages to those who must connect large networks of varying topologies and media and make further connections to wide area facilities, all while planning for a future based on new media and rapid growth. The advantages for the smaller network user are not as clear—Chipcom's products are priced in line with their functionality, and as such are expensive solutions.

In that respect, Chipcom achieves high marks in every category, except scalability, and Chipcom has already taken steps to rectify this situation. The company plans to release, in late summer 1991, a 6-slot ONline chassis that will use the same modules as the 17-slot version. This will broaden the market for this equipment by allowing it to serve in both small networks and in subnetworks. The smaller chassis will almost certainly be a cost-effective path to larger sales for this innovative vendor.

Characteristics

Model: ONline System Concentrator and product family including modules for 10BASE-T and fiber optic Ethernet, token-ring, bridging, routing, and network management.

Date of Announcement: ONline System Concentrator: January 1990.

Date First Installed: ONline System Concentrator: June 1990.

Number Installed: Approximately 1,600 ONline System Concentrators installed as of March 1991.

Distribution: Value-added resellers, systems integrators, distributors, and OEMs.

Architecture

The ONline modular concentrator combines hardware for a number of networking technologies in one chassis. Fiber optic Ethernet networking, unshielded twisted-pair Ethernet (10BASE-T), 4M and 16M bps token-ring, network management, bridging, and routing can all be accommodated in the ONline concentrator chassis.

Ethernet

Ethernet and its standardized cousin, IEEE 802.3, are characterized as Carrier Sense Multiple Access with Collision Detection (CSMA/CD) networks, meaning that stations wishing to transmit data over the network must first check the line to determine if a carrier is present. If it "senses" the presence of a carrier, it defers its transmission for a random period of time before trying again. Since two or more stations can begin transmission at the same time, collisions of packets occur from time to time. When a collision is detected, both stations involved cease transmitting and wait a random time before attempting to retransmit their messages. Ethernet differs from 802.3 networking in that it does not follow the IEEE 802.2 Logical Link Control standard for interfacing the physical (hardware) layer to the higher layers of the OSI model.

Traditionally, Ethernet and 802.3 networks have been connected in a linear bus topology, first over thick coaxial cable, and later, over thinner, more easily handled coaxial cable. In recent years, new media and a new topology have come to the fore. A star topology

with a central hub is used for both unshielded twisted pair (UTP), standardized under the 10BASE-T subsection of the 802.3 guidelines, and fiber optic Ethernet, described by the as yet unfinalized 10BASE-F subsection of the 802.3 standard.

Token-Ring

Token-ring networking, championed by IBM and standardized by the IEEE under the 802.5 standard, is described as a deterministic network, since performance can always be accurately predicted based on the number of stations involved. A token-ring network uses a special data structure called a token to distribute the right to transmit among workstations. The token passes from one station to the next in succession. A workstation that has data to transmit holds the token until it completes its transmission. It then places the token back on the network where it is passed to the next station in line.

Hardware

ONline Product Line

ONline System Concentrator: This is a 17-slot chassis that accepts modules for internetworking, network management, and all types of Ethernet media. Chipcom's TriChannel Architecture allows the ONline System Concentrator to support up to three separate, logical networks in one concentrator unit. Networks using different media, such as twisted-pair and fiber optic 802.3 networks, can reside in the same chassis. 802.3 and token-ring networks can also share this concentrator. Modules can be assigned to any of the three channels either by configuring DIP switches on the module, or remotely through network management software. The three-channel design provides advantages where heavy network loads demand partitioning for load balancing and performance reasons. Quick recovery from network failures is also facilitated by the three-channel design, which allows reassignment of users on one channel to either of the other channels. The ONline System Concentrator can accommodate an optional backup power supply that automatically takes over in the event of failure of the primary supply.

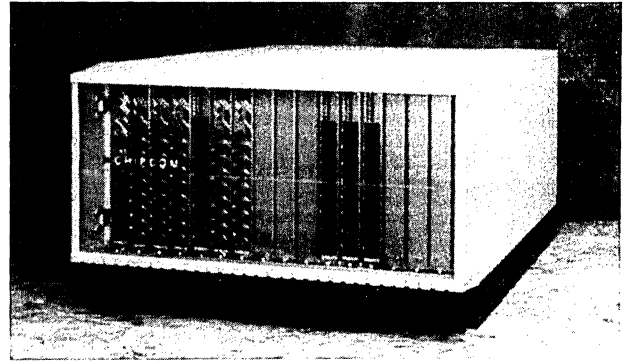
ONline Fiber Module: This is a four-port fiber optic interface card for IEEE 802.3 and Ethernet Version 2.0 networks running on fiber media. Cabling distances of up to 4 kilometers can be achieved using the high-power optics setting that can be enabled using a DIP switch on the module. Normal power allows the module to work with earlier Chipcom fiber optic equipment. Fault-tolerant features include switchover logic that pairs ports 1 and 2 and ports 3 and 4 to provide redundancy. If port 1 fails, for example, port 2 automatically takes over within one second. This cable path pairing is identical in topology to the FDDI counterrotating ring scheme, allowing an easy upgrade path to FDDI when it

becomes available. Chipcom also promises compatibility between these cards and future cards that will conform to the unfinalized IEEE 10BASE-F standard. The ONline fiber module can be ordered with SMA-type 905 or 906 connectors or with ST-type connectors. The card features LED indicators for port operational status, link redundancy status, and traffic activity.

ONline Twisted Pair Ethernet Module: The Twisted Pair Ethernet Module is a 10BASE-T-compliant card for the ONline System Concentrator chassis. The card has eight RJ-45 ports and works with both unshielded and shielded twisted-pair wiring. One module can support any mix of shielded and unshielded twisted-pair connections. The ONline Twisted Pair Module supports cabling distances of up to 150 meters, longer than the 100-meter 10BASE-T standard recommendation. The card also features a long-distance option that allows cabling lengths of up to 200 meters in environments where external noise is minimal. Shielded twisted-pair installations can support 200-meter 10BASE-T runs and 300 meters in the long-distance mode. A pair of LEDs for each port indicates status and activity.

ONline Token Ring MAU Module: The Token Ring MAU Module connects eight workstations, servers, or other devices to 4M bps or 16M bps token-ring networks on both shielded and unshielded twisted-pair cabling. Up to 16 Token Ring MAU Modules can be installed in one ONline System Concentrator providing interconnections for as many as 128 stations. ONline hubs can be linked to form a large ring supporting up to 250 stations on shielded twisted pair or up to 72 stations per ring on unshielded twisted pair. Cable lengths can be up to 275 meters on shielded twisted pair and 100 meters on unshielded twisted pair. The Token Ring MAU Module features automatic ring wrap that reforms the ring in the event of a cable break or a failed port or module. The MAU Module also includes Ring In and Ring Out ports to enable connection of external token-ring resources. The Token Ring MAU Module can be managed by Chipcom's Management Module.

ONline Ethernet Bridge Module: This is a two-slot module that connects any two channels in the ONline System Concentrator, or any ONline channel with an external Ethernet network. The ONline Ethernet Bridge Module has a filtering rate of 20,000 frames per second and a forwarding rate of 10,000 frames per second. The address table can hold up to 8,000 entries and features automatic address learning and aging. It implements the IEEE 802.1 Spanning Tree algorithm for providing redundant bridged links between networks without the possibility of packet looping. The ONline Ethernet Bridge Module can be configured using a console attached to its front-panel RS-232 port for out-of-band management, or via in-band management using the facilities of the ONline Ethernet Management Module, another ONline Ethernet Bridge Module, or a Midnight Bridge.



Chipcom's ONline System Concentrator is a 17-slot, modular cabinet that can house cards for fiber optic Ethernet, 10BASE-T unshielded twisted-pair Ethernet, network management, bridging, and routing. The ONline System's TriChannel Architecture is a three-channel backplane that allows three separate networks to reside in the same chassis.

ONline Ethernet Router Module: Developed jointly with internetworking leader Cisco Systems, the ONline Ethernet Router is Chipcom's latest addition to the ONline system product line. Based on a 16MHz 68020 CPU, the Ethernet Router Module is available in three versions—an Ethernet-to-Ethernet version for connecting local networks; an Ethernet-to-serial version for use with point-to-point WAN connections such as T1 and E1; and an Ethernet-to-serial version for X.25 and frame-relay applications. The point-to-point and X.25 versions use identical hardware, but are supplied with different software for their respective applications. They are equipped with a 50-pin connector that can be configured for RS-232, RS-449, X.21, or V.35 connections. With external clocking, these modules can achieve a 7M bps throughput. The Ethernet Router Module has 1M byte of onboard memory, expandable to 4.5M bytes. The memory is divided into primary and secondary partitions addressed separately by the CPU and the I/O devices, respectively, giving better performance. The router modules support a wide range of industry-standard routing protocols including TCP/IP protocols EGP, IGRP, RIP, and BGP; DECnet Phase IV routing; Novell IPX; XNS; and others. The ONline concentrator's TriChannel architecture allows the Router Module to be used to route packets internally among the three channels, as well as to external connections. This allows network administrators to configure subnetworks for, for example, UNIX workstations whose high performance creates large demands on the network.

ONline Ethernet Network Management Module: The Ethernet Network Management Module plugs into any slot in the ONline concentrator and communicates with other modules through a dedicated control bus. Initial assignment and subsequent reassignment of modules to one of the three channels in the ONline concentrator are accomplished through the Network Management

Module. Individual ports on any module can be turned on or off. Two levels of password control are implemented to protect against unauthorized use of the network. EEPROM storage "remembers" all network configuration data in the event of power failure and re-loads it when the problem is corrected. A new network management module automatically learns all configuration information when plugged into a working concentrator. A terminal or a modem can be connected to the module's RS-232 port for local or remote control and monitoring of the ONline system. The Network Management Module is also addressable by Chipcom's new Network Control System using the Simple Network Management Protocol (SNMP).

ONline Ethernet Repeater Module: The ONline Repeater Module is a two-port card that attaches the ONline concentrator to an Ethernet segment using an AUI connector. Each port can be assigned to any of the three channels in the concentrator, independently of the other ports.

ONline Ethernet Transceiver Module: The ONline Transceiver is a three-port device that can be used to attach the ONline concentrator to bridges, routers, repeaters, and end nodes. As with the repeater module described above, each port can be assigned to any of the three channels in the concentrator, independently of the other ports.

Other Hardware

ONline Twisted Pair Ethernet Transceiver: The ONline Twisted Pair Ethernet Transceiver allows any Ethernet adapter card with an Attachment Unit Interface (AUI) to connect to shielded or unshielded twisted-pair wiring. It includes a 15-pin, D-type AUI connector and an 8-pin RJ-45 modular connector for twisted-pair attachment.

Midnight Bridge: The Midnight Bridge is a local bridge for Ethernet-to-Ethernet connections. It supports the IEEE Spanning Tree protocol that allows redundancy of bridged connections by disabling one of a pair of parallel bridges unless the primary bridge link fails. The Midnight Bridge includes dedicated hardware to perform the packet filtering function. It filters 20,000 packets per second and forwards 10,000 packets per second. Its address table can hold up to 8,000 entries. Two hundred forty addresses can be programmed as "always forward" or "never forward." The Midnight Bridge is available in five different cabling configurations:

- AUI-connector to AUI-connector
- fiber-to-fiber using ST connectors
- fiber-to-fiber using SMA connectors
- AUI-to-fiber ST connector
- AUI-to-fiber SMA connector

Fiber optic models are equipped with LEDs that indicate port status by a varying number of blinks for different error conditions such as jabber, no light, low light, or invalid data.

Software

ONline Network Control System (NCS): The ONline Network Control System (NCS) is a UNIX System V-based network management system that runs on a 386- or 486-based PC. It incorporates the Simple Network Management Protocol (SNMP), a de facto industry standard for network management. An Ingres relational database management system is included for processing and retrieval of network user and configuration data and statistical information. NCS sets and monitors alarm conditions, generates a realtime alarm log, calculates peak network traffic loads and distributions, and monitors the status of individual ports and nodes.

The Santa Cruz Operation (SCO) Open Desktop, which incorporates the Open Software Foundation's Motif graphical user interface, is the basis of the NCS display system. It allows the creation of detailed network maps using icons drawn from the NCS library. Icons are color-coded to reflect current operational status. In the event of an alarm condition or failure of a network device, the icon associated with that device would change color and an alarm window would appear on the NCS management station screen. Network maps can be linked in a hierarchical fashion to realistically depict network topology.

Used with Chipcom's TriChannel Architecture ONline concentrators, NCS allows network managers to reconfigure network topology via software control without powering down the network. Users can also be re-assigned to any of the three networks in the ONline backplane electronically, allowing balancing of traffic loads during peak usage periods. Channels within the ONline hub can also be bridged to each other or to external networks electronically.

Two licensing options for the ONline Network Control System are available, for management of up to 12 ONline System Concentrators, and for 13 or more ONline System Concentrators.

Support

Installation

Installation is provided by resellers and distributors.

Training

Chipcom offers training classes for end users and reseller's and distributor's support personnel at its headquarters.

Warranty

Chipcom warrants all of its products for a period of one year from date of shipment.

Maintenance/Support

Maintenance and support are provided by resellers and distributors. Telephone hot line support is also available for end users, resellers, and distributors.

