Business Internet Access Overview

Broadband is often called high-speed Internet, because it usually has a high rate of data transmission. In general, any connection to the customer of 256 kbit/s (0.256 Mbit/s) or more is considered broadband Internet. The International Telecommunication Union Standardization Sector (ITU-T) recommendation I.113 has defined broadband as a transmission capacity that is faster than primary rate ISDN, at 1.5 to 2 Mbit/s. The FCC definition of broadband is 200 kbit/s (0.2 Mbit/s) in one direction, and advanced broadband is at least 200 kbit/s in both directions. The Organization for Economic Co-operation and Development (OECD) has defined broadband as 256 kbit/s in at least one direction and this bit rate is the most common baseline that is marketed as "broadband" around the world. There is no specific bitrate defined by the industry, however, and "broadband" can mean lower-bitrate transmission methods. Some Internet Service Providers (ISPs) use this to their advantage in marketing lower-bitrate connections as broadband.

In practice, the advertised bandwidth is not always reliably available to the customer; ISPs often allow a greater number of subscribers than their backbone connection can handle, under the assumption that most users will not be using their full connection capacity very frequently. This aggregation strategy works more often than not, so users can typically burst to their full bandwidth most of the time; however, peer-to-peer (P2P) file sharing systems, often requiring extended durations of high bandwidth, stress these assumptions, and can cause major problems for ISPs who have excessively overbooked their capacity. For more on this topic, see traffic shaping. As takeup for these introductory products increases, telcos are starting to offer higher bit rate services. For existing connections, this most of the time simply involves reconfiguring the existing equipment at each end of the connection.

As the bandwidth delivered to end users increases, the market expects that video on demand services streamed over the Internet will become more popular, though at the present time such services generally require specialized networks. The data rates on most broadband services still do not suffice to provide good quality video, as MPEG-2 video requires about 6 Mbit/s for good results. Adequate video for some purposes becomes possible at lower data rates, with rates of 768 kbit/s and 384 kbit/s used for some video conferencing applications, and rates as low as 100 kbit/s used for videophones using H.264/MPEG-4 AVC. The MPEG-4 format delivers high-quality video at 2 Mbit/s, at the high end of cable modem and ADSL performance. Increased bandwidth has already made an impact on newsgroups: postings to groups such as alt.binaries.* have grown from JPEG files to entire CD and DVD images. According to NTL, the level of traffic on their network increased from a daily inbound news feed of 150 gigabytes of data per day and 1 terabyte of data out each day in 2001 to 500 gigabytes of data inbound and over 4 terabytes out each day in 2002.[citation needed]

Technology

The standard broadband technologies in most areas are DSL and cable modems. Newer technologies in use include VDSL and pushing optical fiber connections closer to the subscriber in both telephone and cable plants. Fiber-optic communication, while only recently being used in fiber to the premises and fiber to the curb schemes, has played a crucial role in enabling Broadband Internet access by making transmission of information over larger distances much more cost-effective than copper wire technology. In a few areas not served by cable or ADSL, community organizations have begun to install Wi-Fi networks, and in some cities and towns local governments are installing municipal Wi-Fi networks. As of 2006, high speed mobile Internet access has become available at the consumer level in some countries, using the HSDPA and EV-DO technologies. The newest technology being deployed for mobile and stationary broadband access is WiMAX.

Multilinking Modems

It is possible to roughly double dial-up capability with multilinking technology. What is required are two modems, two phone lines, two dial-up accounts, and ISP support for multilinking, or special software at the user end. This option was popular with some high-end users before ISDN, DSL and other technologies became available.

Diamond and other vendors had created dual phone line modems with bonding capability. The speed of dual line modems is faster than 90 kbit/s. To use this modem, the ISP should support line bonding. The Internet and phone charge will be twice the ordinary dial-up charge.

Load Balancing

Load Balancing takes two internet connections and feeds them into your network as one double speed, more resilient internet connection. By choosing two independent internet providers the load balancing hardware will automatically use the line with least load which means should one line fail, the second one automatically takes up the slack.

