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# Libraries On-line: Making the Most of CD-ROM Technology

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# Making the Most of CD ROM Technology

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#### Introduction

Shared CD-ROM databases are one of the most efficient research tools available in today's modern library. A vast amount of technical, business, legal and statistical information can be placed on-line for rapid, concurrent data searches by multiple patrons. Virtually thousands of CD-ROM titles are available to the modern library, representing hundreds of millions of pieces of data. Modern index and retrieval software products provide the means to perform intelligent, context based searches, often reducing months of old-fashioned research to a few minutes of computer time. Well-designed CD-ROM networking software provides tools to simplify user access while carefully managing these valuable resources.

Unfortunately, the librarian planning to implement a CD-ROM system faces many choices and an often confusing set of computer networking issues to resolve. In this paper I will attempt to clarify these issues, and help guide the librarian through the choices that must be made to implement a first-class CD-ROM system. Among the issues to be addressed are needs assessment, network infrastructure and architectural concerns, software features, hardware features, database and search engine concerns, and upcoming technologies.

# **CD** Use Is Widespread

CD-ROM drives are fast becoming ubiquitous. The best industry estimates suggest that there are now over 50,000,000 CD-ROM drives installed in personal computers and servers world-wide. The industry has experienced a 50% growth rate for the past two years in a row. Once expensive add-on devices sold primarily as after market products, CD-ROM drives are now installed as standard factory equipment, or factory options on as many as 50% of personal computers shipped by OEM manufacturers.

Virtually all file servers sold today include a CD-ROM drive, because Novell, Microsoft, and most UNIX vendors now prefer to ship their operating systems on CD-ROM media. Anyone who has ever installed an operating system using 25 to 100 floppy disks readily appreciates the ease of use a CD-ROM installation offers. Some manufacturers, notably Compaq, also include a range of other software on their server installation discs. Users may choose to install the optional software, often after paying an extra fee for a license key to unlock the software for use.

## Universal, Cross-Platform Media

A key factor in the growth of CD-ROM drives and titles is the ISO9660 file system. This universal, cross-platform file system that allows all CD-ROM drives world-wide on virtually any computer to read the same discs. While there are specialty file

systems (such as HFS for Macintosh and RockRidge for some UNIX systems) for selected operating systems, virtually all operating systems can read and use ISO9660 discs. Without getting into the technical differences that differentiate these file systems, it is important to note what file system is on the discs you want to offer in your library. Unless the disc is available in ISO9660 disc format, access is limited to selected types of computer systems. Some older systems use the High Sierra format, a predecessor of ISO9660. Others may use non-standard sector sizes (virtually all are 2K, but a few are 512 byte), a sign of a vendor who is not keeping current with technology.

# Why Network CD ROMs?

The widespread availability of individual CD-ROM drives installed on individual personal computers has actually complicated the use of CDs in most cases. The more drives in use on individual PCs, the greater the risk of lost or damaged discs. Individual discs in individual PCs are used inefficiently, with only one user at a time able to access the data. Whole sets of discs are occupied for an individual user's needs while others wait. Sneaker-networking of discs between PCs is inefficient, expensive, and provides poor service to patrons.

# **Efficiency**

A CD-ROM network sharing system provides many benefits. First, multiple users can simultaneously access the same data sets, significantly increasing overall system productivity. Databases, particularly the specialized databases found in University and technical libraries, are expensive resources, and the need to maximize use is crucial. Experience has shown minimal performance degradation up to five, or as many as ten simultaneous users of indexed text databases on a well-designed CD-network sharing system. Multi-media titles are less efficient, but are still good candidates for network sharing.

#### **Control**

Security and control of valuable discs are achieved by centrally locating the discs in a server under administrator or librarian control. At the most basic level, there is the physical security offered by the central location and control of access the CD-ROM server. Modern CD network sharing software provides the tools to share the databases, to determine the level of use for each database and to comply with licensing limitations.

# Improved Performance

A non-intuitive but frequent benefit of CD-ROM network sharing systems is faster performance for many titles. High performance network sharing systems always include file caching, either as a dedicated CD-ROM cache, or through the network operating system cache. Many stand-alone systems offer only the very small cache in the drive itself. Frequently accessed data in a network cache is retrieved more quickly than it can be found on the local drive on the PC.

