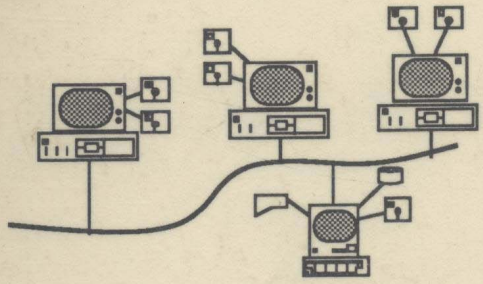
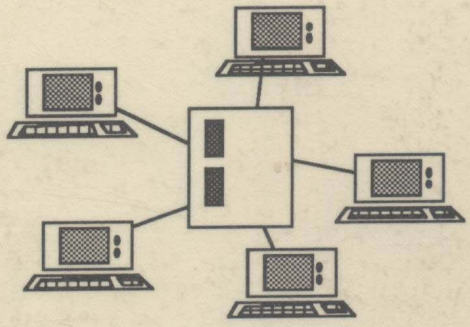
PC LANs vs MULTI-USER SYSTEMS

2nd Edition





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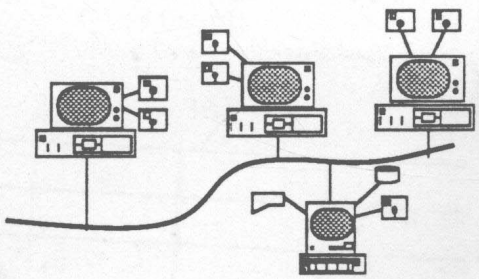

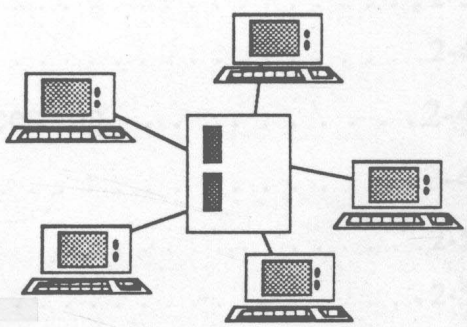

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1. Introduction

Perhaps the debate of applying PC LANs or host-based multi-user technology to satisfy a given set of requirements will never subside. Complicating the matter is the fact that the technologies are becoming less and less distinct. In fact, one can argue that a LAN of PCs is indeed a multi-user system!

The distinction for this report is that multi-user systems will refer to host-based systems consisting of a centralized processor that is shared by several users and their applications. Whether the users are interacting with terminals or PCs with terminal emulation software is immaterial -- the logic which processes applications from these multiple users resides in a single central processing unit (CPU).

PC LANs have PCs attached to a local area network which provides the basic underlying mechanism to share files and other resources. The end-user application is still executed within a PC attached to the LAN -- note that "a PC" does not imply that the PC is necessarily the one at which the user resides. PC operating systems like Operating System/2 (OS/2) will make the location of the execution of a application less of an issue -- i.e. truly distributed processing.

This report will examine the various technical and implementation issues and tradeoffs between host-based multi-user systems and PC LAN systems.

1.1. Departmental Systems

Departmental computing resembles small business computing -- the environment is self-contained and users are capable of creating, storing, and manipulating electronic data. One of the motivations for departmental computing is to keep data in close proximity to the work area to reduce mainframe overhead and data communications costs.

Minicomputers evolved from the 1970s as a move towards distributed processing. Minicomputer architectures were essentially scaled down mainframes. On the other hand, PC LANs evolved from the late 1970s and early 1980s riding the coattails of the huge demand for personal computers. The PC market itself has been driven by low cost and demand for end-user computing vs. host-to-dumb terminal computing as offered by minicomputers and other hosts systems.

Vendors of PC LANs and multi-user systems alike would like prospective buyers to believe that they offer a plug-in-the-wall solution to virtually all data communications requirements that you may have. Since multi-user systems have been available longer than PC LANs, they are probably close to being turnkey solutions than PC LANs are. PC LANs, however, offer differing benefits in terms of performance and flexibility. Users thus find themselves faced with the dilemma: Should PC LANs or multi-users systems such as minicomputers be used for departmental systems? If personal computers are already in place, does it make sense to simply add a PC LAN to that environment?