ISDN

Integrated Service Digital Network (ISDN) is one of the oldest high-speed digital access methods for consumers and businesses to connect to the Internet. It is a telephone data service standard. Its use in the United States peaked in the late 1990s prior to the availability of DSL and cable modem technologies. Broadband service is usually compared to ISDN-BRI because this was the standard high-speed access technology that formed a baseline for the challenges faced by the early broadband providers. These providers sought to compete against ISDN by offering faster and cheaper services to consumers.

A basic rate ISDN line (known as ISDN-BRI) is an ISDN line with 2 data "bearer" channels (DS0 - 64 kbit/s each). Using ISDN terminal adapters (erroneously called modems), it is possible to bond together 2 or more separate ISDN-BRI lines to reach speeds of 256 kbit/s or more.

The ISDN channel bonding technology has been used for video conference applications and high-speed data transmission.

Primary rate ISDN, known as ISDN-PRI, is an ISDN line with 23 DS0 channels and total speed of 1,544 kbit/s (US standard). ISDN E1 (European standard) line is an ISDN lines with 30 DS0 channels and total speed of 2,048 kbit/s. Because ISDN is a telephone-based product, a lot of the terminology and physical aspects of the line are shared by the ISDN-PRI used for voice services. An ISDN line can therefore be "provisioned" for voice or data and many different options, depending on the equipment being used at any particular installation, and depending on the offerings of the telephone company's central office switch. Most ISDN-PRI's are used for telephone voice communication using large PBX systems, rather than for data. One obvious exception is that ISP's usually have ISDN-PRI's for handling ISDN data and modem calls.

It is mainly of historical interest that many of the earlier ISDN data lines used 56 kbit/s rather than 64 kbit/s "B" channels of data. This caused ISDN-BRI to be offered at both 128 kbit/s and 112 kbit/s rates, depending on the central office's switching equipment.

Advantages:

1. Constant data speed at 64 kbit/s for each DS0 channel.
2. Two way high speed symmetric data transmission, unlike ADSL.
3. One of the data channels can be used for phone conversation without disturbing the data transmission through the other data channel. When a phone call is ended, the bearer channel can immediately dial and re-connect itself to the data call.
4. Call setup is very quick.
5. Low latency
6. ISDN Voice clarity is unmatched by other phone services.
7. Caller ID is almost always available for no additional fee.
8. Maximum distance from the central office is much greater than it is for DSL.
9. When using ISDN-BRI, there is the possibility of using the low-bandwidth 16 kbit/s "D" channel for packet data and for always on capabilities.

Disadvantages:

1. ISDN offerings are dwindling in the marketplace due to the widespread use of faster and cheaper alternatives.
2. ISDN routers, terminal adapters ("modems"), and telephones are more expensive than ordinary POTS equipment, like dial-up modems.
3. ISDN provisioning can be complicated due to the great number of options available.

4. ISDN users must dial in to a provider that offers ISDN Internet service, which means that the call could be disconnected.
5. ISDN is billed as a phone line, to which is added the bill for Internet ISDN access.
6. "Always on" data connections are not available in all locations.
7. Some telephone companies charge unusual fees for ISDN, including call setup fees, per minute fees, and higher rates than normal for other services.

T-1/DS-1

These are highly-regulated services traditionally intended for businesses, that are managed through Public Service Commissions (PSCs) in each state, must be fully defined in PSC tariff documents, and have management rules dating back to the early 1980s which still refer to teletypes as potential connection devices. As such, T-1 services have very strict and rigid service requirements which drive up the provider's maintenance costs and may require them to have a technician on standby 24 hours a day to repair the line if it malfunctions. (In comparison, ISDN and DSL are not regulated by the PSCs at all.) Due to the expensive and regulated nature of T-1 lines, they are normally installed under the provisions of a written agreement, the contract term being typically one to three years. However, there are usually few restrictions to an end-user's use of a T-1, uptime and bandwidth speed may be guaranteed, quality of service may be supported, and blocks of static IP addresses are commonly included.

Since a T-1 was originally conceived for voice transmission, and voice T-1's are still widely used in businesses, it can be confusing to the uninitiated subscriber. It is often best to refer to the type of T-1 being considered, using the appropriate "data" or "voice" prefix to differentiate between the two. A voice T-1 would terminate at a phone company's central office (CO) for connection to the PSTN; a data T-1 terminates at a point of presence (POP) or datacenter. The T-1 line which is between a customer's premises and the POP or CO is called the local loop. The owner of the local loop need not be the owner of the network at the POP where your T-1 connects to the Internet, and so a T-1 subscriber may have contracts with these two organizations separately.