Equipment Prices

5017C	ONline System Concentrator	4,950
5104M-FIB	ONline Fiber Module 4-port	1,800
5108M-UTP	ONline UTP Module 8-port	1,600
5100M-MGT	ONline Network Management Module	2,950
5102B-EE	ONline Ethernet Bridge Module	4,250
5102R-EE	ONline Ethernet Router Module (local Ethernet-to-Ethernet)	6,350
5102R-ES	ONline Ethernet Router Module (Ethernet-to-Serial)	6,850
5102R-ESX	ONline Ethernet Router Module (Ethernet-to-Serial X.25)	7,150
5102M-AUIF	ONline Ethernet Repeater Module	1,500
5103M-AUIM	ONline Ethernet Transceiver Module	1,500
5208M-TP	ONline Token Ring MAU Module	1,195
5101T-UTP	ONline Twisted Pair Transceiver	195
8383B-AA	Midnight Bridge IEEE 802.3 AUI-AUI bridge	2,950
8383B-ST1	Midnight Bridge IEEE 802.3 AUI-Fiber bridge (ST connectors)	3,450
8383B-ST2	Midnight Bridge IEEE 802.3 Fiber-Fiber bridge (ST connectors)	3,950
8383B-SMA1	Midnight Bridge IEEE 802.3 AUI-Fiber bridge (SMA connectors)	3,450
8383B-SMA2	Midnight Bridge IEEE 802.3 Fiber-Fiber bridge (SMA connectors)	3,950

27

Cisco Systems Internetworking Products

In this report:

Analysis	-102
Characteristics.....	-106

Product Summary

Editor's Note

Since our last report, Cisco introduced Interior Gateway Routing Protocol (IGRP) IS-IS; enhanced NetCentral Station to run on Sun SPARCstations; released STS-10x, a 10-port multiprotocol Ethernet server; enhanced its routers to support Banyan's VINES; introduced the Integrated Gateway Server (IGS); added AppleTalk II to the list of protocols supported by its routers; enhanced the AGS+ router to support four FDDI interfaces; introduced the CSC-R16 interface card; announced the industry's first SMDS router interface for LAN-to-LAN connectivity; and announced the industry's first frame-relay router interface for LAN-to-LAN connectivity over WANs.

Description

Cisco Systems develops, manufactures, and markets high-performance multimedia and multiprotocol internetworking products, which include routers, bridges, terminal servers, and network management systems. These products serve as building blocks for the creation of wide area

networks that can link an almost unlimited number of geographically dispersed LANs.

Strengths

Cisco's router/bridges achieve high throughputs without sacrificing reliability. The products support the latest standards and protocols.

Limitations

Cisco's limitations extend to the IBM SNA and NetView environments, but the company is currently implementing a five-phase plan to strengthen its position in these areas.

Competition

Proteon, Wellfleet.

Vendor

Cisco Systems
1525 O'Brien Drive
Menlo Park, CA 94025
(415) 326-1941

Price

AGS+—\$12,300 (base price); Integrated Gateway Server (IGS)—\$5,695.

GSA Schedule

Yes.

—By *Barbara Callahan*
Associate Editor

Analysis

Product Strategy

After mastering multiprotocol internetworking techniques, Cisco is ready to carry this expertise into IBM SNA environments, which constitute a significant segment of the market. The company has spent the past two years developing a plan to penetrate IBM environments with LAN support, integrated WAN interconnection, and flexible network management. Through the vehicle of a five-phase strategy, Cisco intends to make further inroads into the IBM camp.

Phase I involves current and future implementations of token-ring capabilities within multiprotocol routers; and support for IBM's source route bridging (SRB) and remote source route bridging (RSRB) environments. In *Phase II*, Cisco plans to incorporate wide area transport of SNA data via the Synchronous Data Link Control (SDLC) data link protocol.

Phase III calls for adding support for the emerging source route transparent (SRT) bridging standard and IBM's LAN Network Manager (formerly LAN Manager). *Phase IV* extends support to full SNA routing and NetView management. *Phase V* delivers peer-based (Physical Unit 2.1) internetworking support under IBM's Advanced Peer-to-Peer Communications (APPC) architecture.

In 1989, Cisco entered the first phase of its plan for IBM-based internetworking by introducing token-ring interfaces to its product line. Since that time, Cisco's support for token-ring has escalated from the original 4M bps rate to selectable 16/4M bps support. In token-ring environments, Cisco's routers can act as both local and remote source bridges while simultaneously routing 16 different protocols.

To advance its IBM internetworking support, Cisco has entered into technology agreements with IBM and Madge Networks. The IBM-Cisco agreement formalized a cooperative relationship in which IBM provides its switchable 16/4M bps

token-ring technology to Cisco. With Madge, Cisco licenses the Madge FASTMAC data buffering and transfer software for incorporation into Cisco's token-ring interface cards. The acquisition of this software is expected to optimize the performance of Cisco's current 16M bps token-ring implementation. Cisco's multiyear agreement with Brixton Systems, concluded in January 1991, is also geared toward strengthening its IBM-based capabilities. The Brixton pact authorizes the use of the company's software in Cisco AGS bridge/routers, enabling the devices to act as IBM front-end processors for routing SNA data.

Although Cisco plans to devote a great deal of attention and resources to fortifying its line for more IBM-based internetworking, the company does not appear to be neglecting the development of internetworking options with other vendors. Recently, Cisco enhanced its NetStation Central network management software to run on Sun Microsystems' SPARCstations, incorporated support for Banyan VINES into its routers, added AppleTalk II support, and enhanced IGS with support for Digital's LAT protocol. All these activities are hardly the work of a vendor that is tilting too heavily to one side. Cisco is also focusing on WANs, as evidenced by its recent introduction of a frame-relay router interface and an SMDS router interface.

Competitive Position

In 1990, International Data Corp. (IDC) cited Cisco as having a worldwide router market share of over 35 percent. This figure does not include FDDI multiprotocol routers, a market in which Cisco excels, having installed approximately 1,500 FDDI-fitted AGS+ units. To expand its market share, Cisco has targeted the IBM-based internetworking environment, a vast segment whose numbers are impossible to calculate. A competitor, Proteon, already has token-ring identification and ranks second to IBM in the token-ring arena. Only Cisco, however, has an agreement with IBM to incorporate IBM's Token-Ring chip set into its router products.

Like Cisco, Proteon is an innovative company that has established many industry firsts, the most recent of which is the introduction of the CNX 500 RISC-based multiprotocol bridging router. A highly acclaimed product, the CNX 500

is the first in a family of bridging routers that will feature speeds leading up to 100,000 packets per second, clearing the path for migration from 16M bps backbones to distributed FDDI backbones. Proteon is counting on RISC to capture even more IBM territory. At this time, however, routers constitute a relatively small portion of Proteon's business, whereas routers are almost all of Cisco's business, and Cisco dominates the FDDI multiprotocol router market.

Following the trend for the nineties, Proteon is strongly emphasizing support. In 1990, the company announced a lifetime warranty for its 4M/16M bps adapters. In addition to strengthening product support, Proteon plans to have 80 percent of customer calls answered by engineers by this summer. Since the support factor frequently swings customers to other vendors, it will be interesting to observe Cisco's future moves in this direction.

Recently, Cisco's other major competitor in the router field, Wellfleet, has been following somewhat of a parallel path. Like Cisco, Wellfleet has added support for SMDS; AppleTalk II; and OSPF, the protocol proposed for the next generation of TCP/IP. Both companies are also interested in frame relay. Cisco, however, introduced frame relay as a software option to its router/bridges in October 1990, but Wellfleet simply announced its intention in October of the same year to introduce a frame-relay interface, which has not yet materialized.

Both companies are also increasing their IBM support and extending their network management capabilities. Wellfleet announced SDLC support in January 1991 through Transparent Sync Pass-Thru, a software feature that allows users to combine serial synchronous data, such as that based on HDLC and SDLC, with LAN network data across a single wide area backbone. Cisco's SDLC software enables IBM mainframe front-end processors and cluster controllers to communicate through Cisco routers.

The companies also differ in their actual SDLC implementations. Cisco routes SDLC through a Cisco net, enabling the data to go across any media—FDDI, token-ring, Ethernet, and serial. Wellfleet bridges SDLC and runs into media limitations. In the area of network management, the software from both companies now runs on Sun's SPARCstations.

Decision Points

Cisco shipped its first multiprotocol router in 1986, and now has an installed base worldwide of over 15,000 internetworking systems. The company started out small—in academic and research environments, then moved into government and commercial installations. Cisco's history is impressive and so is its vision for the future.

Knowing that other companies value a company's expertise is very reassuring for potential users. In Cisco's case, three highly respected LAN wiring concentrator vendors—SynOptics, Cabletron, and Chipcom—concluded technology agreements in 1990, which call for the integration of Cisco routers into their LAN hub products.

In the February 1991 issue of *Data Communications* magazine, Cisco received a Tester's Choice award as a result of tests performed by Harvard University's Scott Bradner. About Cisco, Steven S. King, executive editor, technology, of *Data Communications*, wrote, "In exhaustive tests, Cisco's AGS+ regularly defined the maximum possible traffic throughput, turning in stunning, bridge-like performance for nearly all packet sizes. The speed of Cisco's packet handling so nearly approximates wire speed that its routers are effectively transparent to network devices, even while providing traffic management and enterprise-wide reliability."

More and more users who want to internetwork remote LANs are turning to frame relay, a packet-switching technology that requires only a single high-speed data link to interconnect multiple users to remote LANs through a WAN. In response to the high interest in frame relay, Cisco has incorporated the technology into all its router/bridges. Services making use of Cisco's frame relay routers are now available, such as Williams Telecommunications' WilPak.

Catherine Muther, Cisco's vice president of marketing, commented that the company's development of frame-relay technology for its routers along with StrataCom "was a direct response to customers with T1 multiplexer-based networks who wanted to add high-speed data capabilities, such as electronic mail or file transfer, in a cost-effective way. With our new frame-relay software, a Cisco router attached to a LAN can provide direct connectivity to every device on a StrataCom FastPacket wide area network using only a single serial connection. Unlike traditional circuit

Company Profile

Cisco Systems

Corporate Headquarters

1525 O'Brien Drive
Menlo Park, CA 94025
(415) 326-1941

Canadian Distribution

Cisco Systems Canada,
Inc.
405 The West Mall, Suite
700
Etobicoke, ON M9C 5J1
(416) 695-0433

Officers

President, Chief Executive Officer: John P. Morgridge

Senior Vice President:

John Chambers

Vice President, Finance and Administration: John C. Bolger

Vice President, Engineering: Robert W. Burnett

Vice President, Sales—North America: F. Terry Eger

Vice President Marketing: Catherine S. Muther

Vice President, Manufacturing: David Ring

Company Background

No. Employees: 475

No. Products Sold: Over 15,000 internetworking products

No. Customers: 1,200

In 1979, computer scientists at Stanford University designed and implemented a computer communications internetwork that spanned 16 square miles and connected 11 Ethernet LANs, thereby enabling about 5,000 computers, workstations, and terminals to be on speaking terms with each other. The five computer scientists, including Leonard Bosack and Sandra Lerner, founded Cisco Systems in 1984.

Having gained substantial lead time over competitors by charting a course through the unexplored territory of internetworking, Cisco recorded many industry firsts:

- First multiprotocol router.
- First multiprotocol router with concurrent IBM Token-Ring Source-Route bridging.
- First internetworking router/bridge to concurrently support all major computer protocols.
- First internetworking

router to route TCP/IP data at Ethernet channel speeds.

- First multiprotocol router to support Apple-Talk.
- First combination multiprotocol router/bridge and X.25 packet switch.
- First combination multiprotocol router/bridge and terminal server.
- First TCP/IP Terminal Server with Serial Line Internet Protocol (SLIP) support.
- First internetworking router/bridge to support multiple FDDI network attachments.
- First SNMP-based network management software with integrated RDBMS.
- First router interface with LAN-to-LAN connectivity over SMDS.
- First vendor to offer priority queuing for both routed and bridged protocols.
- First vendor to offer a protocol translator that supports three virtual terminal protocols.
- First vendor to offer a product that concurrently performs internetwork routing, bridging, and protocol translation.
- First vendor to support frame relay on multiprotocol router/bridges.

In February 1990, Cisco executed a successful

initial public offering and raised over \$47 million in capital. For the fiscal year ending on July 29, 1990, Cisco reported net sales of \$69,776,000, which represented a 150 percent improvement over fiscal 1989's net sales of \$27,664,000. The company's net income for fiscal 1990 was \$13,904,000 (\$1.00 per share), a figure more than triple that of the \$4,178,000 (\$0.34 per share) earned in fiscal 1989. In fiscal 1990, Cisco reported that sales in Europe and the Pacific Rim generated 28 percent of revenues. In the third-quarter 1991, ending April 28, 1991, Cisco reported sales of \$49,707,000.

The company markets its products through direct sales, distributors, and original equipment manufacturers (OEMs). AT&T Computer Systems OEMs Cisco routers and sells them as part of its network computing solution. Network Equipment Technologies (N.E.T.) incorporates Cisco router technology into its networking products. Cisco products are also available directly from Digital Equipment Corp. Cisco has also entered into OEM agreements with SynOptics, Chipcom, and

switched networks, frame relay doesn't have the costly requirement of a dedicated line for every traffic path. And it doesn't restrict the user to a fixed 56- or 64-kilobit bandwidth, but provides the needed bandwidth on demand."

