
| Morgan, James Jay. "Expansion and Testing of a Meridian CD-ROM
| Network." Public-Access Computer Systems Review 1, no. 1 (1990):
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Introduction

The Indiana University School of Medicine Library installed a Meridian CD Net system running on an IBM Token-Ring network in September 1989. After operating the network for 7 weeks, it expanded the number of active stations from four to eight for a bibliographic instruction class presented to sophomore medical students on 11/3/89. The class of 140 students was divided into six sections that used the system at six separate times during the day. These brief periods of intensive activity indicated that the CD Net system can be used to successfully support up to 8 simultaneous users.

Previous Evaluations of CD-ROM Network Software

The speed of the Meridian software was tested by OCLC as part of a series of benchmark tests of CD-ROM networking systems from Meridian (CD Net), Online Products Corporation (OPTI-NET), and Artisoft (LANtastic) (Watson and Fausey 1989). The complexity of the systems made them difficult to compare, since each requires a different mix of hardware and software. The Meridian system fared quite well in response to inquiries from multiple workstations, while the LANtastic system shone in response to inquiries from a single workstation.

A evaluation of Silver Platter's Meridian-based MultiPlatter network was recently conducted at Boston College. It indicates that the combination of Silver Platter and Meridian software with a 286-based server and high-speed workstations can provide adequate service to 10 network stations (Grant and Stalker 1989).

Development of the IUSML CD-ROM Network

The library's CD-ROM network was inaugurated on Sept. 9th, 1989 with five network stations connected via the network to three CD-ROM drives holding CD PLUS's 1985- Medline data. The CD Net system was installed on the library's IBM Token-Ring network. It ran continuously (24 hours a day) with no observed problems until the server was taken down briefly on November 3rd to prepare for the test described in this article.

The CD Net server is a 386-based IBM-compatible microcomputer with

5 CD-ROM drives and a 5-drive expansion box. This server is essentially a more powerful version of the 286-based server sold by Meridian and Silver Platter. At the time of the purchase, Meridian was one of three vendors offering software to operate CD-ROM drives on networks.

Since Silver Platter had chosen Meridian for its network software, we felt it would be the safest choice. (Silver Platter has since started using CBIS software in place of the Meridian CD Net.) We purchased the two competing packages (OPTI-NET and LANtastic) for backup, but have not used them.

The principle CD-ROM database used by the library is Online Research Systems' CD PLUS. Online Research Systems provides all of Medline back to 1966 on eight CD-ROM disks, updated monthly. The user can search five years of Medline at a time, rather than the one or two year segments common to other CD-ROM programs. (See Brahma (1989) for a comparative review of CD PLUS and four competing products.) Online Research Systems sells several configurations of single-user workstations with three to eight CD-ROM drives at prices ranging up to \$18,000 per workstation.

IBM Token-Ring Network

The CD Net system runs on an IBM Token-Ring network on the Indiana University-Purdue University Indianapolis (IUPUI) campus. This network uses standard shielded twisted pair wiring, and it runs at four megabits-per-second (MBS).

In November 1988, we began to specify the newer 16/4 cards from IBM, so we now have a mixture of older and newer cards. Although we do not currently run at 16 MBS, this allows for future expansion. We also felt that the 64 KB buffer in the newer cards might offer a significant advantage in working with large files. As a bonus, we have discovered that the newer cards are compatible with a wider variety of machines and processor speeds than the older cards, and allow us to use some of our Zenith, Epson, and IBM computers that would be otherwise unusable. (For a note on compatibility between IBM adapters and their own computers, see LAN Magazine (1989).)

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Network CD-ROM Software: Meridian CD Net

Meridian's system relies on both software and hardware to overcome limitations of networks and of CD-ROM drive speed. The drives are high speed Toshiba drives connected by a SCSI drive controller. The machine has 512 KB of memory (RAM), and uses over 400 KB to create a cache in memory (RAM) that stores recently retrieved material that is likely to be requested again. Its communication software receives data requests from the network, and fills them from either the RAM cache or from the appropriate disk. While one request is being met, other incoming requests

are stored in a small buffer. The system boots from a 360 KB floppy containing the network and the CD Net software.

Meridian's diagnostic software allows the user monitor several categories. The monitor screen gives a constant indication of the number of data requests from the network, the number met from the RAM cache, and the number met from the CD-ROM disks. It also shows the position of the drive heads at any moment, and whether or not a disk has been inserted.

Installation of the network was slowed by inadequate and incorrect documentation of key points, but the actual installation process was quite simple. The RAM board was damaged in shipment, but Meridian was quite helpful in diagnosing and replacing the faulty board.