The nomenclature for a T-1 varies widely, cited in some circles a DS-1, a T1.5, a T1, or a DS1. Some of these try to distinguish amongst the different aspects of the line, considering the data standard a DS-1, and the physical structure of the trunk line a T-1 or T-1.5. They are also called leased lines, but that terminology is usually for data speeds under 1.5 Mbit/s. At times, a T-1 can be included in the term "leased line" or excluded from it. Whatever it is called, it is inherently related to other high-speed access methods, which include T-3, SONET OC-3, and other T-carrier and Optical Carriers. Additionally, a T-1 might be aggregated with more than one T-1, producing an nxT-1, such as 4xT-1 which has exactly 4 times the bandwidth of a T-1.

When a T-1 is installed, there are a number of choices to be made: in the carrier chosen, the location of the demarc, the type of channel service unit (CSU) or data service unit (DSU) used, the WAN IP router used, the types of speeds chosen, etc. Specialized WAN routers are used with T-1 lines that route Internet or VPN data onto the T-1 line from the subscriber's packet-based (TCP/IP) network using customer premises equipment (CPE). The CPE typical consists of a

CSU/DSU that converts the DS-1 data stream of the T-1 to a TCP/IP packet data stream for use in the customer's Ethernet LAN. It is noteworthy that many T-1 providers optionally maintain and/or sell the CPE as part of the service contract, which can affect the demarcation point and the ownership of the router, CSU, or DSU.

Although a T-1 has a maximum of 1.544 Mbit/s, a fractional T-1 might be offered which only uses an integer multiple of 128 kbit/s for bandwidth. In this manner, a customer might only purchase 1/12th or 1/3 of a T-1, which would be 128 kbit/s and 512 kbit/s, respectively.

T-1 and fractional T-1 data lines are symmetric, meaning that their upload and download speeds are the same.

Wired Ethernet

Where available, this method of broadband connection to the Internet would indicate that the Internet access is very fast. However, just because Ethernet is offered doesn't mean that the full 10, 100, or 1000 Mbit/s connection is able to be utilized for direct Internet access. In a college dormitory for example, the 100 Mbit/s Ethernet access might be fully available to on-campus networks, but Internet access speeds might be closer to 4xT-1 speed (6 Mbit/s). If you are sharing a broadband connection with others in a building, the access speed of the leased line into the building would of course govern the end-user's speed.

However, in certain locations, true Ethernet broadband access might be available. This would most commonly be the case at a POP or a datacenter, and not at a typical residence or business. When Ethernet Internet access is offered, it could be fiber-optic or copper twisted pair, and the speed will conform to standard Ethernet speeds of up to 10 Gbit/s. The primary advantage is that no special hardware is needed for Ethernet. Ethernet also has a very low latency.

Rural broadband

One of the great challenges of broadband is to provide service to potential customers in areas of low population density, such as to farmers and ranchers. In cities where the population density is high, it is easy for a service provider to recover equipment costs, but each rural customer may require expensive equipment to get connected. A similar problem existed a century ago when electrical power was invented. Cities were the first to receive electric lighting, as early as 1880, while in the United States some remote rural areas were still not electrified until the 1940s, and even then only with the help of federally funded programs like the Tennessee Valley Authority (TVA).

Several rural broadband solutions exist, though each has its own pitfalls and limitations. Some choices are better than others, but are dependent on how proactive the local phone company is about upgrading their rural technology.

Wireless Internet Service Provider (WISPs) are rapidly becoming a popular broadband option for rural areas.

Satellite Internet

Main article: Satellite Internet

This employs a satellite in geostationary orbit to relay data from the satellite company to each customer. Satellite Internet is usually among the most expensive ways of gaining broadband Internet access, but in rural areas it may only compete with cellular broadband. However, costs have been coming down in recent years to the point that it is becoming more competitive with other high-speed options.

