

Business Owner's Guide to Internet Connectivity

White Paper

Abstract

Nearly every business today requires Internet connectivity. This is a radical departure from as little as five years ago when it was only the largest companies that had general Internet access. Today, it's no longer a question of whether or not to have it, rather the question is how much is needed and how to gauge usefulness of the connection once acquired. In this paper, we'll discuss Internet connectivity, how it works, how much it should cost, and what options are available to your organization.

Background

Getting a connection to the Internet has always been difficult and even though significant advancements have been made in the technology involved, it's still an obtuse and often frustrating experience for non-technical people. MicroData is often asked:

- why does it seem so difficult, and
- why is it so expensive?

Unfortunately, most users' experience with the Internet comes in the form of e-mail or a web browser. Both of these experiences are pretty straightforward and even the most technologically unsophisticated user can master these two areas quickly. The problem is that the underlying technology to make e-mail and web browsers work is some of the most complicated in the information technology field. There are essentially three areas that must be managed to establish Internet connectivity:

- The actual connection to the Internet,
- The ISP providing services, and
- The internal network configuration required to use the Internet connection.

Before we tackle these, let's first focus on the underlying structure of what the Internet is.

The Internet is a network – similar in many ways to the network your organization might have. More precisely, the Internet is a network made up of networks. As you are probably aware, connecting to any network requires some type of physical connection (sometimes a wireless connection, but that really isn't a viable option for corporate Internet access – yet). Deciding upon a connection method should be one of the first considerations.

I mentioned that deciding upon a connection method should be done first because this takes the longest period of time to accomplish. Unless your organization is in a wired building (that is, a building that is already connected to the Internet and you have the option of simply running some wire inside the building to gain access), you will need to place a service order for the connection. If you are purchasing connectivity from an ISP, they may do this for you at the same time that you negotiate how much bandwidth you want to purchase (how fast your connection to the Internet will be). The distinction is important. An ISP usually sells bandwidth. A carrier (phone company or large access provider) usually provides physical wire or fiber. You need both. Further, the capacity of the wire must equal the capacity of the bandwidth you are buying. For example, if you want a 256KB Internet connection for your LAN, you will have to buy 256KB of bandwidth from your ISP and you will have to lease a 256KB line to get the bandwidth from your ISP to your office. Some of the larger national ISP's will bundle these together for you, but they are both always there.

Further, it's interesting to note that delivery of bandwidth doesn't necessarily have anything to do with the carrier that's providing the physical line to your company. In fact, the largest carriers by far in the US are the local telephone providers. However, they provide very little of the Internet bandwidth that ultimately ends up going out over their wires. Also, this hints at where cost savings can and cannot be made. In New England, for example, many locations still are only served by Verizon (the local telephone company). This means that your costs for physical connectivity are pretty well fixed, non-negotiable, and there are no alternatives to consider. Much of the deregulation legislation that has been passed in the past decade is aimed at changing this fundamental concept, but there is still quite a distance to go.

Connection Types

What are the available physical connection options? There are essentially the following:

- POTS
- ISDN
- Frame Relay
- Digital Signal X/T Carrier System (DS1C)
- DSL
- Optical Carrier (OCx)

Let's begin to review each of these options and associated costs. We'll also define some terms that are frequently used for data communications.

POTS is an acronym for *Plain Old Telephone Service*. It is also called the public switched telephone network (PSTN). This is the one that everyone is familiar with. Data can be transferred over telephone voice lines by using of a special hardware device called a modem. The service is very limited in terms of speed, or bandwidth. Bandwidth is the amount of data that can be transmitted in a fixed amount of time. For digital devices, the bandwidth is usually expressed in bits per second (bps) or bytes per second. POTS lines are limited to about a theoretical maximum of 52Kbps. While POTS service is relatively slow, it is generally available everywhere and costs are moderate – typically \$20 - \$30 month plus the cost of the telephone call. Most businesses will not want to use POTS service for shared network Internet access because of its speed.