About Cisco, it can also be said that the company never met a protocol that it didn't eventually

like. At present, Cisco products support all the leading multivendor communication protocols, recently adding Banyan's VINES to its fold. Cisco's routers also "route the unroutables" by slipping into their bridging functions. Cisco routers can

Cabletron, three vendors of 10BASE-T wiring hubs, which authorizes these companies to incorporate board-level versions of Cisco routers into the chassis of their hubs.

Approximately 1,200 companies, government agencies, government contractors, universities, and research centers constitute Cisco's worldwide customer base. The company numbers among its customers AT&T, Aetna Insurance, Amoco, Boeing, Ciba-Geigy, Convex, Deutsche Bundespost, Digital Equipment, European Space Agency, Harvard University, Hewlett-Packard, IBM, NASA, MIT, Matsushita, Motorola, Nippon Telephone & Telegraph, Northern Telecom, N.V. Philips, Shell Oil, and the U.S. Air Force. Over one half the *Fortune* 100 U.S. companies are currently Cisco customers.

During 1990, Cisco opened new sales offices in Denver, Orlando, Chicago, Houston, Minneapolis, and Atlanta, bringing the total of U.S. sales offices to 20, as well as an office in Toronto. Internationally, Cisco has recently added a direct sales and support office in Australia and the U.K. and plans to expand to

Germany this year. The company added new distributors in Austria, France, Greece, Norway, Hong Kong, Korea, Singapore, and Taiwan. Worldwide, Cisco has 28 distributors. Its European direct sales subsidiary, located near Paris, doubled its staff in 1990.

Recent Agreements

April 1990—signed a joint technology agreement with SynOptics Communications to integrate Cisco's router technology into SynOptics' LattisNet intelligent wiring center systems. The agreement calls for a version of Cisco's router technology developed by the two companies to be incorporated onto an integrated module for the LattisNet System 3000 intelligent wiring center systems.

April 1990—entered into a joint development agreement with Chipcom, which calls for the two companies to co-develop a modular version of Cisco's multi-protocol LAN/WAN routing technology that will be integrated into Chipcom's ONline System Concentrator.

April 1990—announced a joint frame-relay program with StrataCom in which the two companies are

developing an enhanced frame-relay interface to provide their customers with improved network performance.

May 1990—signed an agreement with Cabletron Systems which calls for the two companies to jointly develop a router module to plug into Cabletron's Multi Media Access Center (MMAC) intelligent hub.

October 1990—announced an alliance with ADC/Kentrox Industries to jointly develop an interface to T1 SMDS networks that would support LAN access to high-speed SMDS networking services.

October 1990—reported an OEM agreement with IBM through which IBM provides its switchable 16/4M bps technology to Cisco for use in Cisco's line of bridges and routers.

December 1990—entered into an agreement with Madge Networks Ltd. in which Cisco licensed Madge's FASTMAC token-ring technology for use in Cisco's token-ring routers.

January 1991—announced a multiyear agreement with Brixton Systems that enables

Cisco to use Brixton software to empower its router/bridges to route SNA data over existing multiprotocol internets. The agreement will also provide Cisco with hooks to IBM's NetView network management system.

March 1991—entered into an agreement with NEC America to develop the first Switched Multi-megabit Data Service (SMDS) router interface that operates at the DS3 speed of 44.736M bps. The development effort is expected to produce a high-speed interface that will enable Cisco's AGS+ router/bridge to link remote LANs over a packet switched WAN through SMDS, an emerging standard.

March 1991—signed an agreement with Digital Equipment Corp., which authorizes Digital to sell Cisco's complete line of high-performance, multi-protocol internetworking router/bridges, terminal servers, and network management products. The contract, renewable after one year, does not mandate minimum purchase requirements for Digital.

bridge unroutable protocols, such as Digital's LAT, while simultaneously routing other supported protocols.

To satisfy requirements for higher speeds, Cisco has complemented the AGS router with the AGS+ router, which uses a proprietary, half-gigabit-per-second, high-speed bus to support up to

four FDDI interfaces. In a large organization, the AGS+ can link several departments, each with its own FDDI backbone. It can also interconnect multiple FDDI LANs that handle high-speed applications, such as medical imaging or CAD/CAM.

Characteristics

Products

Routers/Bridges

Modularly designed, the Cisco family of internetwork router/bridges offers users wide latitude in configurations. The products support Ethernet, 4M and 16M bps token-ring, FDDI, T1, DS3, Switched Multi-megabit Data Service (SMDS), and frame relay. Chassis size and board slots govern configuration options.

Users can configure Cisco's routers to route data Ethernet-to-Ethernet; Ethernet-to-token-ring; Ethernet-to-FDDI; FDDI-to-FDDI; FDDI-to-token-ring; token-ring-to-token-ring; and any combination of FDDI, Ethernet, and/or token-ring to a wide area network with synchronous serial lines.

All Cisco router/bridges support concurrently, with multiprotocol routing, the transparent bridging (IEEE 802.1) of nonroutable protocols, such as Digital Equipment's LAT (local area transport) terminal-to-host protocol and many proprietary nonroutable protocols. In addition, all Cisco router/bridges support concurrent token-ring/source-route bridging, both local and remote, except for the two-slot CGS and the single-board IGS.

Frame Relay: In October 1990, Cisco announced frame relay support as a software option on all its router/bridges, starting in November. The Cisco announcement coincided with the introduction by StrataCom of a frame-relay interface card for its FastPacket IPX system. In April, the two companies announced their intention to jointly develop frame-relay hardware and software to connect their respective products. Working together, Cisco's software and StrataCom's frame-relay interface allow users to create a wide area network unhampered by traditional restraints for dedicated lines or by fixed bandwidth rates. The combination of Cisco routers and StrataCom switches is already being commercially implemented in the nationwide frame-relay service announced by Williams Telecommunications in April 1991.

Cisco's frame-relay software implements the frame-relay specification and Link Access Procedure (LAP-D) format described by the CCITT under its I-Series (ISDN) recommendations as L122 "Framework for Additional Packet Model Bearer Services." The current Cisco implementation handles IP and DECnet protocols. Cisco plans to add support for other protocols in the future.

Protocol Support: All members of Cisco's router/bridge family support a total of 16 protocols, including TCP/IP, DECnet, OSI, XNS, IPX, AppleTalk, AppleTalk Phase II, 3+ /3+ Open, U-B Net/One, X.25, and Domain. Interfaces for the high-end AGS+ include FDDI, token-ring, RS-232, RS-449, and V.35. Optional concurrent bridging and source-route bridging handle nonroutable protocols such as Digital's LAT and IBM's SNA and NETBIOS.

In August 1990, Cisco added support for Banyan's VINES to the routers, which enables users of VINES-based PC networks to make use of Cisco's routing technology over high-speed FDDI and T1 networks, and to participate in Cisco's SNMP-based network management. VINES includes the VINES Internet Protocol. The implementation of VINES Internet Protocol and routing algorithm ensures compatibility between Cisco routers and VINES network servers, enabling the two devices to share routing information.

Routing Protocol Support: The company's router/bridges come with support for a number of de facto and industry-standard routing protocols. The Interior Gateway Routing Protocol (IGRP) implementation dynamically monitors the network to determine the availability of each route and to choose the best one for each message. It determines the best data path through a network by evaluating a number of factors, including line speed, reliability, and congestion. In May 1990, Cisco introduced Interior Gateway Routing Protocol (IGRP) IS-IS (Intermediate System-Intermediate System), which acts as an interim solution for the corresponding ISO IS-IS routing protocol, the definition of which is yet to be finalized. IGRP lets users construct large internetworks compatible with all defined ISO 8473 protocols. IGRP IS-IS is a standard feature included at no extra cost in all Cisco routers.

As part of Cisco's dynamic routing technique, gateways examine and interpret routing information from Internet Protocol (IP), Connectionless Network Services (ISO CLNs), and other protocols. Cisco's internetwork router/bridges can simultaneously support a number of routing protocols in addition to IGRP, such as RIP, BGP, and Hello.

In January 1991, Cisco added Open Shortest Path First (OSPF) protocol to the list of routing protocols supported by its routers/bridges. Currently under the evaluation of the Internet Activities Board's Internet Engineering Task Force (IETF), the OSPF protocol has gained initial acceptance among network vendors and the academic and research communities. It is expected that OSPF will eventually replace Routing Information Protocol (RIP).

Priority Output Queuing: In September 1990, Cisco added a software feature to its router/bridges that allows users to assign priorities to classes of data sent over a network, thereby maximizing service on low-bandwidth, congested serial interfaces. Known as priority output queuing, the feature serves as a device for prioritizing datagrams, typically classified by protocol or

subprotocol. When the router is ready to transmit a datagram, it scans the priority queues in order, from highest to lowest, to find the highest priority datagram. When that datagram has been transmitted, the queues are rescanned. This feature is particularly helpful to large, multiprotocol internets where some data traffic, such as Novell IPX and Digital LAT, might otherwise "time out" in a network transmission.

SMDS Interface: In March 1991, Cisco introduced the first router interface that supports LAN-to-LAN connectivity over the Switched Multi-megabit Data Service (SMDS). The interface enables Cisco's router/bridges to link remote LANs over a packet switched WAN using the SMDS service at a rate of 1.544 megabits per second (DS1/T1 rate). The interface affords Cisco's customers full advantage of SMDS, an emerging standard data service offered by Regional Bell Holding Companies (RBHCs) and alternative-access and long-haul carriers. The SMDS interface consists of two parts: SMDS software residing in any Cisco router/bridge chassis; and a special SMDS DSU/CSU device, jointly developed by Cisco and ADC/Kentrox, connected to a serial port on the router via an RS-449 interface.

Also in March 1991, Cisco announced a joint development agreement with NEC America to deploy the first SMDS router interface at the DS3 speed of 44.736 megabits per second. The interface, scheduled for release in the fourth quarter of 1991, consists of Cisco software running on the Cisco AGS+ and a NEC-developed SMDS CSU/DSU unit called the SMDS Adaptor or SADP.

The same Cisco router/bridge can support both SMDS and frame-relay interfaces to provide a gateway function between the two services. The device can concurrently perform full-function, multiprotocol internet routing; remote source-route bridging; and SDLC transport for SNA-based networks. Ethernet, token-ring, or FDDI can serve as the transmission media for the attached LANs.

Cisco and IBM: In October 1990, Cisco announced an OEM agreement with IBM in which IBM provides its switchable 16M/4M bps Token-Ring technology to Cisco for use in Cisco's line of router/bridges. Users will be able to mix and match the token-ring interface card with LAN media, such as IEEE 802.3 Ethernet; FDDI; and with WAN media, such as multiple synchronous serial lines (T1, Fractional T1) in a single Cisco router/bridge. The interface will provide Layer 3 routings, as well as local and remote source-route bridging of PC and IBM SNA data through a Cisco-based internetwork.

Extending its support for IBM's products, Cisco incorporated support for IBM's SDLC protocol, which is the protocol used for communications among remote IBM SNA devices, to its router/bridges. This step allows formerly distinct router- and mainframe-based networks to share the same serial data backbone instead of costly individual ones. The SDLC software enables IBM mainframe front-end processors and cluster controllers to communicate through Cisco routers, with their data

sharing the same pipeline as other protocols in large organizations, such as TCP traffic from UNIX.

Through an agreement finalized in January 1991, Cisco also receives IBM routing and network management software from Brixton Systems of Cambridge, MA, for use in Cisco's router/bridges. Under terms of the multiyear agreement, Cisco initially acquires two key pieces of source code from Brixton—an SNA routing implementation based on Brixton's IBM emulation software and an interface to NetView. Cisco intends to integrate Brixton's front-end processor router technology into its existing and future products to allow users to create a single, common-access corporate network for SNA traffic and other protocols, previously supported by separate networks.

Cisco and Digital Equipment: In May 1990, Cisco announced support of its CGS, MGS, and AGS routers for DECnet Phase V, Digital Equipment Corp.'s architecture. The first phase of Cisco's three-phase implementation of support for DECnet Phase V allows users to connect DECnet Phase IV or Phase V nodes over OSI networks. The second phase, completed in November 1990, gave Cisco's router/bridges the capability to communicate between computers supporting DECnet Phase IV and computers supporting DECnet Phase V. In the third phase, Cisco supports the DECnet Phase V/OSI protocol, which enables Cisco routers to communicate with Digital's routers.

In the second phase of the program, the transition gateway feature disseminates routing information with the Phase IV and IGRP IS-IS routing protocols. In addition, packets from either protocol can be translated to the packet format of the other protocol, when necessary. The Phase IV-Phase V transition gateway became a standard feature for Cisco's router/bridges in November 1990. Cisco offers this capability as a software upgrade for previously installed units.

In March 1991, Cisco announced a marketing agreement with Digital that gives Digital the right to sell Cisco's complete product line. The renewable one-year contract initially applies to the United States, but it is expected to be expanded to a worldwide agreement soon.

AGS+

The router/bridge, AGS+, supports 100M bps FDDI-internet links. Supporting up to four FDDI interfaces, AGS+ incorporates an architecture that combines the Multibus backplane with a 533M bps cBus. Autonomous switching among interfaces on the cBus produces a switching rate of more than half a gigabit per second. The nine-slot chassis of the AGS+ houses a high-speed processor card that supports software functions, such as routing-table computation and the SNMP agent; an environmental monitor card; cBus controller; and up to six network interface cards supporting FDDI, Ethernet, token-ring, and serial communication interfaces. The maximum configurations support 28 Ethernets, or 7 token-rings, of 4 FDDI interfaces.