#### **Elements of planning a CD-ROM system**

There are seven areas that anyone planning a CD-ROM network sharing system must consider.

- 1. Network technology selection
- 2. CD-network sharing software selection
- 3. CD-network sharing hardware selection
- 4. Vendor selection
- 5. Title selection
- 6. Protecting your investment

# Future technologies Network Technology Selection

## Novell NetWare and Microsoft Windows NT are Top Network Choices

The choice of network technology will affect all of your other choices. If you don't already have a network that is suitable for sharing CDs, you can base your network choice on the available CD-ROM sharing software and titles to be sure that you have the most compatible system. If you already have a network, you will find some of your choices for a CD-system are limited to what is compatible with your network.

The vast majority of CD ROM database titles are available as DOS or Windows applications, with a small minority available as Macintosh applications. Almost none are available as native applications based on UNIX, OS/2, or other platforms. Considering this, the only viable network technologies for CD-ROM sharing in most libraries are Novell NetWare, Microsoft Windows NT, and Banyan Vines. These network operating systems can easily and seamlessly share DOS and Windows applications through a variety of CD ROM sharing applications.

If you are using Novell NetWare, Microsoft Windows NT, or Banyan Vines network operating systems, over IPX, NetBEUI, TCP/IP, NetWare IP, or Banyan IP, you have a number of CD ROM sharing software choices available to you. Your choices are much more limited if you are using UNIX, VMS, OS/2, or other operating systems, or NFS protocol. You may want to consider setting up a dedicated network using NetWare, NT, or Vines for CD-ROM sharing purposes.

# **CD-ROM Sharing Network Architectures**

There are several basic network architectures for sharing CD-ROMs. Your choice will depend upon a number of factors, including your existing network (if one exists), your philosophy of system administration (centralized control of CDs, vs. department by department control), the size of your system, it's potential for growth.

#### Server Centric

Server centric systems use a standard file server to share CD-ROMs. Typically, this is a Novell file server with an NLM-based software package such as Meridian's CD Net for NetWare loaded on the server, or Microsoft NT server with a package like Meridian's CD Net for NT. CD-ROM drives are directly connected to the file server via SCSI, and the users receive native volumes or shares from the file server that are mounted as drive letters to their client PCs. These type systems are usually very efficient and relatively low cost because they depend upon the existing file server. Using this type of system as a dedicated CD-server requires installation of a file server with an additional network operating system (NT or NetWare) license for the CD-server, but usually provides the highest performance.

#### **Dedicated CD Servers**

There are two basic types of dedicated CD-servers that communicate on a peer-to-peer basis with client PCs. One type relies upon the network operating system communications protocol to provide client/server services using a file system redirector model. The other type emulates a file server, either Microsoft NT or Novell NetWare, and delivers drive letter access to the clients. Advantages of both types include minimal or no workload on the system file server, ease of installation, and uniform performance regardless of system file server workload for other activities.

#### **Miniservers**

The newest trend in CD-sharing is the miniserver. There are several on the market. The most familiar product uses a file-server redirector model in which all traffic to and from the miniserver is routed through the system file server first, and then to the miniserver. Newer products offer either direct peer-to-peer communications to clients, or in the case of Meridian's new CD NetLink Miniserver, the ability to function in either model. Primary advantages to miniserver systems are the ability to add CD-ROM drives to a network without downing the main file system server, low cost, and easy installation. Check for system Scalability when looking at this type of installation. How many miniservers can be installed on the LAN, and how do they function together?

## **CD-network sharing software selection**

The most important choice you will make in setting up a CD-ROM networking system is which CD-ROM sharing software to use. Almost all of the key features that you will need to effectively share and control your CD-ROM resources will be found in the software, not the hardware or network operating system. In over eight years of experience networking CD-ROMs at Meridian Data, we have identified a set of software features that are key to success. No one system has all of these features, and some implement them better than others. Overall, however, the more of these features you can find in your CD-ROM sharing software, the more likely you are to have the system you need.

# Why not just use the native network operating system features?

The general answer to this question is that the native CD ROM services offered by the NOS are limited and experience has shown them to unsatisfactory for most library installations. There are some differences between NetWare and Windows NT that make use of the native service easier in NT.

