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The Evergreen State College

Olympia, WA 98505

Computer Services - Administrative Computing Group

Report to Jim Johnson

MICOM Data Switch Network System and Teltone Data Carrier System

Alexander S. Mar

Date: Monday May 18, 1987

MEMORANDUM

TO: Networking Task Force  
FROM: Alexander S. Mar  
SUBJECT: MICOM Data Switch Network and Teltone Data Carrier System

I. Description of MICOM and Teltone

At TESC, we use a MICOM System to link all computer resources with the users. Our MICOM Data Switch Network System, INSTANET6600, is a high capacity data switching system which forms transparent connections between asynchronous electronic devices. Data communication ports of all computers are connected to the MICOM System which provides data switch connection with the user terminals. Digital information is routed from the MICOM System to a Teltone Data Carrier System which modulates digital data into the telephone network. The Teltone Data Carrier System is a data over voice system that uses existing telephone wiring to connect RS-232-C terminals or computer ports to a data switch system. At a user terminal, a Teltone DCS-2B or DCS-3B modem then demodulates digital information from the analog signal and sends the digital information to the appropriate PC or data terminal. Data communication via Teltone Data Carrier System is limited to either 19,200 baud if a pair of DCS-3B is used or 9600 baud if a pair of DCS-2B is used.

II. Advantage of MICOM and Teltone combination

The MICOM and Teltone combination represents a very flexible and quite low cost option of data communications. Because this combination takes advantage of a necessary and existing telephone network, there is very little installation cost. There is also a natural redundancy in the electronic circuits. For example, if a MICOM channel for a computer port is out of order, MICOM automatically routes the connection request from user to another operational computer port. Likewise if a computer data communications port is out of order, we can shut its MICOM channel off so that the user will no longer access that defective computer port. Unless a higher electronic circuit module is involved, a single MICOM Interface Module which controls four channels at a time can be individually removed and repaired without shutting down the entire MICOM Network. There is also a security advantage. MICOM defines access right for each user terminal. If we grant access right of only one computer resource to a user terminal, no one can use that terminal to access any other computer resource.

### III. Disadvantage of MICOM and Teltone combination

The maximum data communications rate of MICOM and Teltone combination is 19,200 baud. Because nearly all of our Teltone modems and modules operate at a maximum rate of 9600 baud, our normal data communications speed is 9600 baud. This speed is definitely not sufficient to support the sophisticated, powerful microcomputer hardware and software which is rapidly dominating the office automation market. Even switching to the higher 19,200 baud rate is not enough. However, both 9600 and 19,200 baud are sufficient to support a less sophisticated database application of college administrative function.

### IV. Expandability of MICOM and Teltone

Our MICOM Data Switch Network System is an INSTANET6600 with one cabinet and four shelves. Maximum configuration of an INSTANET6600 is four cabinets with a total of 16 shelves. Each shelf can support 128 data communication channels. We have about 35 spare MICOM channels supported by available MICOM Interface Modules. There are another 80 potential MICOM channels if we purchase and install additional MICOM Interface Modules.

The Teltone Data Carrier System has two sets of power supplies which are capable of supporting up to 128 Dual Channel Termination Cards or 256 data communication channels. We are now filling up 4 racks for a total of 128 data communication channels. We are in the process of ordering one additional rack which will give us space for 32 more data channels.

### V. Future of MICOM and Teltone Systems

Discussion with MICOM and Teltone shows that there will be no further technological improvement of existing INSTANET6600. Our only avenue of data communications improvement is a gradual replacement of existing 9600 baud Teltone modems and termination cards by their 19,200 baud equivalent. The MICOM and Teltone combination has been a real work horse at TESC. For the foreseeable future, this combination will continue to adequately serve users who have no need of powerful and sophisticated microcomputer equipment. A 19,200 baud data communications rate is quite adequate to support a centralized information database system.