ISDN technology appeared in the 1980's. ISDN is an abbreviation of integrated services digital network, an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. ISDN supports data transfer rates of 64 Kbps (64,000 bits per second). Most ISDN lines offered by telephone companies give you two lines at once, called B channels. You can use one line for voice and the other for data, or you can use both lines for data to give you data rates of 128 Kbps, three times the data rate provided by today's fastest modems. While ISDN was introduced nearly 20 years ago, it is still not available in many parts of the country. ISDN is strictly distance limited and local carriers were reluctant to install the expensive required circuitry in advance of demonstrated demand. Also, ISDN is generally offered on a measured call basis – a measured call or connection is one that has an associated cost per minute charge. When used for a permanent connection of a corporate network to the Internet, this quickly becomes more expensive than other options and can easily run several hundred dollars per month. The telephone companies have generally abandoned ISDN development in favor of DSL service (talked about below).

Frame Relay is a packet-switching protocol for connecting devices on a *Wide Area Network* (WAN) – such as corporate networks to the Internet. Frame Relay networks in the U.S. support data transfer rates at T-1 (1.544 Mbps) and T-3 (45 Mbps) speeds. Most telephone companies now provide Frame Relay service for customers who want connections at 56 Kbps to T-1 speeds. Frame Relay is of very high quality and service – primarily because it is subject to state and federal tariffs.

A tariff is a mandated service level and set price negotiated between the government body involved and the carrier. In the case of Frame Relay, both the cost and the required services levels are set out under the tariff. This insures a high service level specifically designed for businesses. Banks and their ATM machines are heavy users of Frame Relay service for this reason. Frame Relay service is also available almost anywhere, but installation times can be delayed depending upon the remoteness of the facility being served. One cost advantage of

Frame Relay service is that the connection made by Frame Relay to and ISP is virtual in nature eliminating the per mile connection costs.

For example, a business site with a Frame Relay connection will only have a physical wired connection running a few miles (typically) to a carrier's data center where it will connect into what's called the *Frame Cloud*. The frame cloud is a nationwide backbone that a carrier maintains and to simplify, everyone shares the cloud and connects at a local point.

This keeps costs down as wiring for a business only is required to the closest point of the cloud. Typical Frame Relay pricing is less than \$1,000 per month for a T-1 speed connection. Businesses with multiple sites commonly use Frame Relay to interconnect their sites. To get Internet service, a business simply has its Frame Relay service connect to an ISP's Frame Relay service.

Digital Signal X/T Carrier System (DS1 or more commonly, T1) lines are dedicated phone line connections supporting data rates of 1.544 Mbits per second. A T-1 line actually consists of 24 individual channels, each of which supports a data rate of 64Kbits per second. Each 64Kbit/second channel can be configured to carry voice or data traffic. Most telephone companies allow you to buy just some of these individual channels, known as fractional T-1 access. This service is a point-to-point service, is subject to normal tariffs, and typically has an associated cost per mile of installation. For long distances, this can make the cost of implementing a T1 line prohibitive. Typical deployment costs for a T1 service are similar to Frame Relay service, but can be significantly less where mileage charges can be kept low.

T1's are business class lines and offer high reliability like Frame Relay. Be careful with the designation of T1, also, as it is normal parlance to call any line that provides near 1.5Mbps data rates as a "T1."

DSL Refers collectively to all types of digital subscriber lines, the two main categories being ADSL and SDSL. DSL technologies are a relatively new technology and use sophisticated modulation schemes to pack data onto existing copper phone wires. They are sometimes referred to as last-mile technologies because they are used only for connections from a telephone switching station to a home or office, not between switching stations. This is similar to ISDN, but DSL offers much greater speeds – up to 32Mbps for downstream and up to 1Mbps for upstream.

In general, DSL services are not tariffed. While this makes pricing very compelling (some as low as \$39/month), users need to be cautious to understand that as non-tariffed services, support when something breaks typically gets handled in the same class as other consumer services. This doesn't imply that businesses shouldn't use DSL service, but rather that they need to understand and plan accordingly.

The final media connection standard is Optical Carrier, or OCx. OCx designations are used to specify the speed of fiber optic networks.

The carriers typically interconnect their switching offices with this technology – speeds range up to 155Mbps. Most businesses will not need these types of connections although carriers are wiring cities and many local switching offices with this technology leaving only the last mile or two to be bridged with more conventional media.