Table 1. AGS+ Features

Protocol Support	TCP/IP, DECnet Phase IV and V, ISO CLNS, AppleTalk Phase I and Phase II, Banyan VINES, 3Com3+/3+Open, Novell IPX, Ungermann-Bass Access One, Xerox XNS, Apollo DOMAIN, PUP, Chaosnet, X.25, DDN X.25, Point-to-Point Protocol, Frame Relay, Concurrent Transparent Bridging, Concurrent Transit Bridging, Concurrent Source Route Bridging
Routing and Bridging Protocols	IGRP, RIP (IP, XNS, Ungermann-Bass), BGP, EGP, OSI ES-IS, IGRP IS-IS, RTMP, and Spanning Tree 802.1d
Network Management/Security	SNMP, Telnet Remote Access, MOP Remote Access, Access Lists (routing), Administrative Filtering (bridging), Debug Commands, Syslog Logging, Priority Queuing
Network Interfaces	IEEE 802.3 Ethernet, Token-Ring, FDDI (DAS), Ultra-Network Technology, Synchronous Serial (up to 4M bps)
Serial Interfaces	RS-232, RS-449, V.35, HSSI, X.21
Processor	68020 @ 30MHz, interfaces—various bit slice processors
Memory	4MB RAM, 1MB ROM, and 48KB nonvolatile configuration

The cBus controller and all interface cards make use of high-speed, bit-slice processors that execute over 16 million instructions per second. AGS+ has a current routing performance figure of 50,000 packets per second.

For software and hardware details of AGS+, see Table 1.

The **Multiport Ethernet Connector (MEC)**, introduced in May 1990, is a six-port card that enables a Cisco router to support up to 28 Ethernet LAN connections. When used in conjunction with Cisco's FDDI interface card, the MEC allows the AGS+ to support connections between an FDDI ring and more than 20 Ethernets. Based upon a bit-slice processor executing 16 million instructions per second (MIPS), the MEC provides a high-speed path from Ethernet-to-Ethernet or from Ethernet-to-FDDI over the cBus of the AGS+. Data transmits at a maximum rate of 50,000 packets per second.

Users can plug up to four MEC cards into cBus slots, resulting in 24 Ethernet connections. With four additional ports from two Cisco Multiport Communications Interface cards that operate in the AGS+'s backplane, users can achieve 28 Ethernet connections.

MGS and CGS

The four-slot MGS and two-slot CGS router/bridges offer identical software performance and vary only in the number of types of media attachment. They can reach data routing rates of 20,000 pps and support 16 protocols (software selectable). The MGS supports eight WAN/LAN media attachments, and the CGS four. Both routers feature 30MHz Motorola CPUs on central processing cards. The routers' asymmetrical processing architecture includes 16 MIPS, RISC-based processors as the primary routing engines on the interface controllers. They also include 160 M bps system buses.

The four slots on the MGS enable it to be configured with a range of Cisco network interface and serial interface cards. This flexibility, as well as the router's capability of supporting many interfaces, allows it to function as a hub in a medium-sized, regional office. Acting as a regional hub, the MGS can interconnect multiple networks with other Cisco routers to create an organization-wide internetwork.

For additional details on MGS and CGS, see Table 2.

IGS

The Integrated Gateway Server (IGS) is a single-board, two-port internetwork router that features the full software functionality of Cisco's high-end routers, including routing support for 16 protocols. IGS comes in two versions: local, with two Ethernet ports that connect two adjacent Ethernet LANs or segments an Ethernet backbone; and remote, with one Ethernet port and one high-speed (up to 7M bps) serial port that serves as a link between remote satellite offices and corporate headquarters or between two LANs across a city or country.

IGS filters packets at a speed of 19,000 per second and forwards them at 6,000 per second. The IGS board is housed in a compact chassis. It includes a 16MHz Motorola MC68020 processor as the main system controller, 1M byte of system memory, eight 32-pin sockets for the ROMs for IGS software, and 16K bytes of nonvolatile memory for onboard storage of network configuration information. The remote IGS has a generic 50-pin connector that interchangeably accepts modem interface cables supporting RS-232, RS-449, or V.35 interfaces.

Protocol Translation Software: According to Cisco, this software option for the IGS router/bridge makes the IGS the first product to concurrently perform internetwork routing, bridging, and protocol translation. The software supports intercommunication between networked devices running the TCP/IP, X.25, and Digital Equipment Corp.'s LAT protocols. When the routing, bridging, and protocol translation functions of the IGS with the protocol translation software are activated, the IGS can link multiple LANs over an X.25, frame relay, T1, or serial line.

While TCP/IP or any of the other 16 protocols supported by IGS are directly routed over the WAN, unroutable LAT traffic will first be locally translated to TCP/IP or X.25. Since the LAT sessions are maintained

Table 2. CGS/IGS/MGS Routers

Protocol Support	TCP/IP, SDLC Transport, Novell IPX, AppleTalk (Phase I and 2), Banyan VINES, DECnet Phase IV and Phase V, 3Com 3+/3+Open, ISO CLNS (OSI), Xerox XNS, Ungermann-Bass Net/One, Apollo DOMAIN, Xerox PUP, Chaosnet, HP Advancenet
Wide Area Network Protocols	X.25, DDN X.25, Frame Relay, SMDS Interface Protocol, HDLC, HDH (HDLC Distant Host), PPP (Point-to-Point Protocol)
Routing Protocols	Interior Gateway Routing Protocol (IGRP), Routing Information Protocol (RIP), Border Gateway Protocol (BGP), Exterior Gateway Protocol (EGP), Open System Interconnect End System-Intermediate System (OSI ES-IS), IGRP Intermediate System to Intermediate System (IGRP IS-IS), Routing Table Management Protocol (RTMP)
Network Management/Security	SNMP, Telnet remote access, Maintenance Operation Protocol (MOP), Priority Output Queuing, Username/password for remote access security control, Access Lists (routing), Administrative Filtering (bridging), Debug Commands, Syslog Logging

by the IGS and the local LAT device, they are not affected by timing delays occurring across the WAN. When the wide area connection is activated, the IGS can still translate between local LAT and TCP traffic. With all three functions activated, the IGS supports 32 concurrent translation sessions. With this software, the IGS can serve as a dedicated protocol translator supporting 100 concurrent translation sessions.

For additional details on IGS, see Table 2.

Servers

Cisco's terminal servers are high-performance LAN communications processors that connect multivendor terminals, computers, and printers. They allow users to share mainframe resources and devices with an RS-232-C interface that use a TCP/IP or Digital Equipment's LAT protocol. At speeds up to 38.4K bps asynchronously, the servers can scale from 10 to 96 lines and support parallel I/O ports, which facilitates the addition of high-speed devices such as printers. The servers support Ethernet, token-ring, and synchronous serial lines. The ASM and MSM terminal servers can also serve as Terminal Access Controllers (TACs) on public packet switched networks or the Defense Data Network, with synchronous serial support up to 4M bps.

MSM Terminal Servers

The M-Chassis Terminal Server Systems include *MSM/2-E*, *MSM/2-S*, and *MSM/2-T*, and *MSM/2-R*. All the servers have a four-slot, midrange, rack-mountable chassis assembly; a Cisco 608020-based, 12MHz processor; one 16-line asynchronous attachment card; and terminal system operating firmware. These devices can support 16 to 32 lines.

ASM Terminal Server

The ASM Terminal Server System includes a nine-slot, rack-mountable chassis assembly; a Cisco 68020-based 12MHz processor; and terminal system operating firmware. CSC-M nonvolatile configuration memory is recommended. These devices can support 16 to 96 lines.

STS-10x Server

The STS-10x, a replacement for the STS-10, provides connections for up to 10 asynchronous devices to an Ethernet (IEEE 802.3) LAN, running TCP/IP or LAT protocol. The STS-10x offers simultaneous Ethernet network access and support for terminals and other devices, including remote printers and over 10 RS-232-C asynchronous serial channels, each running at speeds up to 38.4K bps. Each RS-232-C interface is factory configured to operate as a data communications equipment (DCE) device and can be user configured to operate as a data terminal equipment (DTE) device with a variety of dial-in or dial-out modems.

Fully compatible with Cisco's line of internetworking gateways and larger terminal servers, the STS-10x provides user-configurable port, system, and network parameters, including selectable port/modem control parameters and full network access control. Distributed network management facilities include performance monitoring, run time error logging, and selectable symbolic names. STS-10x software supports caching of remote host names and handles an unlimited number of sessions for each local terminal. The multiple-session feature enables the terminal to open and switch among multiple remote connections. STS-10x users can use rlogin, Telnet, or Serial Line Internet Protocol (SLIP) for communication with UNIX- or ULTRIX-based hosts.

As do other Cisco terminal servers, the STS-10x features the remote booting capability, which allows users to load system software from a remote host over the network. Remote booting occurs over the Trivial File Transfer Protocol (TFTP), which is a standard part of TCP/IP and many of its UNIX implementations. Users with existing STS-10 units can upgrade to STS-10x under Cisco's standard software maintenance contract. The upgrade takes place through the installation of a new PROM in the STS-10 and remote booting of the upgraded software from an STS-10x unit or a TFTP host.

TRouter

This device combines multiprotocol internetwork routing and TCP/IP terminal service. The company designed this multifunction device for use by small workgroups

that require both terminal server and packet-switching functions. TRouter provides routing support for the TCP/IP, DECnet, XNS, and X.25 environments. It also provides terminal server support for up to 16 asynchronous devices.

When functioning as a terminal server, TRouter can link up to 16 multivendor terminals, printers, and other asynchronous devices into a network. TRouter supports the full TCP/IP Telnet protocol, thereby allowing connections to any type of computer on the network. The rlogin protocol facilitates connection to UNIX hosts and the SLIP protocol to PCs.

For high-speed, multiprotocol internetwork routing, TRouter uses Cisco's Multiprot Communications Interface (MCI) board, which routes packets at speeds reaching 12,000 packets per second. Users can also perform TCP/IP routing with Cisco's Interior Gateway Routing Protocol (IGRP), developed for complex, parallel network topologies, or with EGP, RIP, or Hello, or with a combination of them. The MCI board can support configurations for connections to two Ethernet (IEEE 802.3) networks, two synchronous serial lines, or one of each. The serial ports support HDLC, LAPB, X.25, and DDN X.25 communications at speeds up to 4M bps.

As a terminal server, the unit can multiplex data from its RS-232-C serial lines out of either of the two high-speed network interfaces on the MCI board. Each terminal line supports data rates of up to 38.4K bps. Users can configure lines individually for rotary and modem functions, or for SLIP services to PCs or Apple Macintoshes.

A TRouter located on a network segment can provide service to a remote Ethernet via a 56K bps serial line; asynchronous dial-in and dial-out modems can be attached to the unit's 16 asynchronous serial lines for access to local and remote networks. As an alternate arrangement, users can place TRouter units at each of their company's multiple remote offices that are connected by an X.25 private data network. TRouters interconnected over X.25 and the LAN can route TCP/IP and DECnet traffic, and PCs can use SLIP to access other PCs or computers on the LAN or across X.25 WAN links.

A network administrator can manage TRouter operations locally or remotely, accessing them from anywhere on the network to perform configuration and monitoring functions. The Simple Network Management Protocol (SNMP) serves as a standardized method to request network monitoring and management information for both the server and the routing functions.

Interface Cards

Token-Ring Interface

The Cisco Token-Ring Interface features Texas Instruments' TMS380 token-ring chip set and Intel's 80186 controller. It provides a network connection to IEEE 802.5 token-ring networks running at 4M bps. With Cisco's Gateway Servers, users can interconnect token-ring LANs with Ethernets or synchronous serial

lines attaining T1 rates, including X.25 protocols. In addition, the IBM cabling system can be used to connect Ethernets via Cisco gateways equipped with the Token-Ring Interface.

Users can also install the Cisco Token-Ring Interface in a Cisco terminal server to connect up to 96 different asynchronous devices to a token-ring network. Users on the ring can access network resources and share peripherals. The Token-Ring Interface is fully compatible with Cisco's entire product line and is supported in the AGS and MGS Gateway Servers and ASM and MSM Terminal Servers. It must be used in conjunction with Cisco's enhanced memory board, which includes volatile and nonvolatile memory.

The product is compatible with IEEE 802.5 protocol specifications, the IBM Token-Ring Network Adapter, and the standard IBM Cabling System. The Token-Ring Interface supports TCP/IP, XNS, and DECnet running concurrently.

CSC-R16 Interface Card

The CSC-R16 represents the first in a series of high-performance interface cards that connect router/bridges to IEEE 802.5 token-ring networks. Configurable for 4M or 16M bps token-rings, the CSC-R16 works in Cisco's MGS (four-slot) and AGS+ (nine-slot with FDDI) products. The unit is based on an MC68020 processor running at 25MHz. A Texas Instruments second-generation token-ring chip set executes MAC/LLC firmware to provide data link-level functionality. Routers equipped with the CSC-R16 interface support multiple, concurrently operating protocols, including IPX, TCP/IP, XNS, OSI, VINES, and AppleTalk. They also concurrently support local and remote source-route bridging.

The CSC-R16 uses Madge Networks' FAST MAC microcode, which gives the interface a performance of 10,000 pps. The Cisco/Madge joint technology partnership was announced in December 1990.