In the case of NetWare, you have CDROM.NLM, which must be loaded on the file server. This is what we call a "featureless" NLM, in that all it provides is native drive letter support for discs, with no management features, no user client features, and generally poor performance. Mounting and dismounting discs is cumbersome and slow. Each disc becomes a volume, and with a limit of 64 volumes on a NetWare server, a significant number of discs will quickly consume valuable resources. This does not provide any MSCDEX emulation, thus this driver must be loaded on each workstation to translate the CD file system into a file system that DOS and Windows workstations can understand. A significant number of users with multiple discs have reported to us that CDROM.NLM is also unstable, resulting in server ABENDS (abnormal ending) when running CDROM.NLM.

Microsoft has done a better job of providing native CD ROM sharing facilities. NT shares CD-ROMs like any other type of drive, and for small scale systems with a limited number of drives and small number of users, is often sufficient. It also emulates MSCDEX, the DOS CD-ROM device driver required to translate the CD file system into a DOS-style file system. However, as your system grows, adding drives, it eats up server drive letters (one CD = one drive letter, and there are only 26 drive letters available on your NT server). Additionally, you get no CD disc management tools, no user client features.

In both cases, using the native features results in the need to manage client application launch setups on each client individually, a time-wasting nuisance for most libraries where discs may be mounted or dismounted from a system frequently.

## CD ROM Sharing System Client Features

Most important to the user is the client interface, which must be easy to use, robust, and require no training. Some of the key issues to consider in evaluating client software for CD ROM sharing include:

- 1. Is the client software required or optional? Can you run the client software from a central server location, or does it require software loaded on each workstation. There is no correct answer to this question, but it is an important issue for some system administrators who do not want to load software on individual client PCs. In general, running without client software provides only native drive-letter access to CDs, and ends up requiring more configuration effort than simply loading client software, and provides no ease-of-use features.
- 2. Does the client software include an application launcher menu system? This is the key to client functionality, and it should allow for centralized control of menus, segmented access to menus for different groups of users, and automatic network connect/drive mount/application execution/dismount/disconnect capabilities. Ideally it should have a configurable user interface so that individual users can be customized to limit or grant access to configuration tools. (i.e., a high school library should have a run-only menu, while a graduate science library might want to grant "power user access" to some menu configuration tools.) Also, can the application launcher launch any application, or only CD-based applications?
- 3. **Is scripting required, or just a simple form-fill-in.** Is the application launcher based on a database with simple form-fill-in for adding new applications, or do scripts have to be constructed to mount and launch new CDs. Can multiple databases be maintained (for different user groups), or is there only a single database available?
- 4. **Installation and distribution.** Does the software provide for creation of server-based installation sets to ease the process of distributing client software to individual PCs.
- 5. **Graphical tools vs. command-line execution.** Does the client offer completely graphical tools for graphical environments such as Windows, or does it require command-line operation.
- 6. **No TSRs or use of low-memory in Windows software.** Does the client make use of low-memory, or require you to load a DOS TSR to communicate with the server. Does the client require you to load MSCDEX.EXE in DOS

- memory? A client that makes no use of low memory, does not use a TSR, does not require MSCDEX.EXE, and makes no.ini file change is much easier to install and maintain.
- 7. **Are both 16- and 32-bit Windows clients offered?** Native 32-bit Windows clients for Windows 95 or Windows NT Workstation provide better performance than 16-bit clients running in emulation mode.
- 8. **Is a Macintosh client offered?** This is important only if you have Macintosh applications on CD that you need to share.
- 9. Can the client access multiple CD servers? How does the client handle multiple CD servers on the same LAN? Can it access them simultaneously? Can an application launcher menu contain applications from multiple servers? Cross platform compatibility. Can the client see more than a single type of server? Can the client access both NT and NetWare servers transparently to the user?

