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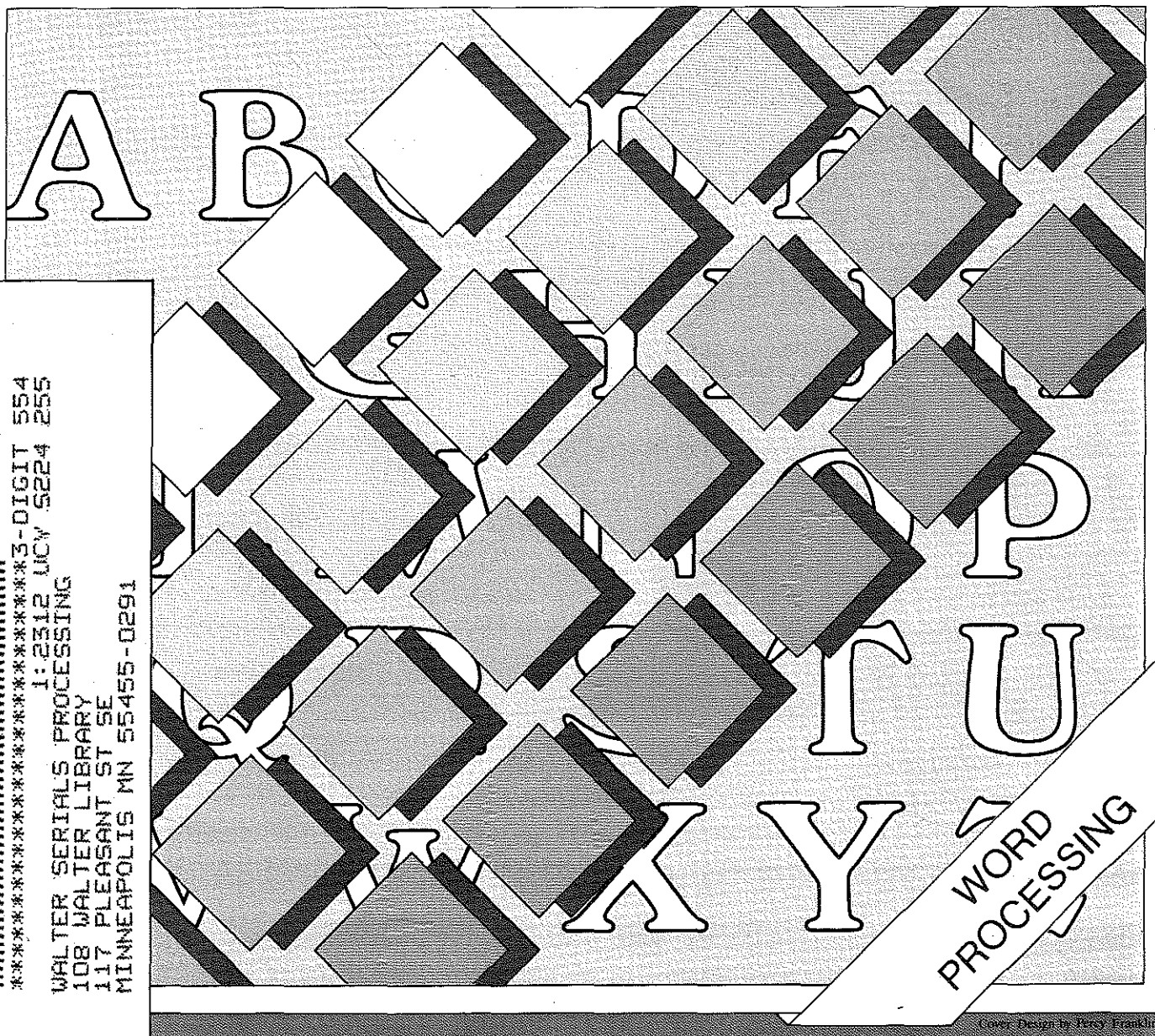