MICOM System supports Ethernet network. They offer NTS470, a network terminal service, which links between Ethernet network and the MICOM Data Switch Network System. This link does not improve data communications speed of accessing computer resources via INSTANET6600 whose maximum baud rate remains 19,200. NTS470 can provide up to eight multiplexed connection to an INSTANET6600. Cost of an NTS470 ranges from \$3,000 to \$13,000.

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If TESC eventually connects the college with the Ethernet network, NTS470 will allow Ethernet network users to access the Administrative database in a conventional way without duplicate MICOM/Teltone connection.

## NETWORKING COMMITTEE REPORT - PC LOCAL AREA NETWORKS

### AT&T STARLAN - Porsche Everson

Starlan is a medium size local area network that can support up to 200 pc's with a maximum of 32 virtual connections at any given time. There are some doubts about whether or not Starlan can handle that many pc's, however. Starlan is a perfect network for building networks; 4,000 feet is the maximum distance between points on the network when a Network Repeater Unit is installed. Starlan uses a relatively inexpensive twisted pair wiring scheme, operating at 1 megabit/second. New versions forthcoming will operate at 10 megabits/second (requires new Network Access Units).

Building networks can be connected via ISN; however, this is prohibitively expensive at present. The cost of connecting two buildings is roughly \$10,000.

Servers can be either 3B2 minicomputers or microcomputers, depending on the size of the network. For small networks, a 6300+, 6310 or 6312 could be used. Note that the 6300+ and 6310 have been discontinued by AT&T. Larger networks need a minicomputer (3B2) to operate efficiently as a file/printer server.

Currently, there are two Starlan networks on campus. One is in the President's Office and one is in the Computer Applications Lab. The President's Office Starlan consists of four pc's connected to a 6300+ server with two printers. Although the network is reliable, printer services and file transfers often take an excessive amount of time. This is due to the slow performance of the 6300+ being used. The Starlan in the Computer Applications Lab consists of 19 pc's, two printers, and an AT&T 3B2/400 minicomputer operating as the server. This Starlan performs well on file and printer services -- time is not a problem. A concern is that troubleshooting procedures are often haphazard. One bad card can take down the entire network. It then becomes a step-by-step process to locate the problem as each branch of the network is isolated and tested.

Plans for expansion on campus include adding eight workstations in the President's Office, networking select science faculty in Labs I and II, and networking the Computer Science Teaching Laboratory. After expansion, roughly 80 machines will be networked on three separate Starlans.

### Costs

Each pc in a Starlan network needs a Network Access Unit card and Starlan Client/Server software, at a cost of \$337. Wiring is inexpensive; the greatest cost being installation. A Network Extension Unit (required for more than 10 pc's) costs

\$406. Up to five NEU's can be installed on a network. A Network Repeater Unit costs approximately \$581. Attention needs to be paid to the cost of a server as well.

#### Pros

Using 3B2 server and ESCI devices can have large storage resources -- 1.44MB - 1GB+.

Supports terminal emulation and pc's.

Supports parallel and serial printers and peripherals.

Electronic mail -- full service DOS/UNIX mail package available.

#### Cons

Starlan is not the direction the industry is headed.

AT&T is very proprietary about their network protocol.

Method of connecting Starlans between buildings--ISN--is prohibitively expensive.

AT&T provides very little support for their Starlan installed base.

#### Connectivity

At present, AT&T Starlan is not a significant networking standard. AT&T is very proprietary about its transfer protocol, making it difficult at best to interconnect different LAN's. Given the almost daily changes in networking, however, this will probably change by the time we are ready to network the campus.



NOVELL/3COM - Mike Simmons

NOVELL

### File Servers

? Novell network servers do not run MSDOS. There are two main versions of the Novell Netware operating system; Advanced Netware, and System Fault Tolerant (SFT) Netware. These two types of the Netware operating system are tailored to the type of server on which they are running.