Satellite Internet also has a high latency problem caused by the signal having to travel 35,000 km (22,000 miles) out into space to the satellite and back to Earth again. The signal delay can be as much as 500 milliseconds to 900 milliseconds, which makes this service unsuitable for applications requiring real-time user input such as certain multiplayer Internet games and first-person shooters played over the connection. Despite this, it is still possible for many games to still be played, but the scope is limited to real-time strategy or turn-based games. The functionality of live interactive access to a distant computer can also be subject to the problems caused by high latency. These problems are more than tolerable for just basic email access and web browsing and in most cases are barely noticeable.

There is no simple way to get around this problem. The delay is primarily due to the speed of light being only 300,000 km/second (186,000 miles per second). Even if all other signaling delays could be eliminated it still takes the electromagnetic wave 233 milliseconds to travel from ground to the satellite and back to the ground, a total of 70,000 km (44,000 miles) to travel from you to the satellite company.

Since the satellite is usually being used for two-way communications, the total distance increases to 140,000 km (88,000 miles), which takes a radio wave 466 ms to travel. Factoring in normal delays from other network sources gives a typical connection latency of 500-700 ms. This is far worse latency than even most dial-up modem users' experience, at typically only 150-200 ms total latency.

Most satellite Internet providers also have a FAP (Fair Access Policy). Perhaps one of the largest cons against satellite Internet, these FAPs usually throttle a user's throughput to dial-up speeds after a certain "invisible wall" is hit (usually around 200 MB a day). This FAP usually lasts for 24 hours after the wall is hit, and a user's throughput is restored to whatever tier they paid for. This makes bandwidth-intensive activities nearly impossible to complete in a reasonable amount of time (examples include P2P and newsgroup binary downloading).

Advantages

1. True global broadband Internet access availability
2. Mobile connection to the Internet (with some providers)

Disadvantages

1. Very high latency compared to other broadband services, especially 2-way satellite service
2. Unreliable: drop-outs are common during travel, inclement weather, and during sunspot activity
3. The narrow-beam highly directional antenna must be accurately pointed to the satellite orbiting overhead
4. The Fair Access Policy limits heavy usage
5. VPN use is discouraged, problematic, and/or restricted with satellite broadband, although available at a price
6. One-way satellite service requires the use of a modem or other data uplink connection
7. VoIP is not supported.
8. Satellite dishes are huge. Although most of them employ plastic to reduce weight, they are typically between 80 and 120 cm (30 to 48 inches) in diameter.

Cellular Broadband

Cellular telephones are becoming more and more capable as Internet browsers. The widespread use of cellular phones in most areas has allowed cellular telephone networks to expand quickly into broadband Internet service networks. Since the cellular phone towers are already in place, cellular broadband access is rapidly becoming a popular means to access the Internet, with or without a cell phone.

Most of the cell phones sold today have some kind of support for Internet access. Broadband access is mainly concentrated in the cities at this time (2007), but all of the major U.S. carriers intend to expand the broadband offerings they have. New broadband technologies such as the 3G EVDO Rev. 0 and Rev. A are being deployed for CDMA phones, and HSDPA for GSM phones in the US. Currently (2007), GSM phones in the US are most often on a low-speed EDGE system, however, but HSDPA should catch up soon.

This means that for now, nationwide broadband cellular in the U.S. is only offered by carriers that use EVDO or HSDPA, offering customers a typical 400-700 kbit/s download speed. With cellular speed ratings, the companies always specify a range of typical speeds due to the fact that congested cellular networks mean lower data download speeds. They do not highlight the fact that the technology is capable of 2.4 Mbit/s burst download rates, because this is nowhere near what can ever be expected.

Since cellular networks often cover large areas of the nation, many traveling people prefer cellular Internet access to other technologies such as WiFi wireless and satellite. Although some satellite services allow end-users to reposition their dish antenna, there are

considerable drawbacks to pointing a large satellite dish on a mobile platform (such as an automobile or vessel). Cellular service can normally be received using a small omnidirectional antenna.

Because many people need to connect computer equipment to the Internet, and not just their cell phone, cellular broadband access is available with this in mind. A user with a single computer can access the Internet by tethering their cell phone to their laptop or PC, normally using a USB connection. There are also Cardbus, ExpressCard, and USB modems available that can perform a similar function but require no cell phone. Some of these modem cards are compatible with cellular broadband routers, which allow more than one computer to be connected to the Internet using one cellular connection.

