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Internet Access Technologies
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In recent years, the Internet has boomed as individuals and businesses employ its ability to provide access to all kinds of information, communicate with friends and colleagues, debate potential new technologies, and conduct daily business activities. Today's technology offers multiple options for individuals and businesses to gain access to the Internet. Internet access technology is the means of gaining communication to the Internet, and the communication methods and protocols involved in the process.

In this document we will briefly overview the different methods to connect to the Internet, and discuss some of the different aspects of each technology.

Access is provided through dial, broadband, or dedicated technologies (as defined below). The residential services include, Dial-up modem, ISDN, Cable modem, DSL, Wireless, and Satellite. Some carrier-based services that we will take a look at are T1, ATM and Frame-Relay.

Dial-up Modem:

This has been the most common, and typically traditional home and travel Internet access option. Dial-up access is extremely affordable, but at times extremely slow. A modem is a device that converts data from digital computer signals to analog signals that can be sent over a phone line. The most common modems are analog. The newer 56K modems are a transition from analog to user affordable digital technology. Anything under 56k modem access is almost unheard of in today's market. Other options include V.90, and more recently V.92 modems.
Heavy competition by ISP's for people wishing to connect with traditional modems means that prices in this sector have plummeted, with many ISP's offering access for free. Prices vary, however, and for unlimited access the cost is usually about $20 a month. Some providers offer many different dial-up numbers for access from several different locations throughout the country. Remember- dial-up access is just that, you need to dial the number to gain access to the service. Some of the protocols used in TCP/IP dial-up access are:

SLIP - Serial Line Protocol. It transports TCP/IP over dial-up modem line for PC and Macintosh.
PPP - Point-to-Point Protocol. I t supports TCP/IP and IPX over dia-lup modem line for PC and Macintosh.
ARA - Apple Remote Access. It supports Appletalk over dial-up modem line for Macintosh only.
ATCP - Appletalk Control Protocol. It supports Appletalk remote access over PPP dialup connection.
ISDN - Integrated Services Digital Network. It integrates wide area data network service with voice telephone service, described in more detail below.

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ISDN

This is a fast and reliable dial-up connection. The ISDN service is carried from the telephone company along a traditional twisted pair copper cable. This single pair of wires carries two Bearer (B) channels and one Delta (D) channel. These three channels make up an ISDN basic rate line. The B channels carry communication at a rate of 64 kbit/s. The D channel carries all the control information to the digital exchange including dial up information. So passing back and forth along your single ISDN line are two 64 kbit/s B channel data streams and one 16 kbit/s D channel data stream. The line can be used simultaneously for voice calls and Internet access. Because ISDN has two communication paths, you can perform multiple tasks simultaneously. For example, you can send a data file and receive a phone call at the same time without the phone call disrupting the data transmission. The newer ISDN modems are digital to allow for the higher speeds.

Pricing will vary, but is usually under $100 dollars per month with an average installation cost of $195. (1)

- **High Quality Audio** - Broadcasters can establish their own digital quality audio links without having to book expensive analogue music circuits in advance.
- **Internet Access** - Surf the Internet up to four times faster than traditional modems.
- **Data Transfer** - Move anything from just simple data to large video or image files.
- **Desktop conferencing** - Real time on-line document discussion.
- **LAN to LAN bridging** - Establish fast, reliable inter-connection between small Local Area Networks.
- **Newspapers** - Press photographers can instantly relay their pictures around the world.
- **Home / Remote Working** - Remote Access is possible to your LAN or computer network from any ISDN line, be this at home or in one of the increasing number of hotels offering ISDN lines.
- **Video conferencing and videotelephony** - Opening a new world of opportunity - distance learning, business meetings and access to remote expertise.
- **Video Surveillance** - Allowing police and security firms to monitor live pictures from remote surveillance cameras using video codecs.