The Advanced Netware offerings are: Advanced Netware/86, Advanced Netware/286, and Advanced Netware/68. Advanced Netware/86 runs on IBM PC compatible machines. Advanced Netware/286 runs on IBM AT compatible machines and also on models 286A, 286B, T286A, and 286B Novell file servers. Advanced Netware/68 runs only on the Novell 68B file server. There is a SFT Netware product equivalent to each of the Advanced Netware products with two exceptions: there is no version of SFT for CPUs of the 8088/8086 based PC's (IBM PC, AT&T 6300), and there is a version for 80386 based machines (Compaq Deskpro 386, AT&T 6386). All of the Novell network operating systems are optimized for file serving functions. Novell LANs are very fast according to all sources.

### Client Workstations

? Novell clients are all MSDOS machines. All versions of MS/PC DOS 2.0 and later are supported. A small program called The DOS Interface Shell is installed on each client. This allows access to the file server.

### Costs

SFT v2.1 5,075.00

This is the System Fault Tolerant version of Novell Netware. It supports 80386 based machines such as Compaq Deskpro 386.

Netware server 286B file server 10,156.00  
With tape backup 10,928.00

This is one of Novell's dedicated file servers. The server software is bundled along with support for 100 client workstations.

Netware 286 server software 2,373.00 to 2,908.00

This is the same software that runs on the 286B file server. It can be used to set up an AT compatible (AT&T 6310/12, Compaq Deskpro 286) as a file server.

### Client software

Client workstation software is included with server software.

NOTE: These prices are due to change very shortly due to introduction of product upgrades to support OS/2.

### Connectivity

Shared Modems:	Yes, via synchronous Communication Server. A dedicated PC is required to support this service.
3270 Gateway:	Yes
Decnet Gateway:	No
Appletalk Gateway:	No
Networks Bridged:	AT&T Starlan, Token Ring, Ethernet

Note: Since Novell network operating systems will run on so many different types of network hardware, specific applications may vary considerably in this aspect.

### Pros

Novell LANs are high performance systems. The server architecture is optimized for its job. It is commonly acknowledged that Novell LANs have the best response time of all PC LANs.

Novell has certified more than 3000 applications to run on Advanced Netware.

The Advanced Netware operating system runs on 27 other manufacturers LAN hardware.

Novell LAN hardware and software provides a high degree of security.

Novell product support is said to be excellent.

### Cons

Novell network software and hardware is very expensive compared to other LANs.

(Since the Novell file server operating system is not MSDOS based, commonly used MSDOS tools such as The Norton Utilities cannot be used to salvage files on the server hard disk. Even if the server is shut down and rebooted with MSDOS, the hard disk cannot even be recognized by DOS. Also, only Novell hard disk drives, controllers, and tape backup units will work on the server.



Client users are restricted from performing many operations that other networks routinely allow. For instance, client users cannot create subdirectories on any network drive. The administrator must create each user's personal subdirectories and file sharing permissions when the user I.D. is created.

Many administrative operations require the server to be brought down. Adding a workstation, changing a workstation configuration or removing a workstation requires the server to be brought down and reconfigured.

Installation and administration of a Novell LAN requires considerable technical expertise. The first time installation of Novell Netware on a server by an experienced administrator takes an average of nine hours!

### Pierce County Novell Networks

#### Server information

Servers used are IBM AT, Sperry IT, Compaq 386 20mhz clock. All servers are dedicated and none run MSDOS. The performance seems to be satisfactory, with the exception of the Compaq 386 pc's. These have just been acquired and have had some memory compatibility problems.

There are 13 separate networks. All networks have one server. The transmission media that is being used is type 3 shielded twisted pair. The number of clients on each net range from 4 to 25. All software is stored on the server. Software packages used are: Network version WordPerfect, Lotus 1-2-3, and RBase system 5.

There are two different topologies in use. The first and most important is IBM Token Ring. The second is Corvus bus. The Corvus system is antiquated and was only used because parts of it were in place prior to the installation of the Novell system.

There is currently a gateway to a Univac 9080. Planning is underway to install a gateway to an IBM 4381 as soon as the 4381 installation is complete. Pierce County also uses an HP 3000 and some unspecified DEC hardware. There are no connections planned for those two machines.