Multiprot Communications Interface Board

This unit provides one or two Ethernet ports and one or two synchronous serial ports on a single card. The Ethernet ports support Ethernet Versions 1 and 2, as well as IEEE 802.3 packet types. The serial ports support HDLC, LAPB, X.25, DDN X.25, and DDN 1822-J (HDH) transmission. For each serial channel, users can select a V.35, RS-232-C, or RS-422 electrical interface. With the Multiprot Communications Interface, users can configure gateways with up to 10 serial ports or up to eight T1-speed circuits in the Cisco CSC-A (nine-slot) chassis. Other configurations are limited by chassis size.

Software

NetCentral Station Network Management Software

NetCentral Station provides centralized management, planning, and control for multivendor internetworks that

support Simple Network Management Protocol (SNMP). The software handles the requirements of large or complex internetworks and provides a dynamic, visual network map for realtime status monitoring and a fully integrated relational database management system.

NetCentral Station can query all the devices on the internetwork that support SNMP. A collection of SNMP standard object definitions or the Management Information Base (MIB) supports communication between the agent (software on the network device) and the network management system. Through NetCentral Station's user-definable windows feature, network managers can view private MIB extensions.

Network managers can establish multiple NetCentral Station systems to simultaneously monitor a common group of network devices or manage separate administrative domains, or a combination of these entities. In the network management mode, administrators can retrieve status and administrative information about network devices and display it for multiple devices concurrently.

The product provides these status windows:

- Device—displays software details and cumulative uptime since last reload
- Interface—lists interfaces, status, and packets statistics for a device
- ICMP statistics—displays the contents of the Internet Control Message Protocol table for a device
- ARP table—displays the ARP cache of a device for mapping network and hardware addresses
- Routing table—shows the path of the data flow
- Performance meter—provides a line graph of continually updated performance information

- User-definable windows—allows network managers to design custom windows

The graphics editor, residing in NetCentral Station's map, allows users to create and position their own graphic images of routers, bridges, hosts, and links. A toolbox positioned at the left edge of the drawing area enables users to duplicate, resize, and move objects, as well as add text blocks. A three-button mouse and pull-down menu facilitate use.

The integrated relational database enables administrators to control the types of data and the structure of data elements monitored by the system. Users can create tables that specify the equipment, polling intervals, and MIB variables. Vendor-specific MIB variables are also supported. The DBMS graph supports a graphic display of network statistics, such as a line graph of a MIB variable. The Report Writing feature creates customized reports that follow standard Structured Query Language (SQL) commands. A utility program enables users to create a customized report format for almost any collection of data elements included in the database.

The software runs on the Sun Microsystems workstations, specifically the Sun-3/xx series and the SPARCstation 1 or 1+. The Sun workstation must be running SunOS 4.0.3 or SunOS 4.1 with a minimum configuration of 12M bytes of RAM, 208M bytes of disk space (including the SunOS and the X Windows program), 20M bytes of swap space, ¼-inch tape drive (local or remote), X Window System Version X11R3 or X11R4, and color monitor. The actual amount of disk space used depends on the network's size and the quantity of data being examined and stored.

Equipment Prices

Cisco Products	Purchase Price (\$)
AGS+ Router	12,300 up
Integrated Gateway Server (IGS)	5,695
Integrated Gateway Server (IGS) with protocol translation	6,595
IGS/L (local version)	4,995
IGS/R (remote version)	5,495
Remote source-route bridging for routers	925-1,800
CPT LAT/TCP protocol translator with one Ethernet interface	7,925
CPT LAT/TCP/X.25 for serial communication up to 64K bps	9,400
CPT LAT/TCP/X.25 for serial communication up to 4M bps	10,125
Frame-relay software option, including X.25 packet switching on IGS single-board router	750
Frame-relay software option, including X.25 packet switching on two-slot CGS router	1,200
Frame-relay software option, including X.25 packet switching for four-slot MGS router	2,100
Frame-relay software option, including X.25 packet switching for nine-slot AGS and AGS+ routers	3,200
Class A FDDI Interface Card supporting one Dual Attach Station (DAS) inter-face	14,000
Multipoint Ethernet Connector (MEC) card with 2 Ethernet ports	6,000
Multipoint Ethernet Connector (MEC) card with 4 Ethernet ports	9,500
Multipoint Ethernet Connector (MEC) card with 6 Ethernet ports	12,000
SMDS DSU/CSU	6,500

	Purchase Price (\$)
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Cisco Products (Continued)	
SMDS software for the IGS	900
SMDS software for MGS	2,100
SMDS software for AGS or AGS+	3,200
STS-10x terminal server	2,995
STS-10x terminal server	2,995
LAT option for STS-10x	250
NetCentral Station for the SPARCstation	14,000



CLEO Communications PC-to-Host Products

In this report:

Analysis	-102
Characteristics.....	-104
Pricing.....	-105

Product Summary

Editor's Note

Since our last report, CLEO Communications has strengthened its UNIX-based product line with a full-featured 3270 terminal emulation offering for both coax and remote bisync and SNA connections. This report examines the functionality and pricing of CLEO's UNIX- and DOS-based products and the company's product strategy and competitive position in the computer industry.

Description

CLEO Communications offers hardware/software combinations that allow users of DOS- and UNIX-based microcomputers—in either standalone or network environments—to perform terminal emulation and file transfers to access IBM host systems.

Strengths

CLEO products provide low-memory benefits. DataTalker 3270 requires only 128K bytes of available RAM when using a co-processor board and offers full functionality on as few as 40K bytes of RAM.

—By Donna Horsley
Staff Writer

Limitations

Networking connectivity has become an integral part of vendor strategy as the usage of LANs continues to increase in corporate environments. CLEO, however, has no immediate plans to feature networking bridge and gateway products.

Competition

Rabbit Software, Systems Strategies, Inc. (SSI), Digital Communications Associates (DCA), and Attachmate Corp.

Vendor

CLEO Communications
3796 Plaza Drive
Ann Arbor, MI 48108
(313) 662-2002, (800) 233-2536

In Canada

Markham Computers
633 Dennison Street
Markham, ON L3R 1B8
(416) 475-5100

Price

3780Plus—\$995; high-end 3270
LINKix—\$2,995.

GSA Schedule

Yes.

Analysis

Product Strategy

Recognized for its popular IBM 3270/3780 terminal emulation offerings for DOS- and UNIX-based systems, CLEO Communications is securing a strong niche in UNIX connectivity. In January, the company released 3270LINKix—its finest product offering in five years. With it, a UNIX system operates as an IBM 3278/79 terminal for both coaxial and remote bisync and SNA connections.

With the new offering, CLEO has assembled a comprehensive UNIX line of connectivity products that includes a 3780/2780 bisynchronous solution for applications requiring fast, efficient data transfer. The company is currently developing LU6.2 and QLLC-X.25 protocol support (required for the international market).

CLEO's 3780Plus for both UNIX and DOS environments is the company's leading product, with over 50,000 packages installed worldwide. Donald Redding, CLEO president, said, "The 3780Plus has always been a very high-profile, recognized product, and we will continue to market it aggressively; with the introduction of the 3270ix products, we have moved to the forefront in 3270 UNIX connectivity."

Much of 3270LINKix' appeal, according to Redding, is its cost efficiency. 3270LINKix is easily integrated in corporate UNIX environments, as it runs on either its own coax board or any IBM advanced coax adapter or compatible boards.

CLEO has sold more than 80,000 packages from its product line, with sales surpassing \$7 million in 1990.

DOS and UNIX Connectivity

CLEO Communications offer various routes to the IBM mainframe—remote UNIX-to-mainframe connectivity, coaxial UNIX-to-mainframe connectivity, SNA/SDLC and bisync connections for DOS-based systems, and SNA/SDLC and bisync for UNIX.

With **3270LINKix**, UNIX systems operate as IBM 3278 monochrome display terminals or 3279

color display terminals. The package provides full IBM 3287 printer emulation for UNIX-attached ASCII printers, with remote versions providing IBM 3274 controller emulation.

3270LINKix Coax provides complete local access UNIX-to-mainframe connectivity via coaxial connection to IBM 3270 controllers.

3270LINKix Remote delivers up to 254 simultaneous UNIX-to-mainframe connections through a synchronous interface board. **3270LINKix RemotePlus** off-loads 3270 communications to a co-processor, freeing the UNIX system for high-performance applications. All 3270LINKix versions support IBM's HLLAPI 3.0 and IND-\$FILE file transfer for CMS, TSO, and CICS. Remote versions also provide IBM NetView support in SNA. 3270LINKix STREAMS implementation is supported on SCO UNIX System V/386 3.2, AT&T UNIX System V/386, and Interactive Systems 386/ix.

CLEO expects 3270LINKix, which was released in January, to replace **DataTalker 3270 u/x** as the company's main UNIX offering. Available for both DOS- and UNIX-based systems, **DataTalker 3270** provides remote PC-to-mainframe connectivity and eliminates controller and coax boards to save money. DataTalker 3270 provides full emulation of IBM 3278 display terminals and 3274 controllers for remote IBM PCs, PS/2s, or other DOS- and UNIX-based systems through any bisync or SNA/SDLC network. It also provides IBM 3287 printer emulation for PC-attached ASCII printers. DataTalker 3270 features API (HLLAPI 3.0, plus CLEO's own API), IND-\$FILE file transfer, IBM NetView support, and up to 32 simultaneous mainframe sessions.

First installed in 1983, CLEO's **3780Plus** is the preferred 3780/2780 bisync solution for DOS or UNIX systems for applications requiring fast, efficient data transfer. With more than 50,000 packages installed, applications include EDI, point-of-sale, RJE, medical claims filing, check clearing and deposits, and electronic funds transfer. 3780Plus offers full IBM 3780/2780 RJE emulation for IBM PCs, PS/2s, and compatibles. It also works with RS/6000, Digital VAX, HP 9000, NCR Tower, Prime, Pyramid, Sequent, Altos, and Apple Macintosh systems. Features include forms control, auto dial/auto answer, and a communications line monitor. CLEO's Scripting Command Language and API allow unattended operation.

Competitive Position

In the crowded market for PC-to-host products, CLEO's DOS- and UNIX-based offerings maintain strong popularity, helping CLEO generate more than \$7 million in annual profits. As many competing vendors expand their product lines with network connectivity offerings, CLEO opts instead to strengthen its niche in UNIX connectivity and enhance the usability and cost efficiency of its existing products.

The 10-year-old company provides 3270 and 3780 connectivity solutions for DOS- and UNIX-based systems. In one-on-one product comparisons, CLEO's products successfully compete with Rabbit Software's DOS-based RabbitStation and UNIX-based Open Advantage, as well as Systems Strategies' Express UNIX-based software.

In January, CLEO strengthened its UNIX base with the release of 3270LINKix. With it, a UNIX system operates as an IBM 3278/79 terminal for both coaxial and remote bisync and SNA connections. It is the first 3270 coax product for UNIX.

Like its competitors' products, CLEO provides users with high-performance data communications solutions that are easy to install and use and are first-rate in comprehensiveness, pricing, and printer support. CLEO packages are particularly cost-effective. 3270LINKix Coax provides an economical UNIX-to-mainframe connectivity solution for the user who already has controllers and modems in place; it works with any IBM advanced coax adapter or compatible or CLEO coax board.

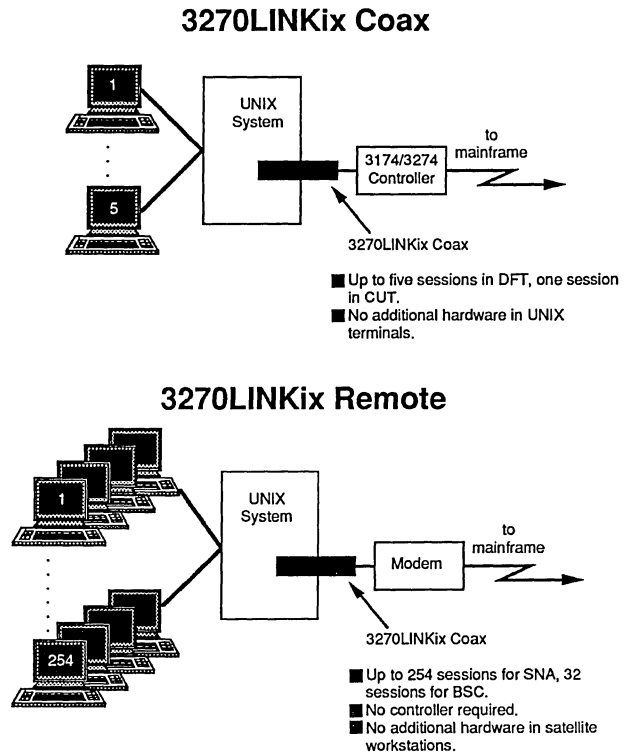
Rabbit Software and Systems Strategies are expanding their product lines with networking connectivity products. As LANs increase in popularity and the terminal emulation market matures, such vendors are responding with routers and links for gateways and token-ring devices. For example, Rabbit's DOS SNA gateway product line provides unmatched experience in SNA technology.