## CD ROM Sharing System - Basic Server Features

- 1. Does the software run on the NetWare or NT file server? Native NetWare or NT server software can be installed on your existing file server if desired, saving the cost of adding a dedicated server and sharing resources. Generally, NetWare NLM-based server software, and NT software will provide native services, volumes in the case of NetWare or shares in the case of NT, which provides added flexibility in configuring your network. Dedicated file servers can also be set up running NetWare or NT to provide services without adding workload to your primary file server.
- 2. **Does the server software run on a dedicated server?** Several vendors provide software that runs on a dedicated server, either a miniserver, or a DOS-based server that emulates a network operating system like NetWare or NT. There are pros and cons to this approach. Systems that emulate a NOS and offer "native volumes" are vulnerable to innovations by the network operating system vendor that they are emulating, and often these systems actually emulate a much older version of the NOS.
- 3. How does the software handle CD-ROM drive connection limitations? CD-ROM applications are often multi-disc, and it takes only a few applications to quickly fill up a CD server. This is particularly an issue with Windows NT that normally utilizes a drive letter for every CD drive connected. Good software should overcome this issue gracefully.
- 4. **Does the server offer drive letter management for clients?** Just as servers run out of drive letters and available volumes, clients are often short of drive letters on a heavily configured network. Does the system offer a way to group CD-ROMs under single drive letters at the client?
- 5. **Does the server software auto-mount discs?** Remember, CD-ROMs are removable media. If a disc is once mounted, then dismounted and removed from the system, how does the system handle it when it is returned to the server? It should be able to remount automatically, without reindexing or requiring menu changes.
- 6. How does the server software handle access control? Actually two issues, security and usage control, the server should integrate with the native operating system where possible to enable secured access to sensitive discs, and user group segmentation for controlling usage of popular discs.

- 7. **Does the server provide for license metering?** Networked CD applications often have concurrent user license restrictions that require metering. Is a metering capability provided, and is it mandatory or optional?
- 8. **Idle User Time Out.** Will the system monitor users and automatically log out a user that is inactive?
- 9. **Load balancing.** Can the system balance workload on multiple copies of popular discs?

# System Management Software

- 1. Does the product offer system management tools? Can you configure a server remotely from a client PC (e.g., without having to go to the system console)? Are the tools graphical, or command line oriented. Do they drive lock/unlock capability, trouble shooting tools, and access control?
- 2. Are the system management tools integrated with the network operating system? Particularly an issue with NetWare based LANs, do the system tools integrate with either NetWare NDS or Novell's Managewise application, enabling you to integrate management of the CD-ROM system into standard network management tasks?
- 3. Do the system management tools provide usage statistics? Usage statistics are valuable for determining the need for additional application licenses, and for user accounting.
- 4. Do the system management tools provide server and drive level performance monitoring? If a user cannot gain access to an application, or the system is running slowly, can you pinpoint the cause?

#### **Scalability**

One of the most important factors to consider is how well the system will grow with your needs. Under-estimation of the demand for CD ROM sharing services is almost a given when a system is first planned. Databases grow in size, requiring additional drives. Patrons request new databases. New patrons are attracted by the system, and ask for more services. You can count on needing to grow. In evaluating software for CD-ROM sharing, check how well it handles:

- 1. **Adding additional CD-ROM drives.** Do you have to down your file server? Do you have to add additional servers because your server cannot accommodate enough drives? You thought you didn't have a problem with drive letters or available volumes, but is that still true?
- 2. **Adding servers.** What impact does this have on your network operating system licenses? How do users see applications on multiple servers?
- 3. **Adding users.** How do you manage security for large user lists across multiple servers? Do you have to re-enter user lists for every server?

# **CD Network Sharing Hardware Selection**

Specifying the hardware for a CD-ROM networking system is relatively simple. However, because of the special nature of CD-ROM drives, there are some aspects of this process that are not immediately intuitive, even to personal computer experts facing their first purchase of a CD system. The first key decision is to choose from

among one of the basic system architectures listed earlier in this article, as this will control many of your hardware choices.

Regardless of the system architecture chosen, the basic elements of a CD-ROM network system always include the following:

- 1. Server
- 2. Network Interface
- 3. Drive controller interface
- 4. CD-ROM drives and cabinetry

#### Server

# **Server Centric Systems**

For light duty CD installations, most server-centric systems are run off the existing primary file server by simply loading a NetWare NLM or NT server software. In this case, the only considerations are workload, assuring sufficient RAM and disk space to handle caching, and availability of installation slots and interrupts to install an array of CD-ROM drives.

If a server is being installed to provide server-centric CD-ROM services, the key consideration is to obtain a server that is fully compatible with the Network operating system you have chosen. Generally, any server that will run the chosen network operating system successfully will work as a CD-ROM server. Servers from specialized CD-ROM system vendors provide the advantage of built-in CD-ROM drives and single-point service and support.