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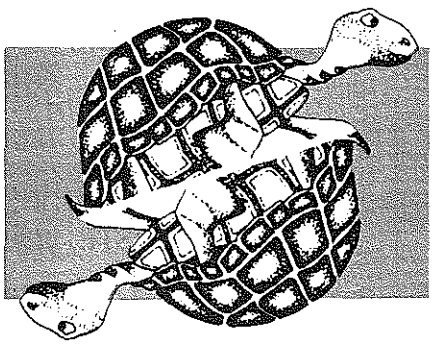

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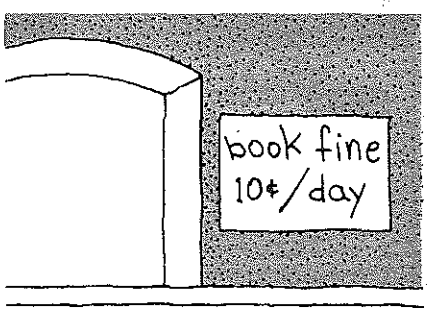

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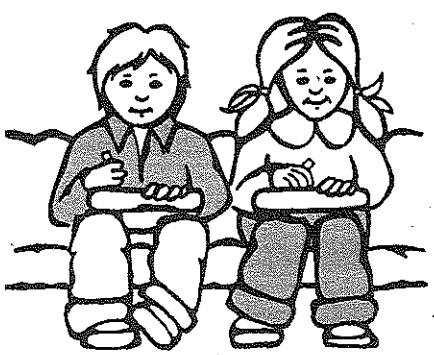

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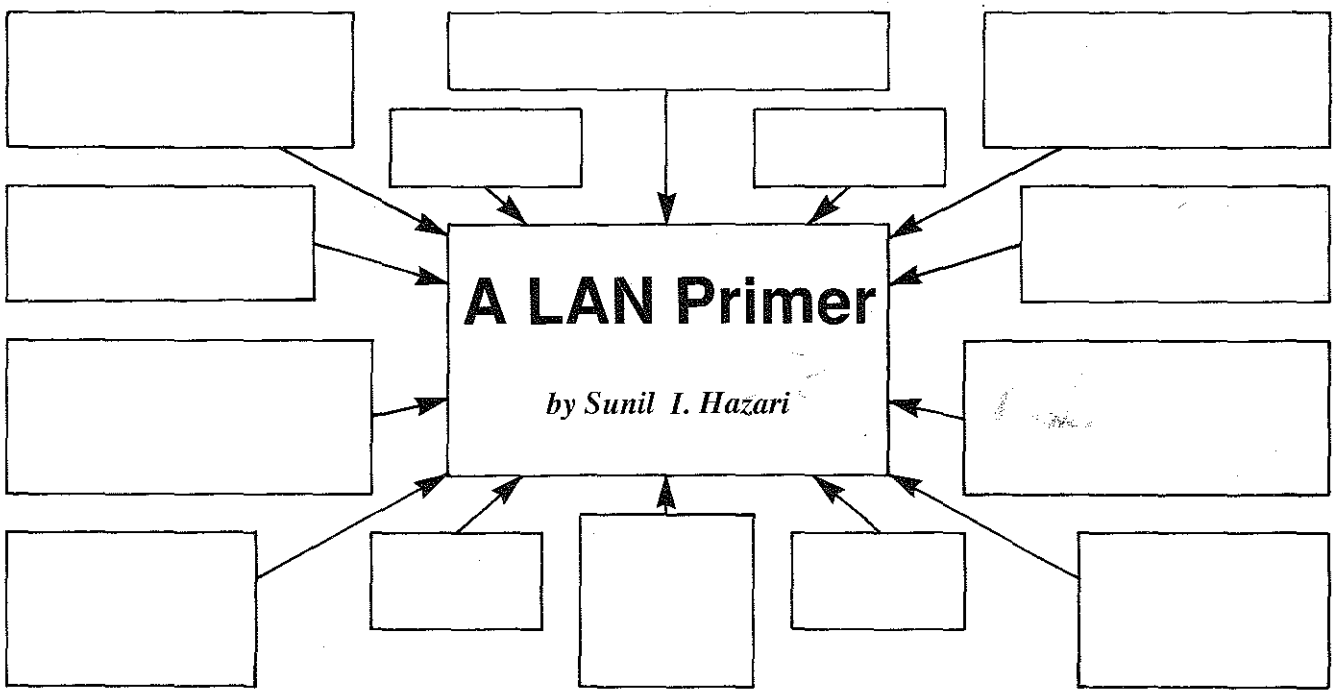


