INTERNET AND WAN ACCESS OPTIONS

By Richard W. Boss

Twenty-five years ago libraries had two simple choices when seeking to access a remote computer: dial-up or leased voice-grade telephone circuits. In most cases, bandwidth was limited to 1,200 bits per second or 1.2 Kbps. Both options continue to be available, but bandwidth over voice-grade lines now is a minimum 56 Kbps when suitable hardware is used. For many libraries 56 Kbps is not enough, however, because they are seeking to access both the graphics-rich Internet from a number of PCs simultaneously and to maintain a WAN (Wide Area Network) to connect multiple library facilities to an automated library system.

Libraries now face a bewildering array of options, including dial-up and leased telephone company (telco) circuits of several types, CATV modems, and satellite modems. Not all are available in all areas, but almost every library has several options available.

OPTIONS

Most of the options are provided by telcos, but cable TV (CATV) and satellite options are becoming more widely available. While CATV companies have a tremendous opportunity to become the leader for delivering data communication, they face serious limitations in today's cable access equipment and in their experience with data. Unlike telco equipment, CATV equipment is not engineered to provide 99.99+ percent reliability. It is also not easily and quickly scalable, meaning that a surge in demand can saturate a CATV system unless substantial excess capacity is installed well ahead of the need. Finally, the vast majority of CATV managers and technicians have little experience with data. For these reasons, few CATV companies bill themselves as MSO's (Multiple Service Offerors). While cable modems are not yet widely used by libraries, given a CATV company with a good track record in providing data communication, it is an option that should be seriously considered.

The satellite option is somewhat safer than CATV because most of the providers have extensive experience with data even though much of their revenue may come from satellite TV. The equipment is highly reliable and easily and quickly scalable. The most serious limitation is that the satellite dish must have an absolutely unobstructed view of the southern sky. Even a partial obstruction by a tree limb can adversely affect the signal. Professional installation of the dish is essential.

Telcos offer the highest level of reliability and scalableness--nearly 100 percent reliability and scalable to such a degree that the number of users can briefly surge with only temporary deterioration in response times, and an increase in demand that is not temporary can be accommodated in a matter of days. Telcos are also the most experienced with data. Finally, they offer an extremely wide range of options.

The telco options are the most widely used, therefore, they will be discussed first.

Telco Options

Dial-up telco circuits utilize inexpensive modems and support download (receiving) and upload (sending)

speeds of up to 56 Kbps over voice-grade telephone lines. The service is measured on the basis of distance, time of day, and length of connection. Dial-up can be a cost effective way to access the Internet if a circuit is within a single local calling area and is used fewer than 20 hours per week.

Leased telco circuits can be voice-grade analog, conditioned analog, or digital. An analog circuit is limited to download and upload speeds of 56 Kbps unless multiple circuits are combined. A leased circuit is dedicated, therefore, it is always open and available for use. Analog service is priced on the basis of distance. If the distance is greater than 15 miles, it often is more cost effective to contract for an option that is Adistance independent. The most common telco offering that does not base prices on distance is a leased frame relay circuit. The most common digital circuits are ISDN and xDSL. They are described in the following paragraphs.

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ISDN (integrated services digital network) is an international communications standard for sending voice, data, and video over digital telco circuits. ISDN supports data transfer rates of 64 Kbps. Two lines usually are combined to provide a rate of 128 Kbps. When fiber optic cables are used a transmission rate of 1.5 Mbps is possible, however, fiber optic cable is not widely available . ISDN circuits are limited to 20,000 feet, therefore, the user must be close to a telco switching station. The service is priced on a flat rate approved by a state public utility commission.

xDSL (Digital Subscriber Lines) refers to all types of digital telco circuits, the two main categories being ADSL and SDSL. xDSL is similar to ISDN in that it requires a short run of less than 20,000 feet to a telco switching station. However, xDSL offers much higher rates--up to 32 Mbps for downloads and from 32 Kbps to 1 Mbps for uploads. When the download rate is greater than the upload rate, the category is ADSL (Asymmetric Digital Subscriber Line); when the download and upload rates are the same, the category is SDSL (Symmetric Digital Subscriber Line). The service is priced on the basis of bandwidth.