Advantages

1. The only broadband connection available on many cell phones and PDA's
2. Mobile wireless connection to the Internet
3. Available in all metropolitan areas, most large cities, and along major highways throughout the U.S. (See a map)
4. No need to aim an antenna in most cases
5. The antenna is extremely small compared to a satellite dish
6. Lower latency compared to satellite Internet
7. Higher availability than WiFi "Hot Spots"
8. A traveler who already has cellular broadband will not need to pay different WiFi Hot Spot providers for access.

Disadvantages

1. Unreliable: drop-outs are common during travel and during inclement weather
2. Not truly nationwide service
3. Speed varies widely throughout the day, sometimes falling well below the 400 kbit/s target during peak times
4. Asymmetric service: the upload rate is always much slower than the download rate.
5. High latency compared to other broadband services

Remote DSL

This allows a service provider to set up DSL hardware out in the country in a weatherproof enclosure. However, setup costs can be quite high since the service provider may need to install fiber-optic cable to the remote location. Also, the remote site has the same distance limits as the metropolitan service, and can only serve an island of customers along the trunk line within a radius of about 2 km (7000 ft).

DSL repeater

This is a very new technology which allows DSL to travel longer distances to remote customers. One version of the repeater is installed at approximately 3 km (10,000 ft) intervals along the trunk line, and strengthens and cleans up the DSL signal so it can travel another 3 km (10,000 ft).

Power-line Internet

This is a new service still in its infancy that may eventually permit broadband Internet data to travel down standard high-voltage power lines. However, the system has a number of complex issues, the primary one being that power lines are inherently a very noisy environment. Every time a device turns on or off, it introduces a pop or click into the line. Energy-saving devices often introduce noisy harmonics into the line. The system must be designed to deal with these natural signaling disruptions and work around them.

Broadband over power lines (BPL), also known as Power line communication, has developed faster in Europe than in the US due to a historical difference in power system design philosophies. Nearly all large power grids transmit power at high voltages in order to reduce transmission losses, then near the customer use step-down transformers to reduce the voltage. Since BPL signals cannot readily pass through transformers, repeaters must be attached to the transformers. In the US, it is common for a small transformer hung from a utility pole to service a single house. In Europe, it is more common for a somewhat larger transformer to service 10 or 100 houses. For delivering power to customers, this difference in design makes little difference, but it means delivering BPL over the power grid of a typical US city will require an order of magnitude more repeaters than would be required in a comparable European city.

The second major issue is signal strength and operating frequency. The system is expected to use frequencies in the 10 to 30 MHz range, which has been used for decades by licensed amateur radio operators, as well as international shortwave broadcasters and a variety of communications systems (military, aeronautical, etc.). Power lines are unshielded and will act as transmitters for the signals they carry, and have the potential to completely wipe out the usefulness of the 10 to 30 MHz range for shortwave communications purposes.

Wireless ISP

This typically employs the current low-cost 802.11 Wi-Fi radio systems to link up remote locations over great distances, but can use other higher-power radio communications systems as well.

Traditional 802.11b was licensed for omnidirectional service spanning only 100-150 meters (300-500 ft). By focusing the signal down to a narrow beam with a Yagi antenna it can instead operate reliably over a distance of many miles.

Rural Wireless-ISP installations are typically not commercial in nature and are instead a patchwork of systems built up by hobbyists mounting antennas on radio masts and towers, agricultural storage silos, very tall trees, or whatever other tall objects are available. There are currently a number of companies that provide this service. A wireless Internet access provider map for USA is publicly available for WISPS.

iBlast

iBlast was the brand name for a theoretical high-speed (7 Mbit/s), one-way digital data transmission technology from Digital TV station to users that was developed between June 2000 to October 2005.

Advantages:

1. Low cost, high speed data transmission from TV station to users. This technology can be used for transmitting website / files from Internet.

Disadvantages:

1. One way data transmission and should be combined with other method of data transmission from users to TV station.
2. Privacy/security.
3. Lack of 8VSB tuner built into many consumer electronic devices needed to receive the iBlast signal.