The use of local area networks (LANs)—local systems of computer systems and peripherals connected together using nonpublic common carriers—has become very popular in schools and colleges. LANs offer electronic mail and the convenience of sharing information and expensive resources. Equipment like hard disks, printers, plotters, and modems can be located on the network in such a way that they can be shared by all computers. Application software like word processors, database managers, spreadsheets, graphics packages, and programming languages can reside on a single computer with the capability of being accessed by any device on the network.

If you've ever had to handle multiple copies of multiple kinds of software and load it into multiple machines (all at once of course), and then worry about software damage, theft, or piracy, a LAN sounds like a dream come true. And it can be, if it is properly planned and executed according to the area needing to be covered and the amount of activity on the network, and if it is adequately managed by a LAN administrator. With today's shrinking budgets, that planner and/or administrator may be you, the classroom teacher who has a strong interest in educational technology, or the building computer coordinator who has learned everything you know on your own time or on the job. The following primer of options in planning a LAN and the tasks necessary to manage it are offered to help get you started or at least sound knowledgeable as you ask questions.

Planning a network is not an easy task because of the multitude of options available. When designing a LAN, the components to consider are hardware, software, and management of the network. Each of these components plays an important part in the smooth operation of the network. The discussion below explores the various options available when planning a LAN.

Hardware

A local area network in an educational setting often includes a combination of microcomputer systems running under different operating systems.

	Twisted Pair	Coaxial Cable	Fiber Optics
Use	Small work groups/ single lab	Departmental or backbone for multiple work groups	Between buildings/ longer distances
Data Rate	Up to 1 Mbps	10-50 Mbps	-unlimited-
Medium Cost	$0.20/m	$2.00/m	up to $6.00/m
Interference Susceptibility	High	Medium	Low
Installation Ease	High	Moderate	Low

Table 1: Transmission media comparison.

Several designs are available when planning LANs based on microcomputer systems commonly found in schools. These different designs provide the basis for performance and suitability of a particular network. The network design is based on transmission media, topology, and protocols.

Transmission Media

Transmission media refers to the cables that connect the computers and peripheral devices. The type of cable decides the speed, installation, and maintenance cost of the network. Commonly used transmission media are the twisted pair, coaxial, and fiber optic cables. *Note that more than one kind of transmission media may be used in a LAN—especially a LAN made up of several smaller LANs.*

Twisted pair refers to two wires wrapped around each other for the entire length of the cable. These wires may be insulated (shielded) to minimize electrical interference. Advantages of twisted pair cables are flexibility and low cost. These cables are not suitable for high speed data networks. Common examples of twisted pair cables are telephone wires and Apple's LocalTalk.

Coaxial cables have a single central conductor surrounded by an outer conductor. The outer conductor provides insulation to reduce electrical interference. Coaxial cables are used when high speed data transmission is required. Commonly used cables of this type are the thin wire and thick wire Ethernet cables.

Fiber optic cables, as the name implies, use light beams instead of electricity to transfer data through glass fibers instead of copper wires. These cables are totally impervious to electrical interference, require no shielding, and are much more expensive.

Table 1 gives a comparison of the transmission media in relation to the data rate, medium cost, interference, and installation ease.

Topology

The topology of a LAN is the physical arrangement of the nodes (computers) on the network. The three commonly used topologies are the Bus, Star, and Ring.