Purchasing Bandwidth

Just like for connectivity, bandwidth is measured in terms of bits per second. Bandwidth may be purchased either from your connectivity provider or from another Internet Service Provider (ISP). You cannot purchase more bandwidth than will “fit” into the connectivity you have purchased. As an example, if you’ve purchased a 384KB frame relay connection, you can’t get more than 384KB bandwidth through that line. In some cases you would actually purchase less bandwidth than your line speed – this is mainly related to physical limitations of certain types of connectivity.

For example, if your company wanted a 512KB Internet service, you would have to purchase a T1 connection as there is no 512KB connection available.

At this point, it would seem that shopping for Internet connectivity is pretty straightforward. You simply total the cost of the connectivity and the bandwidth and then you have total cost – or do you? The fact that there is such a wide range of pricing for connectivity hints that there is some other factor that must be considered. That other factor is a topic that ISPs don’t want to talk about. It’s called overselling and here is how it works.

An ISP must themselves purchase Internet bandwidth which they can then resell. On the surface, this would seem to simply be the classic economic model of buying in bulk, repackaging in small quantities, and then reselling. The difference lies in the fact that ISPs sell more bandwidth than they actually have. Before you conclude that all ISP are duping unsuspecting customers, we need to explain this practice a bit more because some degree of overselling is, in fact, reasonable and desirable.

Consider a small ISP with 10 customers who have each purchased T1 service. How much bandwidth does the ISP need to service all those customers? If you guessed 10 x T1, you’ve made the same assumption that many users make and you’re likely off by a great deal. Internet bandwidth is an interesting commodity because you pay for it whether you use it or not. Most organizations never use all the available Internet bandwidth they have for several reasons.

- The web site or servers that you access while at your desk can’t supply information as fast as you can request it because **their** bandwidth is limited. So having a faster connection doesn’t matter – you’re frequently waiting on equipment and a connection somewhere else.
- Organizations tend to use bandwidth in a ‘bursty’ type of fashion. Consequently much of the time, very little bandwidth is actually being used.

This means that it is reasonable and economically beneficial for an ISP to actually have only some fraction of the total bandwidth they resell. A bandwidth ratio of about 1:8 is quite good. So in our above example, if the ISP had 10 T1 customers, they might only have a single T1 themselves to supply that service.

The problem that has occurred in the ISP world is that in an attempt to present ever lower prices to consumers, some resellers have pushed their bandwidth ratio far beyond where it should be. Some particularly bad examples have ratios of 1:60 or 1:80. Some really aggressive ISPs go even beyond that point. Yet all still advertise that the same "T1" service.

What is the lesson to be learned? If you purchase connectivity from a discount provider, expect there to be a performance hit. If you purchase from a top level provider like Sprint, AT&T, Level 3, MCI or one of the regional Bell's, you'll get top level performance, but can expect to typically pay \$500 - \$800/month for T1 bandwidth.

The Internal Network Configuration

Once Internet connectivity reaches your office, what is done with it next? In all cases, some sort of communication device is required to establish the link from your location to the opposite end. In addition, a router is required in order for machines to share the connection.

The router will be configured to work with your network based upon its setup. The actual programming is beyond the scope of this paper and is usually left to the technical professionals. Just be aware that you may have to purchase this router if your ISP doesn't provide it as part of their service. A good quality router can easily exceed \$1,500.

If you have DSL or cable modem service, you won't have a router but typically will have a special modem. This is because these services are normally only intended for a single computer. Aftermarket routers can be purchased to share these connections. Note that with DSL and cable modem services, there is typically only a single Internet address (IP) provided, and it changes each time the connection to the ISP is re-established. This isn't a problem for web browsing, but it doesn't permit the use of an internal e-mail system or remote access options like virtual private networking, or VPN. This is why most businesses do not use DSL or cable modem services although these providers are working to provide 'static' IP addresses to their customers.

Summary

Internet connectivity is no longer a luxury for just high-tech firms to utilize. Now, even small not-for-profit organizations need reliable and cost effective Internet service. By understanding the options, connectivity can be selected that meets the needs and the budget of any organization.