It is important to remember that these are general purpose file servers, and can often be used for multiple tasks including the CD-ROM sharing system.

**SPECIAL NOTE:** Do not overspend on extra features such as hot-swap drives, power supplies, or redundant fans that you might include on a file server intended to run a mission-critical system. CD-ROM systems do not have the same urgency as a corporate accounting system, or emergency services dispatch. Remember, CD-ROMs are read-only media, and unlike hard drives, data is not lost if a power supply failure occurs or a drive fails. The worst that occurs is a brief interruption in service. Power supplies rarely fail, and a spare in the closet is significantly less expensive than a costly hot-swap system. Similarly, tests conducted recently with a leading CD server showed that the drives never exceeded the rated operating temperature even with the fan turned off for many hours. CD-ROM systems made from quality components rarely fail, and extra redundancy features are usually just additional expense.

#### **Dedicated Servers With Built-In Drives**

Dedicated servers come in two basic types. One type includes a complete personal computer and an array of CD ROM drives, while the other type generally includes a specialized, single-board computer. Those with a complete personal computer offer advantages in serviceability and future upgradeability. The single-board models are usually less expensive but service is done by only the manufacturer. They are not

upgradeable with new components such as faster SCSI boards or more efficient network interface cards.

#### **Miniservers**

There are several brands of miniserver. All are small, single-board computers, optimized for CD-ROM sharing services. The hardware performance is roughly the same for all of the currently available products, look for superior software features and architectural fit.

#### Network Interface

If you have a choice, the faster the system the better it performs. Most systems are Ethernet, most server-centric systems will support whatever underlying network interface that the operating system will support, including the various 100 megabit and switched networks. Important today, network speed will become vital with the increasing multi-media content on CDs and coming DVD-discs.

#### Drives and drive controller interface

Slightly more expensive, SCSI-drives are the only real choice for CD-ROM network sharing systems. EIDE-systems support a maximum of four drives. More significantly, only SCSI drives have the capability to do asynchronous reads and to multi-task requests from multiple users across multiple drives, resulting in significant performance advantages over EIDE-drives. Use an EIDE-drive in your stand-alone PC, but use SCSI for network sharing of CD-drives.

CD-ROM drive durability is a key factor. CD-ROM drives are designed for use in stand-alone PCs, with at most a 25% duty cycle. In a network application, the workload is often more than two or three times the standard duty cycle. Buy brand name drives, latest technology, high quality. Ask your vendor if they have a formal process to test drives for durability.

#### **Cabinets**

Ordinarily a mundane subject, the cabinet becomes important when large numbers of CD-ROM drives are involved and valuable, removable CDs are exposed to public access. Choose a cabinet that includes a locking door, easy access to the internal components, and the ability to change drives quickly. Look for wheels on heavy cabinets (28 drives or more.)

## Performance factors

CD-ROM server performance is not usually predictable in the same way you might predict the performance of a personal computer. In particular, since CD-ROM servers rarely use a significant portion of their system's CPU capacity, a faster CPU often has very little effect on overall performance. Most CD-ROM servers are performance limited by the following factors, in this order:

- 1. Network bandwidth and NIC card throughput
- 2. SCSI subsystem bandwidth
- 3. Drive speed
- 4. Efficiency and amount of the available system RAM cache
- 5. Overall amount of RAM in the server (NetWare and NT systems in particular)

- 6. Availability of a hard drive cache
- 7. Processor speed

#### **Vendor Selection**

# Types of Vendors

Several types of vendors sell CD-ROM network sharing systems. These break down into those companies that develop their own software and those that integrate hardware with software obtained from another vendor. Some vendors will sell direct to end users, while others work only through distribution channels. It is not crucial which type of vendor you choose, but it is important that you know which type you are purchasing from. Different types have differing abilities to provide support, upgrades, and service in the future.

Some of the questions you should ask before purchasing include:

## Will the vendor be there when you need them?

- 1. Years in business
- 2. Financial strength
- 3. Widespread distribution
  Widespread availability
  Local service from local vendors

### Technical strength

- 1. Number of development engineers
- 2. Experience, breadth of product line
- 3. Product maturity
- 4. Technical support Number of dedicated support staff On-line services Hours of operation

#### **Title selection**

Title selection involves both content selection and technical issues. Content selection is familiar ground for any librarian, and I will not address it beyond saying that content decisions are often affected by available technology. Technology decisions now become an added factor in the well-understood process of determining what your patrons need and locating published materials to meet those needs.