## 3COM

### File Servers

3Com supports two types of servers. The high end is the 3Com 3server3, a dedicated file server. Many of the options that 3Com offers are only available on this server. With the addition of an EtherLink or TokenLink Plus network access card and 3+ or EtherSeries networking software, an IBM PC, XT, AT, or compatible can function as a dedicated server or a concurrent client/server. All servers run MSDOS 3.1 or later.

The transmission media is thick or thin coax. The data rate is 10 million bits per second. The maximum distance that the net can extend depends on the coax type. Thick coax can go up to 3280 feet; thin coax can go 1000 feet. The distance can be extended with repeaters.

There are two versions of the 3Com network software; EtherSeries and 3+. EtherSeries was the earlier version. 3+ is a superset of EtherSeries. 3+ software will run on four types of network hardware; Ethernet, AT&T Starlan, IBM Token Ring, and Appletalk.

### Client Workstations

Com supports PC compatible and Macintoshes as client workstations when equipped with the appropriate network access cards.

### Pros

3Com servers run MSDOS 3.1. This simplifies management and maintenance.

3Com's strength is in its flexibility. It allows MSDOS pc's and Macintosh computers to share files.

3Com's 3+ network software is said to be one of the simplest to install and maintain.

3Com 3+ network software is particularly easy to use. Most commands are menu driven.

3Com EtherSeries network software and 3+ software can co-exist on a multi-server network.

The 3Com mail package is said to be one of the best in the industry.

### Cons

The coax cabling is expensive to install and requires some expertise in proper layout.

Since 3Com is a bus system, a cable failure can bring down the entire network (this also applies to Token Ring configurations).

#### Costs

These prices are assuming AT&T 6300 client workstations and AT&T 6312 file servers.

3Com's pricing structure is that the first package you buy supports up to five user workstations. To support more workstations you buy a second identical package. This allows you to support unlimited users. This policy applies to 3+ share, 3+ mail, and 3+ menus. All prices here are for the first copy.

3+ share	595.00
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This is the server software.

3+ share user	(One copy per workstation)	81.00
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Client workstation software.

3+ Mail	270.00
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Office mail system.

3+ Menus	162.00
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3Com menu system.

NOTE: These prices are due to change very shortly due to introduction of product upgrades to support OS/2.

#### Connectivity

Shared Modems:	Yes
3270 Gateway:	Yes
Decnet Gateway:	No
Appletalk Gateway:	Yes, only on 3Com 3server3
Networks Bridged:	Token Ring to Ethernet

## BANYAN -- Judy Lindlauf

Unlike the AT&T Starlan, 3Com and Novell networks which traditionally offer network solutions at the departmental level, Banyan offers a network architecture in the form of VINES (virtual networking system) that meets networking requirements on a organizational level.

Banyan's key objective is integrating pc's and LANs with hosts and minicomputers. Banyan sees itself as "super glue," by making multiple LAN types, transport protocols, and processing environments appear to users as a single, seamless system.

Banyan supports multiple LAN technologies while not actually building any itself. Currently the VINES Operating System supports: the IBM Token Ring PC Adapter and Adapter II, IBM PC Network (broadband), Standard Micro-Systems Corporation, NPI LANstar, ARCnet, Nestar ARCnet, Corvus Omninet, Proteo ProNET-10 and ProNET-4, Interlan (Micom) Ethernet, 3Com Etherlink and Etherlink Plus, Ungermann-Bass Net/One Ethernet and Net/One Token Ring, Allen-Bradley VistaLan, AT&T Starlan and the David Systems Information Manager (modified data-over-voice Ethernet). Additional LAN's to be included in the future include Western Digital and AST Research Starlans and TCP/IP Ethernet boards from Excelan and Communication Machinery Corporation. 3COM and Novell servers cannot run VINES software.

Though not directly supported by a Banyan server, an Appletalk bridge is also available through Centram Systems West, maker of the TOPS network, which supports both IBM PC's and Apple Macintoshes.