T-1 Carrier is a leased telco circuit supporting data rates of 1.544 Mbps per second. A T-1 line actually consists of 24 individual channels, each of which supports 64 Kbps. Most telcos offer the option of leasing just some of these individual channels, known as **fractional T-1 access**.

Because the circuits are dedicated, bandwidth is guaranteed. The service is priced on the basis of bandwidth and distance.

T-3 Carrier is a leased telco circuit supporting data rates of 43 Mbps. A T-3 line actually consists of 672 individual channels, each of which supports 64 Kbps. T-3 lines are used mainly by Internet Service Providers connecting to the Internet backbone and for the backbone itself.

Frame Relay is based on transferring data in packets via a T-1 telco circuit. It is available not only at the full T-1 bandwidth of 1.544 Mbps, but also as fractional frame relay. While 64, 128, 256, 512, 640, 768, and 896 Kbps are common fractional frame relay offerings, most telcos limit the number of choices to four. Because the circuits are shared, bandwidth is not guaranteed. When there is not enough bandwidth available, the bandwidth is shared and the excess data is temporarily buffered. The service is priced on the basis of the number of ports (the connections at the locations) and the bandwidth. Distance is not an element in the pricing, therefore, it is particularly attractive when the distance to an ISP is more than 15 miles and/or the WAN covers a large geographic area. Frame relay is particularly attractive when there are at least eight ports because the fixed price of the virtual circuit, which connects the ports, is then distributed over a large number of locations.

ATM (Asynchronous Transfer Mode) is based on transferring data in packets of a fixed size over a telco circuit. ATM creates a fixed channel or route whenever data transfer begins. The packets travel together and because they are of fixed size, travel very rapidly--up to 622 Mbps. ATM differs from TCP/IP, the protocol of the Internet, in which the packets take different routes from source to destination. Prices are based on bandwidth and distance.

CATV Companies

CATV modems, also known as cable modems, are devices that allow high-speed access to the Internet or to a remote computer via a cable TV company=s circuit. The circuit can consist of coaxial or fiber optic cable, or a mix of the two. Download speeds of up to 2 Mbps and upload speeds of up to 128 Kbps are possible. The Data Over Cable Service Interface Specification (DOCSIS) is the dominant cable standard. Pricing is based on bandwidth.

Satellite Companies

Satellite modems connect to a satellite dish capable of downloading at up to 400 Kbps and uploading at up to 60 Kbps. Most companies, which own satellites, lease capacity in much larger bundles than library can afford. The companies, which offer data via satellite, lease capacity and resell it in smaller units. Among the largest of these companies is EarthLink. The company sells and installs satellite modems, often through distributors, and provides support services. The monthly subscription price is based on the number of PCS sharing the modem.

Wireless Companies

There are hundreds of companies, which provide wireless telephone service. An increasing number of these are now offering data communication, usually at a flat monthly rate. Among the largest of these companies are VoiceStream Wireless Corp. and Boingo Wireless Inc. The focus has been on supporting PDAs and other handheld devices. However, AT&T, AT&T Wireless Services, Cingular Wireless, and Intel have launched Project Rainbow, an effort to build a nationwide high-speed wireless service based on the IEEE 802.11b wireless network standard. Within a local area users would have 11 Mbps service for a flat monthly rate based on the number of minutes in the contract. It may take several years and billions of dollars to complete the

nationwide network. Presumably, it will be introduced a few localities at a time.