Decision Points

Low-Memory Feature

CLEO products are equipped with co-processor boards that process the communications protocol. Significantly reducing the demands placed on the PC's CPU and memory, the co-processor boards free the product for other applications. DataTalker

Figure 1.
UNIX-to-Mainframe Connectivity



Introduced in January, 3270LINKix packages allow a UNIX system to operate as an IBM 3278 terminal for bisync and SNA connections. 3270LINKix Coax provides complete local access UNIX-to-mainframe connectivity via coaxial connection to IBM 3270 controllers. 3270LINKix Remote delivers up to 254 simultaneous UNIX-to-mainframe connections through a synchronous interface board.

3270 requires only 128K bytes of available RAM when using a co-processor board and offers full functionality on as few as 40K bytes of RAM. Like the DataTalker products, the 3780Plus product line makes use of co-processor boards to conserve memory, features a hot key to the operating system, and supports both DOS and UNIX.

Cost-Effectiveness

CLEO provides remote PC-to-mainframe connectivity independent of controller and coax boards, thus providing significant savings for users with boards already established.

Company Profile

Established in 1981, CLEO Communications is a subsidiary of Interface Systems, Inc., a manufacturer of remote micro-to-mainframe communica-

tions products. Like its parent company, CLEO remains consistently profitable, earning annual sales exceeding \$7 million. More than 80,000 packages of its high-speed, PC-to-mainframe data communications products are installed in users' systems worldwide.

At the forefront of CLEO products is 3780Plus. First installed in 1983, 3780Plus remains the preferred 3780/2780 bisynchronous communications solution for applications requiring fast, efficient data transfer, with over 50,000 worldwide installations. CLEO's newest offering, 3270LINKix, is poised to capture the UNIX niche.

Headed by Donald Redding, company president, CLEO targets MIS environments in *Fortune* 1000 companies. Among its customers are major banks, retail chains, transportation companies, and government agencies. The international market represents 10 percent of CLEO's annual profits.

CLEO is headquartered in Ann Arbor, MI, with approximately 55 employees. Interface Systems, founded in 1967, is a NASDAQ-quoted public company, with \$37 million in annual sales; it is also headquartered in Ann Arbor.

Characteristics

Models: DataTalker 3270, DataTalker 3270 U/X, 3270LINKix, 3780Plus, and 3780Plus U/X.

Date Announced: DataTalker 3270—1985; DataTalker 3270 U/X—1988; 3780Plus—1983; and 3780Plus U/X—1986.

Date First Installed: DataTalker 3270—1985; DataTalker 3270 U/X—1988; 3270LINKix—January 1991; 3780Plus—1983; and 3780Plus U/X—1986.

Number Installed: 3780Plus—50,000; DataTalker 3270—5,000; DataTalker 3270 U/X—4,000; and 3780Plus U/X—1,000.

Distribution: CLEO Communications distributes its products through OEMs and authorized retailers/distributors.

Environment

Emulation Modes: 3270LINKix, DataTalker 3270, and DataTalker 3270 U/X products provide IBM 3278/3279 terminal emulation and IBM 3274 cluster controller emulation. 3780Plus and 3780Plus U/X series of products provide IBM 2780/3780 terminal emulation.

Host Environments: 3270LINKix, DataTalker 3270, and 3780Plus support connections to IBM mainframes running in a CICS, TSO, or VM/CMS operating environment.

Protocol: 3270LINKix supports bisync or SNA/SDLC communications. DataTalker 3270 and DataTalker 3270 U/X products support SNA/SDLC and bisync protocols. 3780Plus and 3780Plus U/X support the bisync protocol exclusively.

LAN Support: All CLEO products are NETBIOS LAN compatible.

Transmission Speed: 3780Plus products provide transfer speeds up to 19.2K bps. DataTalker 3270 products support speeds up to 56K bps.

Computers Supported: 3270LINKix, DataTalker 3270, and 3780Plus products support any IBM PC/XT/AT, PS/2, or compatible computer. 3780Plus supports all popular midrange systems, such as Digital VAX and Sequent.

Minimum Configuration: 3780Plus and 3780Plus U/X require at least 256 bytes of available RAM. DataTalker 3270 and DataTalker 3270 U/X require at least 128K and 40K bytes, respectively.

Operating Systems: 3280Plus and DataTalker 3270 are designed for an MS-DOS environment. 3780Plus U/X, 3270LINKix, and DataTalker 3270 U/X are compatible with the SCO UNIX, AT&T UNIX, AIX, and 386IX operating systems.

Hardware

Communications Interface: DataTalker 3270 and 3780Plus products use RS-232-C interface to connect a PC or cluster of PCs to a remote mainframe. 3270LINKix also has type A coax connection to 3174/3274 controllers.

Addressable Port/Interrupts: The IRQ interrupt and settings of the I/O addresses are user configurable for all 3780Plus and DataTalker 3270 products.

Adapter Cards: CLEO's products include one of four basic types of add-in boards (available in a variety of styles): a synchronous interface board, which is the most basic of the four; a modem board, which includes a built-in modem; a coax board; and a co-processor

board, which processes all communications protocols, thus freeing up the PC's memory for other applications.

Software

DataTalker 3270: This software provides file transfer capabilities using IBM IND\$FILE and 3278/3279 terminal emulation—as well as a common user interface—for all CLEO products. CLEO products are completely menu driven, thus simplifying installation and operation for novice users. The software also provides an extensive, context-sensitive help facility, which provides messages relevant to current activity. Other key features of the 3270 software include the capability to conduct up to 254 simultaneous mainframe sessions; a hot key to the operating system; and a keyboard remapping feature, which lets the user map any 3270 key into any PC key.

3780Plus: This software provides file transfer and terminal emulation capabilities, providing 2780/3780 emulation. It provides a hot key to the operating system and is completely menu driven, though it does not provide any type of help facility. The program also provides attended or unattended operation; ASCII or binary file transfers; on-line diagnostics of communications problems; and an easy-to-use script language.

Both software offerings include an Applications Program Interface (API) option, supporting both CLEO's API and IBM's HLLAPI 3.0. The APIs allow PC programmers to write customer applications that make use of communications facilities to interface with the mainframe. Additionally, the CLEO API makes use of library routines that can be linked to the user's program. Both the CLEO API and the HLLAPI are fairly small and require little memory: 10K and 18K bytes, respectively.

Support

Phone Support: Technical support is available to users of CLEO Communications products at (313) 662-2002 from 8:30 a.m. to 5:30 p.m. Eastern Standard Time.

Warranty: CLEO's hardware/software products carry a one-year warranty from the date of purchase.

Maintenance: Service for products no longer under warranty is available from CLEO at a minimum charge of \$100.

Product Prices

	Single- Unit List Price (\$)
3270LINKix Remote	1,295-2,995
3270LINKix Coax	1,195-1,695
DataTalker 3270	995-2,895
DataTalker 3270 U/X	2,195-2,895
3780Plus	995-2,195
3780Plus U/X	995-2,195

Communications Research Group Blast Communications Products

In this report:

Analysis	-102
Characteristics.....	-104
Pricing.....	-105

Product Summary

Editor's Note

Since our last report, Communications Research Group has enhanced all of its Blast products, providing additional terminal emulation options and support for more file transfer protocols. The company has also introduced Blast Plus, a new version of Blast for IBM PCs that provides remote control capabilities.

Description

Blast products allow computers from multiple operating environments to exchange files and provide terminal emulation and file transfer support for general asynchronous communications.

Strengths

Blast's greatest strength is its flexibility; the product currently supports computers under more than 30 different operating systems.

Limitations

The current version of Blast, though superior to previous editions with regard to asynchronous communications, still lacks some features found in other high-end packages, such as a learn facility and a review buffer.

Competition

Crosstalk Communications/DCA; Datastorm Technologies; Hayes Microcomputer Products.

Vendor

Communications Research Group
5615 Corporate Boulevard
Baton Rouge, LA 70808
(504) 923-0888 or (800) 242-5278
In Canada:
Frantek
Contact U.S. office.

Price

Prices range from \$195 for Blast for the Macintosh to \$395 and up for Blast for UNIX.

GSA Schedule

Yes.

Analysis

Product Strategy

Communications Research Group (CRG) developed the original Blast (Blocked Asynchronous Transmission), which was first delivered in 1981, for the oil industry and currently claims an installed base of over 50,000. Initially, Blast was targeted toward users in technical and scientific environments. CRG now also markets the product to business, financial, and commercial end users.

Blast software is perhaps best viewed as one asynchronous communications program available in many different versions. CRG offers versions of the software that are compatible with over 30 operating systems and run on a multitude of microcomputer, minicomputer, and mainframe systems. In fact, the company distinguishes its products by the system under which they operate (i.e., Blast for IBM PCs, Blast for IBM Mainframes, Blast for Macintosh). The one exception to this rule is the company's latest release, Blast Plus, a DOS-compatible program that supplies all the features of the regular Blast product, plus remote control facilities similar to those found in Microcom's Carbon Copy Plus or DCA's Remote2.

Blast maintains a consistent user interface across all of its versions, and allows any two computers running the program to exchange error-free data over phone lines, satellites, X.25 networks, and through PBXs. The program also supports the Kermit, xmodem, ymodem, and other protocols and multiple terminal emulations for general communications with non-Blast systems. This capability makes Blast both a general communications package and a PC-to-host file transfer package, occupying a unique position among asynchronous communications packages. Blast Plus also enjoys a unique standing in the communications marketplace, as the first program to offer both general asynchronous communications and remote control capabilities.

To make Blast a more attractive corporate communications alternative, CRG offers several site licensing options. The private network version offers a proprietary version of Blast that communicates only with systems that have the same version installed. CRG recommends this option for installations connecting more than 500 microcomputers. The cost includes a onetime license fee for external systems, and a renewable one-year fee for host software, including upgrades and technical support. Custom versions of Blast are available under this program and can be built into specific applications. Site licensing offers corporate buyers cost-effectiveness and flexibility.

Competitive Position

CRG has filled an important niche in the asynchronous communications program market with Blast. For applications requiring file transfer among multiple, diverse systems, Blast offers a cost-effective and straightforward solution. As a PC-to-host file transfer package, Blast supports connectivity among 30 operating systems running on over 100 different types of computers, from microcomputers to minicomputers to mainframes—a unique situation in the communications software market.

While Blast also offers general asynchronous communications functions, and has greatly improved in the areas of protocol support and terminal emulation, it still lacks some of the functionality of high-end asynchronous communications programs such as Crosstalk Communications/DCA's Crosstalk Mk.4 and Hilgraeve's HyperACCESS/5. As a result, Blast depends on its PC-to-host file transfer capabilities to set it apart from these packages and help it compete in this segment of the market.

It remains to be seen how well the new Blast Plus product will fair, or how much effect it will have on CRG's overall market standing. As a product that offers both general communications and remote control features, Blast Plus is unique. Therefore, should demand for a product with this type of dual-capabilities materialize, CRG will certainly be well positioned to capitalize on it.

Decision Points

Flexibility

One of the major benefits of the latest version of Blast is its flexibility. The program now features more extensive terminal emulation capabilities and support for more file transfer protocols, allowing it to compete much more effectively in the asynchronous communications market. At the same time, the program's support for more than 30 computer operating systems allows it to act as a PC-to-host file transfer package. In addition, in the case of Blast Plus, users will receive full remote control facilities.

Asynchronous Communications: As a general asynchronous communications program, Blast offers the basic functionality expected of such a package. It offers support for the Kermit, xmodem CRC, xmodem Checksum, ymodem, ymodem Batch, and ymodem G transfer protocols. Blast emulates a variety of terminals, including the following: Digital VT52/100/220/320, Data General D200/410/411/461, Hewlett-Packard 2392A, ADM3A, AMPEX D80, and TeleVideo 920. The program also provides generic TTY and ANSI emulation. Communications parameters can be set up and recalled through the directory, which contains the setup files.

Though it represents a definite advance over previous versions of the program, the current Blast program still lacks some of the more advanced features offered in packages such as Crosstalk Mk.4 or HyperACCESS/5. Blast, for example, does not offer a learn facility, a review buffer, or extensive support for various modems. Blast's strength lies in its capabilities as a PC-to-host file transfer package, and its general communications functions should be considered as an enhancement to those capabilities. Users requiring only general asynchronous communications might be better advised to consider one of the previously mentioned products.

PC-to-Host Communications: As a PC-to-host file transfer package, Blast offers highly automated transfers with host systems that have Blast installed; the host could be a microcomputer, a mini-computer, or a mainframe system. The program offers compatibility with a wide variety of systems,

including Digital VAX minis and IBM VM/CMS- and MVS/TSO-based mainframes. Two areas not covered by the current Blast product line are IBM minicomputers and Microsoft's Windows operating systems. Officials at CRG, however, indicate that versions of Blast for both these areas will be introduced in the future.

Once a connection is established in error-free mode, the package allows the user to send and receive text and binary files, send messages to the remote system, execute remote operating system commands, access local file management commands, and execute command files for repetitive tasks. For error-free file transfers, the package allows path and drive specifications if these are supported by the operating system; for batch file transfers, the package allows wild cards. When a connection is established with a single user system such as a PC, error-free functions require either a user or a script file with the appropriate commands on the remote system. Automatic functions on multiuser systems are controlled by the system type specification in the setup file and the corresponding script file; no operator intervention is required.

The Blast Protocol

The heart of the Blast communications product line is its proprietary Blast protocol. It uses a full-duplex, sliding window design that allows data to be transmitted in both directions at once. The protocol divides data into blocks or packets for transmission, and the size of the block can be adjusted for efficient transmission. Block size can vary from 84 to 4,096 bytes. Lower block sizes are more efficient on noisy lines or over networks with longer delays, such as satellite transmissions. Larger block sizes allow faster transmission across good lines. Blast also offers a half-duplex mode. The protocol uses the cyclic redundancy check (CRC) method for detecting data and control blocks that have not been correctly transmitted. When a file transfer is interrupted, Blast can continue the transfer from the point of interruption; the file does not have to be sent again in its entirety.