Meridian Workstation Requirements

Unlike some network software, the Meridian network requires that each workstation have its own copy of MSCDEX.EXE, the Microsoft CD-ROM Extensions. Since the workstations must have an 8 KB buffer in its memory for each CD-ROM disk it contacts, this can use a lot of the workstation's memory. To provide access to an eight station CD-ROM server, the workstation must load DOS, the IPX.COM network program, MSCDEX.EXE and 64 KB of buffer space. Non-Micro Channel workstations will also need to load TOKREUI.COM to use the Token-Ring board.

Thus, available memory on a 640 KB station might well be less than 500 KB before the station begins to load a CD-ROM search program. This limit will prevent some CD-ROM software from running, and is a factor in favor of network systems like LANTastic that load the Microsoft CD-ROM Extensions on the server.

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Online Research's CD PLUS MEDLINE Search Software

CD PLUS looks for an index drive to be mounted in CD-ROM drive 0, and for it's other 7 disks to be mounted in a precise order if you have 3 or 8 drive configurations. Meridian's CD Net software doesn't provide any facilities to designate different drives as drive 0, so this inflexibility has required us to use drives 0 through 3, or 0 through 7 for CD PLUS. (Silver Platter has developed a more flexible scheme to accommodate its multiple disk databases, and it's program will check all available disk drives for Silver Platter disks.)

At the time of the test, CD PLUS's requirements for its stand-alone workstation included 13 MB of disk space, 506 KB of RAM, and additional RAM to load the DOS PRINT.COM program. Because of these memory requirements, we were only able to load three CD-ROM disk buffers before running out of memory. Thus, we could only mount the last four years of Medline for our test.

In late November, Online Research Systems introduced a newer version of the CD PLUS program that required only 410 KB. They reduced their memory requirements in connection with the introduction of their own network software, which is currently in beta testing. This enabled us to mount all 8 Medline disks and to provide the complete database back to 1966 on the network.

In addition to 13 MB of disk space, CD PLUS search software can use RAM disk buffers of 2 MB and above, when available. The hard disk space is used for indexes and for a 3 MB disk buffer. (Online Research Systems says their forthcoming network version will require much less disk space on individual workstations.)

The CD PLUS search software uses the hard disk and a RAM disk (if available) to reduce it's demands on the CD-ROM drive. On a network this reduces its demands on the CD-ROM server, and gives it a comparative advantage over software which makes less use of hard disks and available RAM.

CD PLUS also loads Medline citations for the 1985- period on one disk, and the corresponding abstracts on two other disks. This has the effect of focusing inquiries on the citation disk in drive 0, and may slow down response time. However, it also means that some segments of drive 0 will be in the 3 MB hard disk buffer, the workstation RAM buffer (if there is one), and the CD-NET server buffer. Use of these buffers improves performance, and may offset the fact that most searches are done on the citation disk.

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Meridian CD Net Test

We tested CD Net on the Library's IBM Token-Ring network. The only database mounted on the Meridian 386 server was the CD PLUS Medline CD-ROM.

For the test, we set up eight active workstations. These included an IBM PC XT with a Hardcard, a Zenith Z-159 with a Hardcard and 128 KB RAM buffer, a Z-159 with a hard disk, 3 IBM PS/2 Model 30-286 machines with hard disks, a IBM PS/2 Model 50-Z with hard disk, and a IBM PS/2 Model 80 with hard disk. One additional Z-159 with Hardcard and RAM buffer was used by the instructor. All workstations were using the newer 16/4 Token-Ring boards except the IBM PC XT, which was using a 4 MBS Token-Ring board.

The various configurations of processor speed, hard disk speed, and buffers means that the speed at the different workstations varied noticeably. This is particularly true with the CD PLUS software, which, even more than most CD-ROM search software, relies heavily on hard disks and local processing to avoid going to the CD-ROM drive.

On November 3 1989, the Medical School Library gave a presentation to 140 sophomore medical students as part of their

introductory course work. One of three sessions presented throughout the day taught users how to search CD PLUS Medline.

The instructor (M. Richwine of the Indiana School of Medicine Library) gave six 40-minute presentations on searching using CD PLUS, including detailed instructions for using the "explode" command to search medical definitions. The students were then given one of two search questions, and asked to form small groups to answer the question. Each session provided a brief period (i.e., 10-15 minute) of intense use of the network.

The two search questions assigned by the instructor were:

1. Print the citations and medical subject headings for a review article written in English on the use of vp16 (etoposide) to treat lung cancer.
2. Print the citation and MeSH subject headings for an article written in English on the use of tretinoin for skin cancer in an adolescent.

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Results

During the test on November 3rd, the six periods of student use generated 18,758 requests to the server. Of these requests, 5,073 (26.99%) requests were met from the server's RAM cache without going to the CD-ROM drives. This percentage is almost identical to the 27% cache rate we had in our first seven weeks of operation, from September 9th through November 2nd. Thus, the test was a good emulation of normal searching activity.