DETERMINING THE NEED

The first step in selecting an option is determining the amount of bandwidth required. While a single PC accessing the Internet requires 56 Kbps of bandwidth, multiple PCs sharing a circuit require 16 to 32 Kbps each. The reason is that they are rarely all downloading or uploading simultaneously. As the number of PCs increases, the bandwidth required per PC goes down. A common formula is 32 Kbps each for up to six PCs, 28 Kbps each for 12 PCs, and 24 Kbps each for more than 12 PCs. A 128 Kbps circuit could, therefore, support up to four PCs accessing the Internet; a 256 Kbps circuit could, therefore, support up to nine, and a 512 Kbps circuit could support up to 21. A library that has more Internet machines than circulation and dedicated patron access catalog machines should expect to support a smaller number of PCs on a circuit than the formula suggests. It is, therefore, a good idea to evaluate performance as the number of PCs connected is increased.

Libraries with branches, or libraries in an automation consortium, will require a WAN to connect the remote peripherals in library facilities to the central site. Presumably, each site will have a mix of remote peripherals, including circulation and patron access catalog workstations. Some facilities may have technical services workstations. Each type will have different bandwidth requirements. The requirements will also vary from one automated library system to another because of differences in design. For example, the extensive use of Java has reduced bandwidth requirements. Bandwidth requirements for an automated library system should, therefore, be obtained from the vendor of the system. However, most automated library systems require less bandwidth per remote peripheral than is required for Internet access.

Once the current bandwidth requirement has been determined, a projection of future need should be made. If it is likely that more bandwidth will be needed in future years, the options that should be pursued are those that can be scaled up as needed. The options which best meet this need are fractional T-1, fractional frame relay, CATV modem, and satellite modem. If the terms of the contract permit it, the bandwidth can be increased to a higher level when needed. While the rate will increase, there should be no penalties for changing to a higher bandwidth tier.

Changing from one option to another can be costly. At best, it may involve a change in hardware; at worst, it may involve a change in vendor. If the change occurs before the contract period is up, there may very well be an early termination penalty. It is, therefore, a good idea to confirm that there is a growth path and acceptable terms for the option selected.

If the total bandwidth requirement for a facility is 55 Kbps and the number of hours of use is fewer than 20 per week, a dial-up telco circuit is the obvious choice; if the use is more than 20 hours per week, a leased circuit

will probably be more cost effective. When more than 55 Kbps of bandwidth is required, the next step up is ISDN, xDSL, fractional T-1, or fractional frame relay from a telco; a CATV modem; or a satellite modem. A single contact with a telco may be enough to obtain a quote for each of up to four options. More than one telco may offer service in an area. All should be contacted. Typically, there is only company to contact for a CATV modem, and one or two for a satellite modem.

COSTS

The costs for equipment vary from under $50 for a basic dial-up modem to many hundreds of dollars for a satellite dish. More significant are the monthly costs for access. These are based not only on the amount of bandwidth required, but also the pricing formula of the service provider and the regulations under which the service provider operates. For example, frame relay is twice as expensive in some areas of the Southwest than it is in some areas of New England. In the former case, the local telco seeks to recover all of the cost of building the infrastructure for frame relay from the users of the technology; in the latter case, the local telco seeks to spread the cost of building the infrastructure for frame relay over its entire customer base. The public utilities commissions of the states approved these approaches.

Two-year contracts generally are less expensive than one-year contracts, and month-to- month contracts are most expensive of all. Three-year and five-year contracts are sometimes available, but they often lock a library into a rate which is attractive at the time a choice is made, but unattractive after two years because data communication rates have a tendency to go down from year to year.

The follow chart summarizes typical costs for bandwidth, however, it is not uncommon for rates in some areas to be as high as three to four times these figures:

Download Speed	2-Year Agreement	1-Year Agreement	Month-to-Month
56 Kbps	$50.00/month	$70.00/month	$90.00/month
128 Kbps	$70.00/month	$90.00/month	$110.00/month

256 Kbps	$90.00/month	$110.00/month	$130.00/month
512 Kbps	$120.00/month	$140.00/month	$180.00/month
768 Kbps	$150.00/month	$210.00/month	$250.00/month
1 Mbps	$180.00/month	$210.00/month	$250.00/month

The highest cost for 1 Mbps that the author has seen in his work with libraries is $900 per month per port for frame relay, although T-1 Carrier would be more expensive over a substantial distance as, of course, would options which offer more than T-1 bandwidth.

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