1.2. Implications of the Architectures

Multi-user environments based on minicomputers are examples of a centralized architecture in which all resources are typically concentrated in some physical location. PC LANs, on the other hand, imply a decentralized environment in which resources are distributed

throughout the system. In essence, PCs on a LAN can be viewed as diving up the processor of a centralized computer and spreading it around.

Once an organization has determined whether to employ a centralized architecture or a decentralized architecture, consideration still must be given to issues such as the type of cabling system to be used, the transmission rates required to support the anticipated traffic on the system, the best way to ensure security, and the types of multi-user applications to implement.

Once the system is installed and operational, administration becomes an important consideration, especially in a PC LAN environment in which resources may be widely distributed. System managers must determine how to expand the system as well as who has access to what resources within the system. This task is complicated by the fact that any given organization can have a variety of different information processing equipment, from microcomputers and mainframes to more specialized equipment such as word processing machines and graphics or engineering workstations. This equipment is likely to be from different vendors and to run different operating systems and different applications.

The first major task facing a system manager in a multi-vendor environment is to put some hardware in place which will enable the various types of equipment to physically communicate. The second major task is to ensure that the various communications protocols are compatible -- this is often a most formidable undertaking. And finally, one needs to make sure the information to be shared is in a format compatible with the diverse devices or that translation services are available.

1.3. Office Automation

Automation of manual office procedures has been one of the major driving forces behind the renewed interest in data processing. Having a system that automates cumbersome procedures allows information to be shared thus increasing the usefulness and timeliness of information available in the workplace.

The type of applications that are typically needed to support office automation are word processing, electronic mail, spreadsheets, databases, and perhaps a multi-user calendar for scheduling purposes. PC and PC LAN applications are available both from third parties such as Microsoft, Lotus Development Corporation, and Ashton-Tate, and from hardware vendors themselves.

On the minicomputer side, Digital Equipment Corporation, for example, offers ALL-IN-1, a suite of software that runs on the DEC VAX-11, MicroVAX, or DEC Professional PC. All-In-One integrates the various aspects of office automation, such as word processing and electronic mail, into one package. In a similar vein, Data General has a software package called the Comprehensive Electronic Office (CEO) that is used to implement office automation on Data General Eclipse machines and desktop computers.Finally, IBM offers Personal Services, a package that provides electronic mail, calendar, and file transfer functions for S/36, AS/400, and S/370 and IBM PC users.

1.4. End-user Requirements

As mentioned before, the types of applications provided to end users might be database access, file transfer, electronic mail, word processing, perhaps some type of teleconferencing,

graphics support, or even real-time voice communication support, and certainly file archiving for document storage and retrieval. End-users requirements should not be lost in the dazzle of technology; after all, they are the ones who are going to be using the system from day to day.

In addition to interactive capability, another performance consideration is speed of transmission. PC LANs typically have high transmission bandwidths -- ranging from 1 to 10 million bits per second (Mbps) -- since they have to support a wide variety of traffic on the system as well as many users at or near the rates of local I/O. A typical multiuser minicomputer that interfaces to a terminal to which the end user has access is typically a much slower 9600 bps.

Performance is obviously the most important end-user consideration. Another important consideration is the type of display presented to the end user. Most terminal-to-host or environments are text-oriented. Users thus interact with the machine a line at a time or a "screen" at a time as in the IBM 3278 terminal environment. As more advanced personal computers and workstations become available, however, more sophisticated end-user interfaces are being developed for various applications. In terms of graphics support, for example, there are now icon-driven end-user interfaces such those used in the Macintosh, as well as those in use by the OS/2 presentation manager for IBM PCs. Input devices other than the traditional keyboard, such as the mouse, the graphics tablet, and even the light pen, are also available.

1.5. Selection Considerations

Very general considerations to keep in mind when choosing between a PC local area network and a multi-user system are throughput, response time, reliability, geography, and life cycle.

Personal computers tend to be more I/O-intensive than multi-user machines because the applications that run on the PC typically take advantage of its internal resources (e.g., high amounts of RAM). The data for a PC application is typically retrieved from a hard disk or floppy and operated on in RAM. In a multi-user system, on the other hand, data resides at the host, and the terminal presents only a minute portion of the total data to the end user.

One reason PC response times are more predictable than multi-user response times is that the load within a PC system is always the same. In a multi-user environment, the load is and thus response time is variable: it depends on the number of users and the types of applications they are running.