The Bus or trunk topology is the easiest to configure because it involves a linear connection of all computers on the network. The devices are "daisy chained" serially such that each device on the network receives and transmits signals. Apple's LocalTalk twisted pair and coaxial Ethernet pair are configured using the bus topology. See Figure 1.

Ring configuration connects the nodes in a continuous circular arrangement. While this type of topology has its advantages, expansion of a Ring network requires interruption of operation of the entire network. The IBM Token Ring functions under the Ring configuration. See Figure 2.

The Star topology is significantly different from the Bus and Ring arrangements. In this type of arrangement, one device is designated as the most important node, and is usually referred to as the "server." All the nodes on the star network connect to this central hub through separate cables. Failure of one node (other than the server) may not necessarily interrupt the operation of the entire network. See Figure 3.

In a one-room laboratory setting, it is more convenient to run a long bus between the stations. However, if computers in different rooms are to be networked together, it would be advantageous to create a Star topology to make troubleshooting easier.

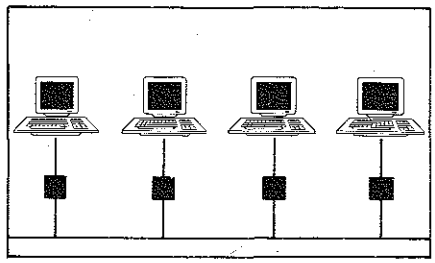
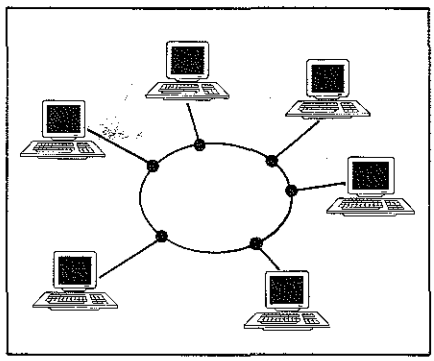


Figure 1.



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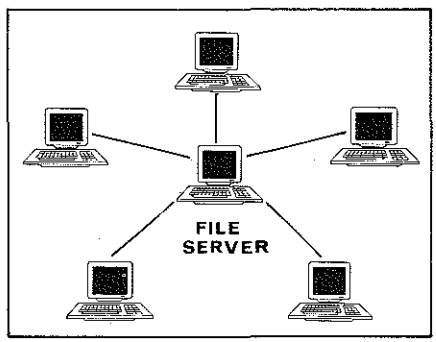

Figure 3.