In the end, the disadvantages outweighed the advantages and the glut of fiberoptic capacity that ensued following the collapse of the Internet bubble drove the cost of transmission so low that an ancillary service such as this was unnecessary, and the company folded at the end of 2005. The partner television stations as well as over 500 additional television stations not part of the iBlast Network continue to transmit separate digital signals as mandated by the Telecommunications Act of 1996.

WorldSpace

WorldSpace is a digital satellite radio network based in Washington DC. It covers most of Asia and Europe plus all of Africa by satellite. Beside the digital audio, user can receive one way high speed digital data transmission (150 Kilobit/second) from the Satellite.

Advantages:

1. Low cost (US$ 100) receiver that combine digital radio receiver and data receiver. This technology can be used for transmitting website / files from Internet.
2. Access from remote places in Asia and Africa.

Disadvantages:

1. One way data transmission and should be combined with other method of data transmission from users to Worldspace HQ,
2. Privacy/security.

Pricing

Traditionally, ISPs have used an "all you can eat" or flat rate model, with pricing determined by the maximum bitrate chosen by the customer. However the use of high bandwidth applications is increasing rapidly, with increased consumer demand for streaming content such as video on demand, as well as peer-to-peer file sharing.

For ISP's who are bandwidth limited, the "all you can eat" model may become unsustainable as demand for bandwidth increases. Fixed costs represent 80-90% of the cost of providing broadband service, and although most ISP's keep their cost secret, the total cost (January 2008) is estimated to be about $0.10 per gigabyte. Currently about 5% of users consume about 50% of the total bandwidth [1].

Some ISPs have begun experimenting with usage based pricing, notably a Time Warner test in Beaumont, Texas. Bell Canada has imposed bandwidth caps on customers, with pricing ranging from $1 to $7.50 per gigabyte for usage over certain limits. For comparison, note that a typical standard-definition movie is 1-2 GB, while a high-definition movie is 4-5GB. This could conceivably result in a charge of $30 to view a movie.

Broadband worldwide

Main article: List of countries by broadband users

See also

Broadband technologies

- Fiber-optic communication
- List of device bandwidths
- Plain old telephone service (POTS)
- Baseband
- Narrowband
- Local loop
- Back-channel, a low-speed, or less-than-optimal, transmission channel in the opposite direction to the main channel

Broadband implementations

- Digital Subscriber Line (DSL), digital data transmission over the wires used in the local loop of a telephone network
- Local Multipoint Distribution Service, broadband wireless access technology that uses microwave signals operating between the 26 GHz and 29 GHz bands
- WiMAX, a standards-based wireless technology that provides high-throughput broadband connections over long distances
- Power line communication, wireline technology using the current electricity networks
- Satellite Internet access
- Cable modem, designed to modulate a data signal over cable television infrastructure
- Fiber to the premises, based on fiber-optic cables and associated optical electronics
- High-Speed Downlink Packet Access (HSDPA), a new mobile telephony protocol, sometimes referred to as a 3.5G (or "3½G") technology
- Evolution-Data Optimized (EVDO), is a wireless radio broadband data standard adopted by many CDMA mobile phone service providers

Future broadband implementations

- White Spaces Coalition a group of technology companies aiming to deliver broadband internet access via unused analog television frequencies

Broadband applications

- Broadband telephony
- Broadband radio

External links

- Beginners' guide to broadband
- Making User-Centric Broadband in Access a Reality, Alcatel, June 13, 2005, Strategy White Paper
- Corporate vs. Community Internet, AlterNet, June 14, 2005, - on the clash between US cities' attempts to expand municipal broadband and corporate attempts to defend their markets
- Marshall University Center for Business and Economic Research, comprehensive study of the economics of broadband internet access

Broadband Research in Canada, academic research on broadband usage, Ryerson University

Broadband guides from one of the UK's leading broadband portals.

Broadband transmission rates

Connection	Transmission Speed
DS-1 (Tier 1)	1.544 Mbit/s
E-1	2.048 Mbit/s
DS-3 (Tier 3)	44.736 Mbit/s
OC-3	155.52 Mbit/s
OC-12	622.08 Mbit/s
OC-48	2.488 Gbit/s
OC-192	9.953 Gbit/s
OC-768	39.813 Gbit/s
OC-1536	79.6 Gbit/s
OC-3072	159.2 Gbit/s