The Blast protocol has proven to be one of the fastest and most reliable protocols available. With its data compression capabilities, Blast has consistently outpaced protocols like xmodem and Kermit, often achieving effective speeds in excess of the baud rate at which it is connected. Additionally, Blast is highly resistant to line noise, allowing

it to boast 100 percent error-free transfers even over bad connections. The capability to function under noisy conditions also means that Blast can maintain connections in situations that could cause other packages to disconnect; this could prove particularly advantageous to users with frequent need for unattended operations or remote control operations.

Cost-Effectiveness

For users in a multivendor environment, who need to establish communications and perform file transfers between a variety of computer systems, Blast certainly represents one of the more cost-effective solutions available. The DOS version of the program, for example, sells for \$250, while offering the combination of general communications and PC-to-host file transfers not available from other packages. In fact, at its current price the DOS version is competitively priced with high-end asynchronous packages such as Relay Gold and Crosstalk Mk.4. Users not requiring the added PC-to-host transfer capabilities, however, might prefer one of these high-end programs, as they generally offer more advanced communications features.

Prospective users of Blast Plus must be particularly aware of the relationship between price and functionality. This program is best viewed as a full-featured communications product, which also offers excellent remote control facilities. At \$295, Blast Plus is priced significantly higher than packages like Carbon Copy Plus, which offer only remote control capabilities. As a result, users needing strictly remote communications would be better served by a less expensive package; while users requiring both general communications and remote control facilities will find Blast Plus a much more cost-effective solution than purchasing separate programs for performing each of these applications.

Company Profile

Communications Research Group was started in the early 1980s to provide error-free data transfer technology to the oil industry. Since the introduction of the original Blast software in 1981, the company has enjoyed steadily increasing business in the communications marketplace. The company currently boasts more than 50,000 Blast installations.

In February of 1990, CRG became a wholly owned subsidiary of the privately held U.S. Robotics, a leading manufacturer of PC modems. In addition, the merger promises much-improved distribution for the Blast products, with a probable increase in name recognition and market standing. Under the terms of the merger, CRG will continue to operate as a separate company.

Characteristics

Product: Blast Communications Software.

Date Announced: 1981.

Date First Installed: 1981.

Number Installed: More than 50,000.

Distribution: Blast products are available through authorized distributors, OEMs, and VARs.

Environment

Computers Supported: Versions of Blast are available for use with any IBM PC/XT/AT or PS/2 model or compatible system, the Apple Macintosh family of computers, and systems running under UNIX and SCO-Xenix. In addition, Blast is available for mainframes and mini-computers, such as IBM's 30XX mainframes and Digital VAX minicomputers.

Minimum Configuration: Blast products require at least 256K bytes of available RAM.

Operating Systems: There are versions of Blast available for use with more than 30 different operating systems, including PC-/MS-DOS, OS/2, Macintosh Finder, UNIX, and SCO-Xenix. The product is also available for use in the VMS and Ultrix operating environments (for use with Digital VAX computers), as well as VM/CMS and MVS/TSO environments (for IBM mainframes).

Media: The product is supplied on either 5.25-inch or 3.5-inch diskettes.

Communications

Addressable Ports: Blast communications products support COM1 and COM8, and also allow the user to select BIOS1 or BIOS2 to call externally installed device drivers.

Transmission Speed: The products support transmission speeds ranging from 300 to 115K bps.

File Transfer: All Blast products support the transfer of text and binary files. Files can be saved to printer or disk.

Protocols: Blast supports the Kermit, xmodem CRC, xmodem Checksum, ymodem, ymodem G, ymodem Batch, and proprietary Blast protocols.

Terminal Emulation: Blast products can emulate the following terminals: TTY, ANSI, Digital VT52/100/220/320, Data General D200/410/411/461, Sperry SVT1220, TeleVideo TV920, Ampex D80, ADM 3A, Wyse 50, and Hewlett-Packard 2392.

Modem Command Sets: Blast products provide full support for the Hayes AT command set. They also allow the user to type commands directly to the modem in Terminal Mode, so that any modem commands can be manually entered.

Parameters: Blast users can set such communications parameters as phone number, user ID, password, COMM port, modem type, baud rate, parity, protocol, translation files, character and line delays, and logon and connect timeouts. These parameters can be stored for each entry in easily retrievable setup files.

Operation

User Interface: All Blast products use the same user interface, featuring nested menus that change automatically with user selections. The menu system can be bypassed with commands. Blast also contains a context-sensitive help facility.

Host/Remote Operations: Blast products can be set as a host system, allowing any other system running a version of Blast to send and receive files using the highly automated functions of the Blast protocol. In addition, the new Blast Plus, for users in an MS-DOS environment, provides full remote control capabilities. With this program (in addition to transferring files) users can access and completely control any remote system also running Blast Plus, as if they were seated at the remote system's keyboard.

Security: Blast supports two levels of password protection. The user can store a password to be sent to the remote system in the setup file. The setup file also contains a transfer password parameter. Once this password is entered, files cannot be requested from, nor can local console commands be sent to, the remote system without the correct password.

Data Handling: Blast products support the creation of translate files for incoming and outgoing files, which allow selected characters to be changed into other characters or stripped from the file entirely. The user can also control whether line feeds are appended to each carriage return on incoming and outgoing files.

Programmability: The Blast script language offers complete control of program functions. It allows branching, calls to subroutines, calls to other scripts, conditional statements, and variables. The Blast script language can be used to customize Blast functions, screens, error messages, and help messages for specific tasks. The language can also be used to automate such repetitive tasks as updating sales files or getting price changes.

Operational Modes: Blast supports auto answer, auto dial, and unattended file transfers. It also functions as a host system for remote callers.

Calling Facilities: Blast communications products store extensive communications parameters for each directory entry, including phone number, user ID, password, comm port, baud rate, parity settings, data/stop bits, terminal emulation type, and transfer protocol.

Support

Phone Support: Telephone support is available free of charge for 90 days after purchase at (504) 923-0888. Users can call from 7 a.m. to 7 p.m., Central Standard Time, Monday through Friday.

Warranty: All Blast communications products are warranted for 90 days.

Maintenance: Extended warranties and maintenance contracts are available. The vendor should be contacted for specific pricing and coverage.

Software Prices

	Purchase Price (\$)
Blast for the Apple Macintosh	195
Blast for IBM PC/XT/AT, PS/2, and compatibles	250
Blast Plus (remote control)	295
Blast for UNIX and Xenix	395-2,595
Blast for Digital VAX	495-2,595
Blast for IBM Mainframes	3,995-9,995
Blast for Hewlett-Packard Systems	695-1,595
Blast for Data General Systems	295-1,795
Blast for NCR Tower	595-1,395
Blast for Prime computers	495-2,995
Blast for Unisys BTOS and CTOS	495-2,995
Blast for Wang VS Series	1,095-2,195

CrossComm Internetworking Products

In this report:

Analysis	-102
Characteristics.....	-104
Pricing.....	-106

Product Summary

Editor's Note

CrossComm entered the internetworking market with the ILAN internetworking products. Recently, the company enhanced the ILAN router/bridge with four token-ring features and introduced the HSB family of high-speed bridges.

Description

The ILAN-H, an enhanced version of ILAN, enables users to bridge heterogeneous LANs. Users can connect any combination of Ethernet, token-ring, and Starlan local area networks with a single ILAN or through multiple ILANs attached over WAN links, broadband backbones, or fiber optic Ethernets.

The ILAN bridge/router Version 4.0 supports SR, SRT, and transparent spanning tree; 16M bps token-ring; SDLC Pass-Through; and IBM's LAN Network Manager.

The HSB family of high-speed bridges includes the *HSB-EE*, which supports the maximum filtering and transfer rates that can be generated on an Ethernet LAN; the *HSB-RR*,

which serves as a token-ring bridge for 16/4M bps LANs; and the *HSB-ELL* and *HSB-ETT*, which connect remote Ethernet LANs using WAN links.

Strengths

CrossComm's products excel in the area of performance and allow users to mix token-rings, Ethernets, and WANs in the same internetworking device.

Limitations

CrossComm offers a three-month warranty on its bridges, while some of its competitors offer a one-year warranty.

Competition

Cisco, IBM, Netronix, Wellfleet.

Vendor

CrossComm Corp.
140-C Locke Drive
Marlborough, MA 01752
(508) 481-4060
(800) 388-1200

Price

ILAN-H: base price—\$7,900.

GSA Schedule

Yes.

—By Barbara Callahan
Associate Editor

Analysis

Product Strategy

In its marketing approach, CrossComm stresses two features that offer irresistible appeal to users caught in the maze of internetworking: performance and ease of use. Through their powerful performance, the products consistently attain high marks for stretching the limits of Ethernet and token-ring, yet their protocol independence simplifies installation and maintenance. By reducing the intricacies of internetworking, CrossComm reduces the number of technical personnel required to staff an internet. In an era of downsizing, the decision to market products that can function without the intervention of a cast of thousands is a very sound strategy.

To penetrate IBM environments, CrossComm has devised a method in which an ILAN router can economically combine SNA and LAN traffic over the same wide area network. Since the CrossComm router can accept SNA traffic and route it concurrently with a user's multiprotocol LAN traffic, there is no need for another network. In recognition of the popularity of IBM's NetView, CrossComm introduced IMS-NV software, which allows users to manage CrossComm's bridges from a NetView system. CrossComm designed IMS-NV to look like an application on the NetView management console.

CrossComm's most recent advance into IBM territory comes from its ILAN bridge/router Version 4.0, introduced in May 1991. Version 4.0 features support for LAN Network Manager, a key element in many token-ring installations. Previously, IBM users could use LAN Network Manager to manage only IBM Token-Ring LANs, but now they can manage an ILAN router/bridge as if it were an IBM product.

Reflecting a significant trend of the nineties, CrossComm has developed a strong customer support program through ExpertWatch, a service that monitors an internetwork 24 hours a day, 7 days a

week. ExpertWatch bypasses the customer and reports real or potential problems within seconds of their occurrence directly to the CrossComm Support Center. The ExpertInstall component of ExpertWatch relieves the customer of any participation in the installation process, except for plugging in cables and powering up the equipment. CrossComm system engineers perform installation procedures remotely. The cost of the ExpertInstall service is much less than charges for on-site installations.

Decision Points

Potential users of CrossComm bridges can gain a great deal of reassurance from results of tests conducted on local Ethernet bridges by National Software Testing Labs (NSTL), of Plymouth Meeting, PA, a Datapro company. NSTL is an independent organization that rates personal computer hardware and software. In a recent issue of *LAN Reporter*, NSTL released its ratings on CrossComm's HSB-EE, as well as on the Retix 4660, the Netronix EtherMaster 100, the Racal InterLan INX400/L, the Hughes ProBridge 8033, and the Persoft Intersect. All the products evaluated are IEEE 802.3-compatible bridges capable of bridging two Ethernet segments at the MAC layer of the ISO model. In its overall rating, with a 10 being the highest, CrossComm's 8.5 ranked second only to Retix' 9.5.

NSTL's rating scale considers from 7.5 to 10 as Excellent, 5 to 7.5 as Good, 2.5 to 5 as Fair, and 0 to 2.5 as Poor. The HSB-EE scored exceptionally well in the *Performance* category of the tests with a 9.1. In the *Features* category, NSTL rated the bridge a 7.6 and for its *Usability* gave it an 8.1.

Some of the highlights of the product cited under *Product Summary* included "very good performance; latencies increase at 400-byte packet size without traffic; short latencies under heavy traffic conditions; comprehensive documentation; automatic learning of source addresses; up to 40,000 source address table entries; fast proprietary lookup engine; can save 128 addresses in nonvolatile RAM; easy installation; good diagnostics; Internetworking Management Software (IMS); Spanning-tree algorithm; and SNMP support."

In a sidebar entitled "Recommendations," NSTL summarized its opinion of the HSB-EE.

“For installations with large numbers of workstations, the CrossComm (HSB-EE) provides the largest source address database and good performance with heavy traffic. Easy installation, comprehensive documentation, informative front-panel indicators, and good source address table support add to the product’s attractiveness. An extremely large address table and fast lookup engine make the CrossComm a good choice for extended networks with large numbers of nodes. Under any traffic conditions, the CrossComm performs well and minimizes cumulative packet delays for network protocols requiring send/acknowledgments for every transmission. It supports the spanning-tree protocol, SNMP, and NetView and automatically learns network addresses. Manually entered and modified address table entries can be saved to and retrieved from DOS files.”

In the ILAN line, the ILAN-H bridge is one of the few products on the market that allow users to transmit data between Ethernet and token-ring LANs in local or wide area environments. The product is of particular value in electronic mail interactions. This versatile product also performs protocol conversion. In addition to its support of the IBM LAN Network Manager, the ILAN router/bridge Version 4.0 supports Novell’s IPX and SPX protocols—a big plus for the token-ring users who have installed NetWare.