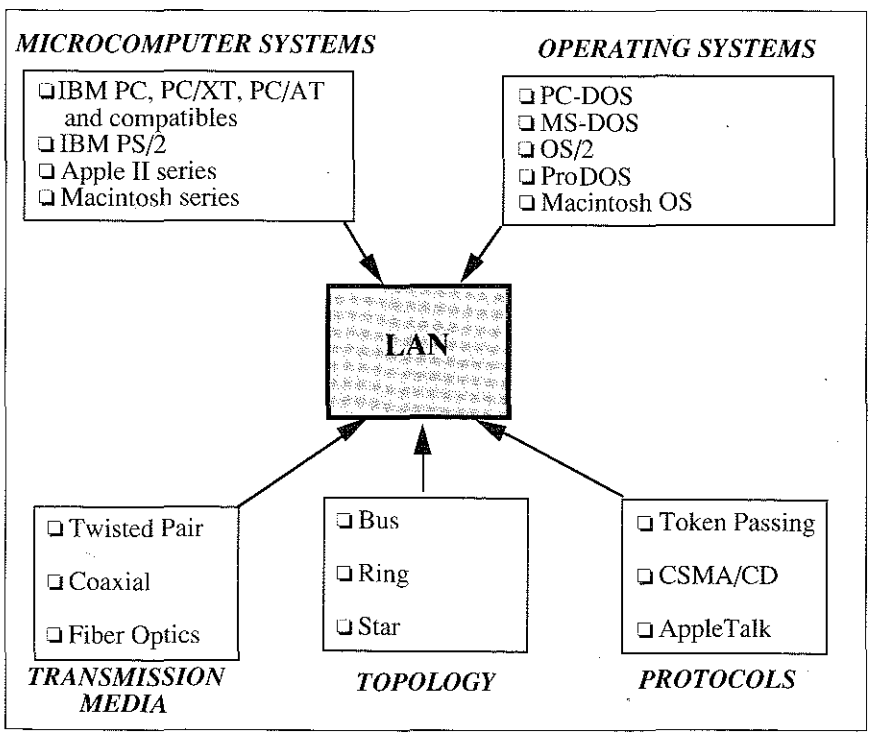

Figure 4. LAN components.

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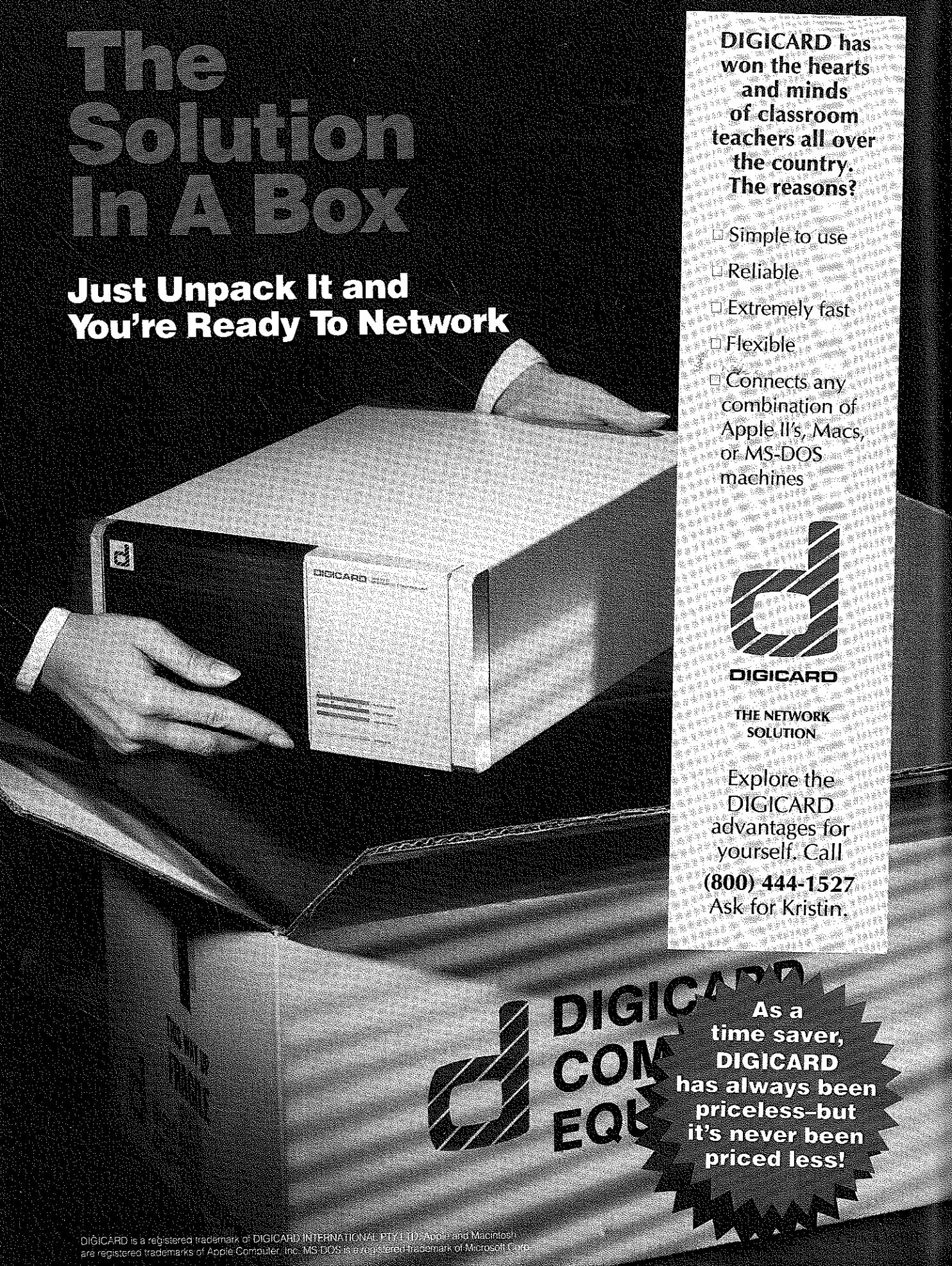