# Technology issues

CD databases consist of search and retrieval software and the actual indexed data. The search and retrieval software is usually installed on a central server or on the individual network client PCs, to access data on the CDs located on the CD-server. Each CD-ROM publisher uses a particular search and retrieval engine with their database, and they have widely varying capabilities and characteristics that can affect how you implement your CD-ROM network sharing system.

Some of the things you have to consider in evaluating a CD-ROM database search and retrieval engine include:

- 1. User interface clarity and simplicity. Raw speed is less important than the ease of use.
- 2. Ability to use a variety of types of searches, including proximity searching and fuzzy logic.
- 3. Windows vs. DOS vs. Macintosh. Many published databases still use a DOS based character interface, despite the advantages of modern graphical user interfaces. Relatively few databases are published in Macintosh format, but they always have a graphical interface.
- 4. Can the search engine be installed on a central server and/or local client PCs? There are advantages to both approaches, and you should have the flexibility to choose. Central server installation simplifies system management and reduces the amount of time spent configuring individual client PCs. Client PC installation often provides faster performance, particularly with large search engines. Some search engines do not allow choice forcing installation on individual workstations. This is largely a licensing issue enforced by the publisher, but in some cases is actually a technical limitation.
- 5. Does the search engine support relative paths and the ability to search discs mounted in subdirectories in a volume or share group? Volume (NetWare based systems) grouping or Share (NT based systems) grouping allow multiple discs to be mounted to a single local drive letter on a PC, conserving valuable drive letters on busy or heavily configured networks.
- 6. Ability to search across multiple disc sets without having to mount and dismount individual discs. You should be able to access databases that span discs as a single large database.

Carefully consider how many titles a publisher offers on CD. Publishers that offer large numbers of titles with common search engines reduce the amount of disk space consumed (often a megabyte or more per search application for the files installed on the server/PC) on your server or local PCs to hold the installed applications. Whenever possible, it is better to obtain as many titles as possible from a single publisher to make the most efficient use of your system.

With some notable exceptions, few of the data publishers actually develop their own search and retrieval engineers. Most are primarily in the business of compiling and publishing the data, and a CD-ROM is just another form of book to them. In many cases the search and retrieval engines are actually technology licensed by the publisher. Look for a publisher with either control over their own technology, or an obvious close relationship with a technology provider, with up-to-date software supporting the latest operating systems.

Avoid products with obviously out-of-date search engine technology, technology that is poorly supported by the publisher, or non-standard disk formats.

# **CD-ROM Technology is Changing - Plan For The Future**

CD-ROM technology is and will continue to change very rapidly over the next several years. Some of the key trends and how you can cope with them are:

**Faster CD-ROM drives.** Currently most CD-ROMs are 4X (600kb/sec) or 6X (900kb/sec) speed. By mid-year all major vendors will be selling 8X drives, and all

4X drives being sold will be inventory sell-offs. Excellent buys are currently available in 4X drives as vendors sell down excess stock in anticipation of 8X sales. Fortunately, faster drives generally just plug in to CD-sharing systems without any problems. You do not need to do anything special.

New technology - DVD discs. In late 1996 or early 1997 the first DVD systems will begin to ship, offering dramatic increases in CD-ROM disc capacity. Depending upon the type of system used, DVD capacities will exceed 8 gigabytes, with faster throughput. CD-sharing software vendors will have to develop modifications to their products to add device drivers where necessary, file system translators, and other changes. Most vendors expect to be able to support DVD without major change, and to offer software and system upgrades as needed. More importantly, a high multimedia content combined with the faster throughput of DVD-systems will stress network infrastructure.

**Internet integration and hybrid systems.** Hybrid systems utilizing local CD resources coupled with Internet or dial-up access will provide greater access to more sources of data. Key to implementing these technologies is the ability of your CD-server to run standard network protocols and dial-up services for access to the outside world. This will be easier for systems that depend upon modern, high performance network operating systems like Novell NetWare and Windows NT. Dedicated, single-board systems will have less capability for external access.