### Supported Servers

VINES is a proprietary network operating environment that is based on the AT&T Unix System V. VINES supports off-the-shelf pc's in addition to its own proprietary servers. VINES/286 runs on PC AT's and compatibles and offers all the functions of the version running on proprietary servers, including support for multiple LAN's (two) and integrated wide-area communications. VINES/286 supports up to 12 users. VINES/386, released last fall, runs on a Compaq Deskpro 386 or compatible. It offers pc users complete and uniform access to network resources. VINES/386 supports up to 50 users.

Banyan has three proprietary network servers: (1) Desktop Network Server (DTS) which supports up to 8 simultaneous links; (2) Banyan Network Server (BNS) which supports up to 20 simultaneous links; and (3) the Corporate Network Server (CNS) which supports 100 connections, based on 80386 technology.

Any number and type of Banyan servers can be interconnected to form a virtual network system.

## Software

VINES provides a variety of network services through a menu driven user interface. StreetTalk, Banyan's distributed naming system, is at the heart of VINES. It maintains the names and attributes of all objects on the network, including users, file volumes, servers, individual services and communication ports. StreetTalk allows users access to remote servers on the network without explicitly connecting to the server first. It allows users to access resources using plain English nicknames.

File Service - Banyan supports multiuser access to files via the record-locking schemes from Novell, 3Com and DOS 3.1.

Printer Service - supports multiple serial and parallel printers, automatic queuing and spooling and extended print commands for forms and headers.

Electronic Mail - provides a full spectrum of features.

Chat - enables up to four users to communicate in an interactive computer conference.

Network Management - Netman enables centralized management of a VINES network with tools for analyzing server-load averages over selectable time periods, disk memory usage, wide area network and LAN-specific utilization, messages processing and rerouting, communications links status, and configuration information.

Connectivity - Matchmaker software is a combination of protocol and a specification language. Matchmaker uses this standard specification to enable remote procedure calls between assorted processors that employ it. As such it handles data-type representation conversions between a CPU data type, common network data types, and back to a CPU data type. To handle interfacing applications to multiple transports, Matchmaker employs the concept of socket families (Banyan, ISO, XNS, TCP/IP), essentially acting as a logical switchboard, plugging remote procedure calls from applications into the appropriate socket addresses.

## Future Development

In 1988 and 1989, Banyan will port VINES to DEC's VAX using the VMS Operating System and IBM's 9370 running the VM Operating System. It is believed that as a natural result of this portability, VINES will support terminals as well as PC's. Banyan has announced its strategy for integrating OS/2 into VINES, though not until 1989.

### Costs

*VINES/286 (software)	2,048.00
*VINES 386 (software)	5,400.00
#Desktop Network Server -2MB mem, 52MB disk	9,724.00
#Banyan Network Server -2MB mem, 70MB disk	18,642.00
#Corporate Network Server -4MB mem, 80MB disk	23,777.00

\*Includes software for all users.

#Includes software and support for all users.

### CONCLUSIONS

Even though there are already AT&T Starlans installed on campus, it's not recommended that TESC consider these LAN's a campus "standard." Starlan is not the direction the industry is currently headed, connectivity is lacking, and support from AT&T is minimal.

It is recommended that we continue to support our current AT&T Starlan installations. However, our next step should be to develop additional small LAN's in logical areas based on Novell and/or 3COM. Novell is currently the industry leader in installed LAN's (43%). Novell is also modifying its approach to LAN's to emphasize software rather than hardware. And, through third party agreements, Novell has enhanced its overall connectivity to achieve organizational (much like Banyan) rather than merely workgroup solutions. 3COM is also changing its direction from providing only workgroup solutions to providing network solutions at the divisional and corporate levels. 3COM's recent merger with Bridge Communications, Inc. provides users with a wide choice of hardware and software products to solve networking problems. While Banyan is currently the Cadillac of network operating systems, the company is still relatively small with a small installed base. We feel support from the Banyan vendors in our geographic area would be lacking. We should stick with a product that has a solid user base and proven track record.

After establishing a few small LAN's on campus, we should interconnect them. It's crucial that we don't have several different networks to attempt to interconnect and support. Given the ever changing nature of network design and standards, we should re-evaluate this recommendation BEFORE making a significant financial investment.