I had expected a higher percentage would be met from the cache, since the students were all searching the same two questions. However, the timing of their searches and the relatively small size of the server buffer combined to imitate normal search activity.

The network met the increased load with little evidence of strain. The Meridian monitor software indicated pending requests were as high as six at the highest point during an afternoon session. However, only a slight slowdown was apparent to reference staff, who were experienced with the system. During most periods of heavy use, the number of requests pending fluctuated between two and four.

Heaviest disk use (multiple disk reads) occurred during "mapping" the original terminology to the MeSH index, "exploding" the resulting MeSH term to include multiple subheadings, and then "limiting" the results to a certain category. The mapping action resulted in from 15 disk access for vp16 to 71 for skin cancer. The explode action created from 50 to 70 reads, depending on the topic, and could vary even more depending on whether or not all "trees" were included. The limit action created no reads for

limits indexed on the hard disk (such as English language articles), but from 28 to 32 reads for limiting to categories like "reviews" or "adolescents."

Other periods of brief activity were created by starting the software, choosing a synonym, combining sets, and browsing. All of these activities required 3 or fewer reads, except browsing a citation which required 6. The use of the "explode" and "limit" commands are typical of trained searchers, and represent more sophisticated and intense use of the drives than the use we get from our typical end users.

Discussion

The test indicated to us that CD PLUS software can be used with the Meridian CD Net system to support at least eight heavily used workstations. We are not yet able to test Meridian's claims of being able to support 25 heavy-use sessions with this system, but at the moment it seems quite possible.

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Even in this test of intense use at eight workstations, the pending request log at the server fluctuated from 0 to a high of 6, with long periods of activity in the 2 to 4 range. In our normal pattern of use such heavy activity only appears at peak times in mid-afternoon, and even then we would not normally have "trained" searchers doing the more time-consuming explode and limit commands at every station.

In periods of light use, we can support far more than eight workstations. Given typical user queuing patterns, heavy use of our available workstations is relatively infrequent.

In the LAN environment, additional stations can be logged into the CD Net server and CD PLUS software without creating any demand on the server until they actually generate an inquiry. Therefore, we presume that we can have the CD-ROM server available to a large number of users without straining the network most of the time.

Future Plans

After the test, we planned three steps to expand use of the network. The first was to bring up all of Medline (eight CD-ROM drives) as soon as CD PLUS reduced its memory requirements. This was done in late November. (We have also added a ninth CD-ROM disk from another vendor.) The second was to install additional workstations within the library, and to merge our CD-ROM network with a second Token-Ring network in the library. The third was to link our network to the campus network to allow selected outside access. Our test gives us confidence that these actions can be supported by our existing equipment.

Conclusions

Over the past few years it has been difficult to predict the evolution of CD-ROM use. As early as 1985, I can remember being told at a CD-ROM conference in Philadelphia that the price of CD-ROM drives would soon drop to the \$300 dollar level, and that such a low cost would make it possible to put them on any workstation. Since then, several years have been proclaimed as the "year of the LAN," when networks would be cheap and easy to install. This has created a race in the CD-ROM market between those who would supply drives to every workstation and those developing multiple-drive network servers.

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To meet our library's requirements, this race is just about over. We would need at least three to eight drives available at every single-user workstation to deliver Medline or an acceptable subset of Medline, never mind other data bases we would like to have. Even if CD-ROM drives dropped to the \$300 range (and I haven't seen much movement since 1985), the space required to stack three to eight drives would be an obstacle.

On the other hand, networks have become easier to set up and manage. First the Token-Ring network and now Ethernet can be run on the same twisted pair wiring that is used for telephone lines. At the software level, the introduction of four competing CD-ROM network systems from Meridian, Online, Artisoft, and CBIS is making the field quite competitive. Because of the comparative economic advantage of networking, the same CD-ROM software vendors that told me in 1987 that CD-ROM drives were too slow to serve networks were busy in 1989 introducing networked CD-ROM systems.

CD-ROM drives are indeed slower than magnetic hard drives on network servers, and even the faster 12" optical drives are slower than magnetic equivalents. However, CD-ROM network systems have used buffering to compensate for this slowness, since stations typically request the same data again and again. In the network we have set up, multiple buffers in the workstation and in the server help overcome the relative slowness of the drives.

The cost of CD-ROM subscriptions may affect the decision to go with either stand-alone workstations or a network. However CD-ROM vendors seldom have multiple copy discounts (Silver Platter is a nice exception), and most have not figured out how to charge for network access, so, at the moment, subscription prices cannot be factored into this decision easily. Except for this unknown quantity, it appears that CD-ROM network systems are a cost-effective way to provide CD-ROM database access to multiple users.

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Acknowledgements:

The author is grateful to M. Richwine of the Indiana University School of Medicine Library for use of the test questions and her help in analyzing the questions, and to the Library administration for its encouragement of experimentation.

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