Cable:

Many television cable companies, such as Time Warner, offer high-speed data services over their cable networks. The speeds can be impressive—although generally cable companies will not publish speed rates, download speeds can be in excess of 600

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k/sec. Prices vary, but they are generally affordable, sometimes as low as $40 per month. The only real challenge with cable modem access is that the speed of the service depends on the number of customers on your network segment. If there are many customers in your “node” using the network at the same time, performance can be frustratingly slow. Another thing to note is that cable companies do not guarantee any rates of speed; they usually just say that access is “fast” to describe their speed rates.
Cable circuits are asymmetrical, meaning the download speed is much higher than the upload speed. Most cable companies limit upload speeds to 128k/sec. (2)

Some security risks with cable modem access:

1. Security Issues inherent in any method of Internet access
data flows through routers, IP spoofing, etc.
2. Shared medium of coaxial cable offers exposure that does not exist with dial-up telco modems
3. Administrators may view your traffic
4. Continuous connection to the Internet means that hackers have more time to break into your system
5. High-speed connection means that large files may be downloaded very quickly
6. Windows file sharing
7. Possible theft of cable modem service
8. Denial of service attacks

XDSL family:

DSL technology uses traditional copper wire (your phone line) and existing phone circuits to deliver high-speed data services at prices that are generally lower than other options. Connectivity speeds generally start at 128/k sec, and can scale up to speeds in excess of a T-1 line)
DSL options vary, and are dependent on the telephone-wiring infrastructure in your area. Distance to a telephone company box called a DSLAM or CO (for Central Office) will determine the maximum rate of speed available to you.
Unfortunately, DSL has been slow to reach some markets. One reason for DSL’s slow rollout is the so-called "3-mile rule." The DSL signal degrades rapidly as it travels from the provider's central office to individual homes receiving the service, and after about 3 miles it becomes too faint to sustain a reliable connection. (3)
DSL circuits can be either symmetrical or asymmetrical. The “consumer grade” circuits are generally asymmetrical (limiting upload speeds to 128k on circuits that allow download speeds as high as 500-600k/sec) but for additional fees symmetrical service is available in some areas. Symmetrical DSL is sometimes referred to as “business class” DSL. DSL rates vary between locations and availability, but generally run about $50 a month, with installation waived (since they send the modem to you to install).

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T-1:

A T1 is a term for a digital carrier facility used to transmit a DS-1 formatted digital signals at 1.544 megabits per second. This is made up of 24 digital channels. This requires a digital connection device (CSU/DSU {customer switching unit/digital switching unit}) to connect to four wires to carry the information. Most small Internet providers have a T1 (or a fractional T1) line as their connection to the Internet. A Full T1 should accommodate from one to over 200+ users and other services from an Internet provider. Unlike the modem that is in most computers, a T1 line requires a CSU/DSU and the connection.

The T1 is like a large water main that serves a city, a large amount of water or traffic flows through it. Unlike the water hose in your front yard (your modem), the T1 is the major carrier of the Internet traffic. The T1 connects the backbone provider to the ISP provider via the telco (telecommunications provider) The signal comes into the CSU/DSU and then goes to the router. From there it goes into the master name server and may be routed to other servers. One of these severs may be a modem or terminal server that allows you to connect to the Internet. You log in and are verified as a user on the local network and then are allowed to proceed to the larger network (Internet).

A CSU/DSU [Channel Service Unit / Data Service Unit] is a piece of equipment that connects a leased line from the telephone company to the customer's equipment (such as a router). It performs line encoding and conditioning functions and often has a loopback function for testing. Although CSU/DSU's look similar to modems, they are not modems, and they don't modulate or demodulate between analog and digital. All they really do is interface between a 56K, T1, or T3 line and serial interface (typically a V.35 connector) that connects to the router. Many newer routers have 56K or T1 CSU/DSUs built into them. CSU/DSU's for 56K, T1, and T3 lines are NOT the same and are not interchangeable as a general rule. In the case of a T1 CSU/DSU, it passes the data in 64K chunks (time slots) on the 24 different channels (64K x 24 = 1.54MB). (4)

Frame-Relay

A “frame relay” T-1 is generally the most affordable version of the circuit. By using the phone company’s frame relay “cloud” to combine the data traffic of many T-1 circuits that the Phone Company sells, it is able to offer the connectivity at a reduced price. Also, some ISPs (Internet Service Providers) charge less for Internet services delivered via frame. The down side is that the Phone Company will only guarantee half of the stated speed of the circuit at any given time.