Another trade-off between PC local area networks and multi-user systems is reliability. Even though a PC LAN consists of distributed components and PCs, it is prone to some degree of failure if components fail somewhere along the system. Multi-user systems are inherently more reliable since their resources are concentrated in a central location, sometimes even right within a machine itself. If the machine goes down, however, it will bring the whole system down since it is a central point of failure. While errors and equipment failures are perhaps more commonplace in the LAN environment, the overall reliability of a LAN may be greater than that of a multi-user system due to its distributed architecture.

Geography may also be a limiting factor in the type of system selected. In a PC LAN environment, distances are typically limited to less than a few thousand feet (without using

bridges and gateways). In a multi-user system, in contrast, distances between the host and terminals can easily be extended by using multiplexers, modems, line drivers, etc.

The life cycle of the system is a further point upon which LANs and multi-user systems can be compared. The life cycle of an average mainframe is about ten years. A super microcomputer lasts approximately five to six years, while a minicomputer might last seven to eight. Historically, PCs have had the shortest life cycle: three years. From a cost standpoint, then, PC LANs are not easy to justify because components may have to be replaced quite rapidly. The local network technology that connects PCs should last longer than three years; therefore, the system must be able to accommodate more technologically advanced personal computers as the old ones are replaced. Matching a LAN to today's requirements may not meet the requirements of tomorrow.

2. Defining the Technology

In order to compare and contrast PC LANs and multi-user systems, a working definition of the end-user components of each is required. The following sections provide such a definition.

2.1. PC LANs

2.1.1. Personal Computers

The personal computer is self-contained desktop computer which is used by one person alone. That person has control of the PC; in other words, the PC's resources are dedicated to him or her. Another distinguishing feature of the PC is the fact that it has an integrated display. The electronic components which drive the video display are typically integral or else housed in a board that plugs into the backplane of a personal computer. In a minicomputer environment, on the other hand, a terminal is typically attached to a communications line that goes back to the host; it is separated from the machine itself.

Personal computers are typically based on a single-chip VLSI (very large scale integration) CPU (central processing unit)/microprocessor such as the Intel 80386. Even though PCs are dedicated to single users (as the term personal implies), they may have multitasking capabilities; that is, there may be multiple applications running concurrently or multiple tasks running within an application. PCs typically have upwards of 1 Mbyte of random access memory (RAM), and cost from $1,000 to $10,000, depending on the configuration.

Personal computers in a stand-alone environment do have certain advantages. Because they are intended for a single user, they are very accessible. It is easy for a user to tell whether the computer is up or down, whether it is in use or not in use, because the entire computer is right in front of him or her on a desktop. Problem isolation can also be easily performed within this small environment.

In a mainframe environment, in contrast, individual users may have no means of knowing the load on the system or even if the machine is up or not.

PCs also allow for linear growth. If new people are to an office, one simply adds new PCs. Each employee has his or her own CPU in the form of a personal computer; therefore, there is no degradation to total processing capabilities as the staff expands. (When new people are added to a mini or mainframe environment in which the central processing unit is shared, degradation may be noticed.) In addition, PCs don't have any special power or cooling requirements, so they can be run in a normal office environment as opposed to a environmentally controlled computer room environment.

PCs have changed the way people are thinking about computer systems. It used to be that the first question anyone buying a mainframe asked was how much the CPU cost. The system was essentially built around a $200,000. The CPU in the PC is, however, essentially free. This low-cost CPU in turn contributes to the low cost of the PC. Because the CPU costs so little, many people can afford to make buying decisions about PCs at much lower levels in the typically hierarchically-oriented corporate structure.

Another point in favor of personal computers is consistent response time. Even though certain PC operations may take a few seconds, a typical operation will probably take less than

one second. Response times tend to be constant for a given operation, allowing users can get themselves "in sync" with the application. Response times in a mini or mainframe environment are, in contrast, random; they vary depending on the load in the system -- personal productivity can suffer due to unpredictable response times.

All this is not to imply that personal computers are panaceas -- they are not always the appropriate computing choice, and they do have some drawbacks. In terms of price, for example, PC add-on devices such as hard disks and printers do not follow the same price revolution that resulted in virtually free CPUs and relatively low-cost RAM; thus floppy disks, CRT displays, hard disks, printers, and plotters still represent the most expensive parts of the system.