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Protocols

Networking protocol is defined as "set of rules that govern communication between computers. Such rules apply to data format, transmission timing and sequencing, and error handling" (Stallings, 1985). The protocols ensure that two or more computers and/or peripherals do not send data simultaneously, thus avoiding data loss on the network. All the nodes on the network must use the same protocol. Commonly used protocols on microcomputer based LANs are the Token Passing (used on IBM Token Ring networks), Carrier Sense Multiple Access/Collision Detection—CSMA/CD (used on Ethernet networks), and *AppleTalk* (used on Macintosh computers connected with LocalTalk cables). Figure 4 shows a graphical representation of these LAN options.

Software

The software used to run the network determines the ease (or complexity) with which the users access the network facilities. The network interface may be a command line prompt (like DOS) or offer a graphic interface (like Macintosh). A network may be set up as a peer-to-peer network or it may use a central server. In a peer-to-peer (distributed processing) network, users are responsible for making their files available to the rest of the network and each users' files can be made accessible to others. TOPS is an example of a distributed file server that allows Macintosh and MS-DOS computers to read and/or write files across the network. A laboratory setting usually requires a central server that stores application programs and provides file and printer sharing. The server may be "dedicated" to networking tasks, or provide networking services in the background. *AppleShare* file server software is one example that works on a dedicated computer. It requires a Macintosh that has the primary task of providing network services. The *AppleShare PC* software provides MS-DOS computers access to the *AppleShare* file server. In a laboratory, when connecting MS-DOS and Macintosh computers for the purpose of sharing files and printers, *AppleShare* is an ideal choice in most cases.

Although a dedicated file server may be more expensive, it provides better security, control, and higher network speed compared to distributed servers performing under similar conditions. When using other computers, it is also important to consider the interaction of network software, operating system, and application software. In case of a software conflict, the network may give unpredictable results.

Management

Once the network is installed, there are routine tasks to be performed to ensure smooth operation. The management aspect looks into issues such as LAN administration, data security, backups, and physical maintenance. A good plan of action is required to prevent major problems that may appear during the operation of the network.

A LAN administrator should be assigned to handle training and maintenance responsibilities. The administrator should have a combination of technical and interpersonal skills to help troubleshoot hardware and software problems, and also train staff and users regarding the operations of the devices on the network. It is also important that the administrator always maintain an updated database on computer configurations, cables, version numbers of software, manuals, and maintenance records. To maintain the integrity of the network, there should be a plan to backup data and update system software periodically. To guard against system errors and data corruption, virus prevention programs should also be installed on the network. All these issues may appear insignificant at first glance, but they are important in the long run to maintain a smoothly running network.

There are numerous options available when designing a LAN. It was beyond the scope of this article to list and explain each available piece of hardware and software. Setting up a network is not an easy task, but with careful planning the LAN designer can eliminate obstacles that stand in the way of optimum network operation. A well designed network not only takes into consideration current needs and requirements of users, but also includes flexibility for further expansion and integration of emerging technologies.

[Sunil Hazari, Ed.D, East Carolina University, 325 Rawl, Dept. of Construction Management, Greenville, NC 27858.]

References

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