Three Different Components of Frame Relay

Fundamental building blocks of frame relay networks include three major components: the local loop, the port, and the virtual circuit. Network equipment required to "ride" on

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frame relay networks includes frame relay access devices (FRADs), bridges, and multi-protocol routers. A brief discussion of the key components and equipment follows. (5)

PVC - Permanent Virtual Circuit
A frame relay logical link, whose endpoints and class of service are defined by network management. A PVC (often referred to as a PVC) consists of the originating frame relay network element address, originating data link control identifier, terminating frame relay network element address, and termination data link control identifier. Originating refers to the access interface from which the PVC is initiated. Terminating refers to the access interface at which the PVC stops. Many data network customers require a PVC between two points. Data terminating equipment with a need for continuous communication use PVCs.

PORT
The frame relay port is the interface point where the local loop meets the frame relay network. It can be literally mapped to a synchronous interface module and port on a particular frame relay switch. The frame relay port represents the maximum speed which data can enter (ingress point) or leave (egress point) a frame relay network. This maximum speed is often referred to as the maximum information rate (MIR) in carrier service level agreements. This is the maximum rate that data can burst to a virtual circuit.

LOCAL LOOP
The network access circuit is the data pipe that connects the customer network to the frame relay point of presence (POP). Supported methods include synchronous technologies such as N x DS0 (fractional T-1), DS1 (T-1), N x DS1 (multiplexed T-1), DS3 (45MB), and ISDN BRI or PRI. Data circuits are terminated on traditional DCE devices such as DSU/CSUs or ISDN terminal adapters connected to network equipment referenced above.

ATM:

Asynchronous Transfer Mode (ATM) is the world's most widely deployed backbone technology. This standards-based transport medium is widely used within the core--at the access and in the edge of telecommunications systems to send data, video and voice at ultra high speeds.

ATM is best known for its easy integration with other technologies and for its sophisticated management features that allow carriers to guarantee quality of service. These features are built into the different layers of ATM, giving the protocol an inherently robust set of controls.

Sometimes referred to as cell relay, ATM uses short, fixed-length packets called cells for transport. Information is divided among these cells, transmitted and then re-assembled at their final destination. ATM is a connection- oriented packet switching

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technique in which all packets are of fixed length i.e. 53 bytes (5 bytes for header and 48 bytes for information). ATM supports these applications: (6)

- Teleconferencing
- Telemedicine
- Real-time Collaboration
- HDTV
- Video-on-Demand
- Distance Learning
- High Speed Data Transfer

Wireless:

Using microwaves and other carriers, vendors are able to deliver connectivity via radio waves. Delivery is limited to line-of-site distances between the transmission tower and a receiver. At this time there are still few private vendors offering wireless Internet connectivity. This is a growing technology, and security risks are still high with this type of service. Typically, service is offered in both rural and urban areas at speeds up to 256k, again dependant on your service area. Higher download speeds are usually available for additional fees.
Wireless circuits can be symmetrical – offering identical upload and download speeds.

Satellite:

Using a personal-sized satellite dish, companies such as Direct TV and Primestar offer download speeds at about 400k/sec. Satellite connectivity comes in two flavors…. the older version could only download data (and required a regular phone line to send Internet requests via an analog modem), but newer versions offer 2-way capability. Satellite circuits are asymmetrical: even the new 2-way dishes limit upload speeds to about 128k speeds, but some users have reported speeds as low as 40k for uploading. They are also subjected to what is known as "latency" – it takes from one to several seconds to bounce the Internet request off of the satellite. Despite the issues, the new satellite technology may well be the best option for libraries in areas with no, little, poor, or expensive physical telecommunications infrastructure in their areas.

Summary

Internet access is the basic ability to connect to the Internet, the essential starting point for enjoying its wealth of information, ease of communication, and operational advantages. There are several different access technologies that make accessing the Internet a more feasible and enjoyable experience, depending on the requirements of the user base. As different technologies emerge and mature, the ability to gain access

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to the Internet, or business-to-business communications, will become an increasingly more available, and enjoyable experience.

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