When numerous stand-alone PCs are in use, communications often becomes a need and an additional source of expenditure. Prior to viable communications techniques between PCs, information was typically "shared" by running one individual's floppy disk in someone else's machine, or by using a peripheral such as a printer that is attached to another PC and therefore not accessible from one's stand-alone PC. (The issue of networking PCs will be taken up shortly.)

Despite the fact that there are thousands of software packages available for personal computers, the majority of them are simply not as sophisticated as mainframe applications. They may lack system accounting functions or security -- functions that may require more "horsepower" than provided by PCs. An additional software problem concerns the lack of standards for information interchange among the various types of PCs. IBM PCs may not be able to share or exchange data with another type of personal computer, such as an Apple computer. Indeed the floppy disk formats of Apple and IBM personal computers are basically incompatible; they are not even readable by each other's machines. And in some cases, even if two PC users who wish to communicate have the same type of machine and the floppy disk media are compatible, the data format of software applications may not be compatible. WordPerfect word processing files cannot be shared easily with WordStar, for example, because each uses a different internal storage format.

Because PCs have been designed as stand-alone computing systems, communication directly between personal computers is generally not supported. Dial-up modems allow transfer of information but unless PCs are networked, they don't have a viable communication mechanism for sharing resources and information.

The typical personal computer environment consists of a number of stand-alone PCs. Within any organization, these stand-alone personal computers might be running a variety of applications under diverse operating systems. Finance, for example, might have IBM PCs running under MS-DOS for spreadsheet applications, while Administration might have Apple Macintosh computers operating HFS, and another department might have yet another machine with another application for a different operating system. If the personal computers in this organization are to be interconnected on a network, problems of compatibility that arise from unlike machines, unlike operating systems, and unlike applications must be considered. Many of the PC local area networks available today support only one type of machine and one operating system, typically the IBM PC running MS-DOS. Even if an organization standardizes on one machine and one operating system, there could still be problems with applications compatibility.

2.1.2. Local Networks

At this point it would be useful to identify the characteristics that distinguish a local area network from other types of networks which may be more familiar, such as public data networks, X.25 networks, mainframe networks, and networks of terminals connected to minicomputers. The transmission rates in a local network tend to be substantially higher than the transmission rates found in other types of networks; they tend to run from 1 to 10 million bits per second in a PC local area network. Also, while all types of data networks rely on packet switching of some sort, in a PC local area network, the switch is typically implemented in the LAN adapter of the attached personal computer. In other networks, the switch might be at the host, the concentrator, or the multiplexer; it is not typically inside the device as in a PC LAN.

Another characteristic that helps distinguish a LAN from other types of networks is the ownership of the system. LANs tend to be owned by a single organization or a single department within a corporation. Managers control the resources on the system, and perhaps even install it. A corporate-wide network such as a terminal/host network or the network in a communications subsystem may, on the other hand, be owned by multiple departments. In some instances, the network may even be owned by multiple corporations. Because LANs are used locally and tend to be controlled by a single group or organization, the range or size of a local network is typically with a few thousand foot radius. Other types of networks routinely extend well beyond one mile in distance.

LAN vendors are shifting from being technical or hardware-oriented companies to being system-oriented companies, thus responding to the needs of end users. Part of the reason for this shift is the maturing of the PC local network market, which really only began in 1982. As LAN vendors move from being product companies to being service companies, they are also moving from offering hardware alone to offering complete systems, although they still do not implement the ideal turnkey system.

2.2. Multi-user Systems

Unlike a PC LAN, which theoretically allows PC users to control their own CPUs and also communicate with others, a multi-user system enables multiple users to concurrently access the same data on one computer. Multi-user computers such as supermicros, minicomputers, and mainframes have their roots in the time-sharing systems of the 1970s. Time-sharing systems provide the illusion of individual access to a computer, but are, in actuality, centralized minicomputers or supermicros with multitasking multi-user operating systems. A batch processing environment, even though it supports multiple users, is not a true multi-user system because the users are not using the data concurrently; in a batch environment, one job is processed after another.

2.2.1. Terminals

Terminals are the most common end-user interface to a multi-user computer. They provide a detached user interface to the host, and typically consist of a keyboard, screen, and I/O port, which connects to the host. Terminals cannot typically operate in a stand-alone mode; they require the host to perform operations. There are, however, many bells and whistles that can be added to make a dumb terminal into a smart one. The smart terminal might have cursor addressability, limited graphics capability, and limited field processing (such as