Competitive Position

Although CrossComm competes in a field of aggressive, innovative companies, it is moving steadily forward, as evidenced by profitability in 14 of its last 15 fiscal quarters and a customer list that includes Citicorp, Bankers Trust, Du Pont, Ford, MCI, Occidental Petroleum, Shell Oil, Xerox, and the U.S. Postal Service.

CrossComm is also successfully going after large corporations with strong IBM ties, among which are American Express and Warner Brothers. The company’s introduction of the ILAN router/bridge Version 4.0 will open even more doors of large corporations. In addition to the bridges’ performance factors, users will respond favorably to their compact size, which requires less space than comparable products from IBM.

A competitor, Netronix, has as its most recent claimant to the IBM market the Remote Token-Master 400, which can serve as an alternative to

Company Profile **CrossComm Corp.**

Corporate Headquarters

140-C Locke Drive
Marlborough, MA 01752
(508) 481-4060
(800) 388-1200

Officers

Founder and Chief Executive Officer: Tad Witkowitz

Company Background

Year Founded: 1988

A privately held company, CrossComm holds the enviable position of having achieved profitability in 14 of its last 15 fiscal quarters, and 14 fiscal quarters represents its total amount of time in business. In 1990, the company reported sales of \$9 million and earnings of \$1 million. By the end of 1991, the company projects revenues to reach \$17 million.

At present, the company is 80% owned by management. In 1989, Greylock Investments gave CrossComm \$1.5 million in venture capital.

CrossComm’s milestones include:

- First multiport LAN bridge on the market
- First modular LAN bridge capable of bridging dissimilar networks
- First connectivity product to provide local and remote bridging in a single unit
- First SRT Token-Ring product
- First product to offer inclusive and exclusive security filtering
- First PC AT-compatible T1 communication card
- First PC AT-compatible, fiber optic universal LAN adapter

IBM Token-Ring remote bridges. Netronix has priced the product at \$6,790. Netronix also markets the EtherMaster line of local Ethernet bridges, which are priced somewhat lower than CrossComm’s HSB bridges, but do not achieve the performance levels of CrossComm’s devices.

Another competitor, Retix, has been quite active in 1991, introducing the 4850 Remote Bridge for midrange internetworking applications

and the 4941 Remote Bridge/Router for point-to-point applications. The 4850 costs \$5,950, and the 4941 sells for \$6,250. Retix also markets the Retix 4660, a well-received local Ethernet bridge that offers excellent performance in networks supporting heavy traffic.

Characteristics

Models: ILAN-H; ILAN bridge/router, Version 4.0; HSB-EE; HSB-RR; HSB-ELL/-ETT.

Date of Announcement: ILAN-H—April 1990; ILAN bridge/router, Version 4.0—May 1991; HSB-RR—July 1990; HSB-ELL and HSB-ETT—January 1991.

Number of ILAN units shipped: Approximately 5,000.

Overview

CrossComm markets integrated local area network (ILAN) solutions and the HSB family of high-speed bridges. ILAN includes communications servers that connect a variety of LANs located at various sites, and router/bridges. At present, the most prominent members of the ILAN family are ILAN-H, an enhanced version of ILAN that supports bridging of heterogeneous LANs, and ILAN bridge/router, Version 4.0. Table 1 lists ILAN configurations.

The HSB family of high-speed bridges includes the HSB-ELL and HSB-ETT, which connect remote Ethernet/IEEE 802.3 LANs by means of wide area network (WAN) links; the HSB-RR, which handles token-ring bridging for 16/4M bps LANs; and the HSB-EE, which supports high-speed Ethernet/IEEE 802.3 bridging.

In March 1991, CrossComm added SNA to the protocols supported by the ILAN routing bridges. This new feature allows SNA data to be merged onto existing token-ring or wide area network backbones.

CrossComm also offers ExpertWatch, a service that monitors the operation of users' internetworking systems 24 hours a day, 7 days a week. ExpertWatch functions through hardware and software incorporated into CrossComm's ILAN Internetwork Server.

Table 1. ILAN Configurations

Model	Functions
ILAN RE00-H	Connects a single Ethernet to a single token-ring; supports TCP/IP, Novell, and IEEE 802.2-type protocols.
ILAN ET00-H	Connects an Ethernet LAN to a T1 link and performs the necessary frame conversions for a token-ring LAN(s) to be connected to an ILAN at the other end of the T1 link.
ILAN RTE0-H	Connects an Ethernet LAN to a token-ring, routing Ethernet and token-ring packets to LANs located at remote sites using the T1 WAN link.
ILAN REE0-H	Provides three-way connection between two Ethernets and a single token-ring; bridges the two Ethernets like any Ethernet-to-Ethernet bridge and bridges one to a token-ring LAN.
ILAN RRE0-H	Provides three-way connection between two token-ring LANs and a single Ethernet; provides protocol-transparent and Source Routing Transparent bridging between two token-ring LANs; also bridges each one to an Ethernet LAN.
ILAN RTLE-H	Provides four-way connectivity between two LANs and two WAN links; Ethernet traffic is bridged to token-ring, and data traffic from both LANs is routed on an as-needed basis to remote sites using the WAN links.
IMS-R (Version 3.95 or higher)	ILAN system management software for use in a PC AT connected to a token-ring LAN; includes token-ring controller and modem card.
IMS-E (Version 3.95 or higher)	ILAN system management software for use in a PC AT connected to an Ethernet LAN; includes Ethernet controller and modem card.

Hardware

ILAN-H

An upgraded version of ILAN, ILAN-H supports the bridging of heterogeneous LANs. Users can connect any combination of Ethernet, token-ring, and Starlan local area networks through a single ILAN unit or through multiple ILAN units connected via wide area network links, a broadband backbone, or a fiber optic Ethernet LAN. This versatility enables LAN users on

Ethernets to send data to users connected on token-rings and to reverse the process, enabling token-ring users to send data to Ethernet users. Since the connection is transparent to users, they can communicate as if they were connected to the same physical LAN. ILAN-H is compatible with IBM's NetView.

ILAN-H nodes connect LANs running TCP/IP and NetWare, as well as protocols that support IEEE 802.2. Devices running NetWare on token-ring can communicate with NetWare devices on Ethernet. At the same time, TCP/IP devices connected to both LANs can communicate with each other.

CrossComm supports ILAN-H with its ExpertWatch and ExpertInstall services.

ILAN Version 4.0

The basic ILAN router/bridge supports 10M bps thin, thick, and fiber optic Ethernet; token-ring; AT&T's 1M and 10M bps Starlan; T1; E1; fractional T1; and leased-line services. The device, which functions as either a bridge or a router, can simultaneously bridge and route traffic. In May 1991, CrossComm's enhancement of the product with four token-ring features resulted in Version 4.0. The features are:

- support for SR and SRT source-routing
- support for 16M bps token-ring
- support for IBM's LAN Network Manager
- addition of a physical layer network connectivity testing function

The testing function, Experttest, is part of CrossComm's ExpertWatch service. By using Experttest, network administrators can run extensive diagnostics from their consoles. Experttest acts as a segment-by-segment LAN tester that tracks down and troubleshoots problems on LANs down to the PC and workstation levels.

HSB Bridges

HSB-EE

A self-learning LAN bridge, the HSB-EE operates at the MAC layer of the ISO model, which enables the device to be user and protocol transparent. The HSB-EE simultaneously supports TCP/IP, DECnet, OSI, Novell, 3Com, and a variety of other network protocols. Its support of 40,000 node addresses makes it appropriate for large network applications. HSB-EE is fully compatible and interoperable with CrossComm's ILAN Internetwork Server. The product allows users to bridge thick-to-thick, thin-to-thin, or thin-to-thick Ethernets without incurring additional hardware costs.

CrossComm's ILAN Management Software (IMS) allows users to set up security procedures on an Address and Network basis. The error statistics provided by IMS include CRC, length, alignment, excess collisions, receiver overrun, transmitter underrun, carrier loss, and CD heartbeat.

For HSB-EE specifications, see Table 2.

HSB-ELL and HSB-ETT

The HSB-ELL and HSB-ETT are high-speed bridges that connect remote Ethernet/IEEE 802.3 LANs by means of wide area network (WAN) links. The HSB-ELL supports two synchronous, full-duplex WAN connections, operating at up to 128K bps per link. The HSB-ETT supports two high-speed connections, operating at up to 2.048M bps per link. When equipped with an appropriate CrossComm interface cable, each link can support RS-422, X.21, V.35, RS-232-C, and V.24 (up to 19K bps). Each WAN link can be internally or externally clocked. The bridges support load balancing and splitting over the WAN links.

The HSB-ELL/-ETT bridges feature self-learning, automatic routing operations that are transparent to user protocols. The bridges support both thick (10BASE5) and thin (10BASE2) Ethernet LAN connections. Users can change between thick or thin through a switch located on the rear of the panel. The HSB-ELL/-ETT bridges are fully compatible and interoperable with CrossComm's modular ILAN Internetworking Server and HSB-EE local Ethernet bridge. CrossComm supports these bridges with its IMS Network Management software and ExpertWatch service.

For HSB-ELL/-ETT specifications, see Table 2.

HSB-RR

A token-ring bridge for 16/4M bps LANs, the HSB-RR supports 16M bps-to-16M bps, 16M bps-to-4M bps, and 4M bps-to-4M bps operations. The bridge complies with IBM's Source Routing Protocol, but unlike IBM bridges, also supports nonsource routing protocols such as 3Com 3+ and 3+Open, and Novell NetWare. The product's protocol transparency enables users to bridge any combination of LAN protocols simultaneously without having to program or "gen" the bridge. CrossComm's IMS Network Management station allows users to manage the HSB-RR from an IBM host NetView console. The bridge is compatible with CrossComm's ILAN, ExpertWatch, and IMS Network Management software.

For HSB-RR specifications, see Table 2.

Software

IMS

CrossComm refers to its ILAN Management Software (IMS) as an internetwork management system. IMS provides in-band (over the user's network of LANs and WANs) access to the individual ILANs and HSBs in the network, as well as out-of-band access via a built-in telephone modem for checking LAN and WAN functions. IMS Release 4.0 and higher supports SNMP and IBM's LAN Network Manager. IMS also optimizes performance in SNA networks by monitoring SNA traffic through ExpertWatch. IMS-NV software allows CrossComm's bridges to be managed by an administrator at a NetView terminal.

Table 2. HSB Specifications

Model	HSB-RR	HSB-EE	HSB-ELL/-ETT
LAN Interfaces	2 DB-9 token-ring/IEEE 802.5 connections	Dual for each Ethernet, Thick Ethernet, Thin Ethernet (switch-selectable)	1 Ethernet/IEEE 802.3 (switch-selectable)
Performance	4/4, 4/16, 16/16, depending on model	30,000 packets/sec. filtering (both Ethernets); 14,000 packets/sec. forwarding	Filters Ethernet LAN traffic at wire-line speeds of 15,000 pps; forwards up to 1,000 pps (ELL); up to 7,000 pps (ETT)
Protocols	IEEE 802.1D Spanning Tree Protocol (STP), Source Routing (SR), Source Routing Transparent (SRT)	All Ethernet protocols	Self-learning protocol transparent operation; using IEEE 802.1D internetworking standard, learns up to 40,000 node addresses
Diagnostics	Power-up self-diagnostics, LAN cable integrity	Loopback, RAM parity check, system configuration check	Power-up self-diagnostics, LAN cable integrity

For remote access to IMS stations, users can work from a laptop or a PC equipped with a built-in telephone modem and RIMS (Remote ILAN Management Software). IMS stations provide NetView PC connections to NetView hosts when the IBM LAN Network Management Station is not in use.

IMS-E (Ethernet) and IMS-R (token-ring) run on a PC AT connected to an Ethernet or token-ring. IMS communicates with ILANs every few seconds, gathering

statistics and information on operating status. The software supports communications via a supplied modem (in North American units only) with RIMS located at the CrossComm Support Center or with RIMS-PC, software that enables ILAN users to establish remote management stations at locations away from the principal IMS. CrossComm supplies a V.24 serial card for international units.

Support

ExpertWatch

CrossComm devised its ExpertWatch service, which performs internetwork monitoring 24 hours a day/7 days a week, by equipping the ILAN internetwork server with hardware and software additions, which include a built-in telephone modem in North American ILAN units, ILAN Management Software (IMS), and Remote IMS (RIMS) software. International units of ILAN include a V.24 serial card.

Alarms generated by an ILAN system travel to the CrossComm Support Center seconds after their occurrence. Computers running RIMS software receive the alarms and notify CrossComm Support Center engineers of problems. CrossComm's support engineers respond within one hour, offering remedial action.

During normal operation, IMS monitors the status of all ILAN and HSB devices, as well as the networks to which they are connected. If IMS detects a problem, it automatically dials the CrossComm Support Center and records the problem on one of the computers. RIMS software enables support engineers to dial directly into ILANs and HSBs at various sites to diagnose problems.

ExpertInstall is a remote installation service that operates via the built-in modem in the ILAN unit and RIMS located at the CrossComm Support Center. Users plug an ILAN into a telephone jack and connect it to their LANs and WANs. CrossComm system engineers set up operating parameters, verify operation, and diagnose any system problems encountered during installation.

Hardware Prices

	Purchase Price (\$)
CrossComm Products	
ILAN-H	7,900 up
ILAN Bridge/Router Version 4.0 with for two 4M or 16M bps token-ring connections	7,500 up
HSB-EE	4,350
HSB-ELL	5,995
HSB-ETT	7,995
SNA option for routing bridges, per LAN	2,000