

Modems

Modems (modulators/demodulators) are data communication devices that convert digital signals to analog signals, and vice versa. Modems allow digital transmissions over analog telephone lines. They allow people to connect their computers with other computers, corporate office LANs, and the Internet. Modems are used to establish connections of the telephone company's local loop, which is the analog copper cable that runs between homes and businesses to the telephone company central office (CO). The phone company then switches the call like any other voice call to create a point-to-point link to the destination.

Analog Versus Digital Transmission

Characteristics of Analog and Digital Networks

Feature	Analog Characteristics	Digital Characteristics
Signal	Continuously variable, in both amplitude and frequency	Discrete signal, represented as either changes in voltage or changes in light levels
Traffic measurement	Hz (for example, a telephone channel is 4KHz)	Bits per second (for example, a T-1 line carries 1.544Mbps, and an E-1 line transports 2.048Mbps)
Bandwidth	Low bandwidth (4KHz), which means low data transmission rates (up to 33.6Kbps) because of limited channel bandwidth	High bandwidth that can support high-speed data and emerging applications that involve video and multimedia
Network capacity	Low; one conversation per telephone channel	High; multiplexers enable multiple conversations to share a communications channel and hence to achieve greater transmission efficiencies

Feature	Analog Characteristics	Digital Characteristics
Network manageability	Poor; a lot of labor is needed for network maintenance and control because dumb analog devices do not provide management information streams that allow the device to be remotely managed	Good; smart devices produce alerts, alarms, traffic statistics, and performance measurements, and technicians at a network control center (NCC) or network operations center (NOC) can remotely monitor and manage the various network elements
Power requirement	High because the signal contains a wide range of frequencies and amplitudes	Low because only two discrete signals—the one and the zero—need to be transmitted
Security	Poor; when you tap into an analog circuit, you hear the voice stream in its native form, and it is difficult to detect an intrusion	Good; encryption can be used
Error rates	High; 10^{-5} bits (that is, 1 in 100,000 bits) is guaranteed to have an error	Low; with twisted-pair, 10^{-7} (that is, 1 in 10 million bits per second) will have an error, with satellite, 10^{-9} (that is, 1 in 1 billion per second) will have an error, and with fiber, 10^{-11} (that is only 1 in 10 trillion bits per second) will have an error

Data Transmission – Parallel vs Serial

What is data transmission?

[Data transmission](#) refers to the process of transferring data between two or more digital devices. Data is transmitted from one device to another in analog or digital format. Basically, data transmission enables devices or components within devices to speak to each other.

What is serial transmission?

When data is sent or received using [serial data transmission](#), the data bits are organized in a specific order, since they can only be sent one after another. The order of the data bits is important as it dictates how the transmission is organized when it is received. It is viewed as a reliable data transmission method because a data bit is only sent if the previous data bit has already been received.



Example of Serial Data Transmission

Serial transmission has two classifications: asynchronous and synchronous.

Asynchronous Serial Transmission Data bits can be sent at any point in time. Stop bits and start bits are used between data bytes to synchronize the transmitter and receiver and to ensure that the data is transmitted correctly. The time between sending and receiving data bits is not constant, so gaps are used to provide time between transmissions.

The advantage of using the asynchronous method is that no synchronization is required between the transmitter and receiver devices. It is also a more cost effective method. A disadvantage is that data transmission can be slower, but this is not always the case.

Synchronous Serial Transmission Data bits are transmitted as a continuous stream in time with a master clock. The data transmitter and receiver both operate using a synchronized clock frequency; therefore, start bits, stop bits, and gaps are not used. This means that data moves faster and timing errors are less frequent because the transmitter and receiver time is synced. However, data accuracy is highly dependent on timing being synced correctly between devices. In comparison with asynchronous serial transmission, this method is usually more expensive.

What is parallel transmission?

When data is sent using [parallel data transmission](#), multiple data bits are transmitted over multiple channels at the same time. This means that data can be sent much faster than using serial transmission methods.



Communication Channels:

Leased Line

A leased line is a bidirectional telephone line that has been rented for private voice, data exchange or telecommunication use. Typically, large organizations purchase leased lines from telephone message carriers to interconnect different geographic locations. In some contexts, a leased line may be referred to as a dedicated line.

Leased lines can be an expensive option for smaller organizations. Alternatives to leased lines include public switched telephone networks ([PSTNs](#)) with secure messaging protocols, asymmetric digital subscriber lines ([ADSLs](#)), [broadband](#) and virtual private networks ([VPNs](#)). Both broadband and leased lines provide telecommunications and internet access at a fixed rental fee, however, a leased line creates a dedicated connection between the organization's

premises and the [local exchange](#). Additionally, broadband has variable [bandwidth](#) and asymmetric data speeds.

It is sometimes also known as a private circuit,

Differences Between Broadband and Leased Line Connections

1. Monthly Price

There's a big difference in cost between leased lines and broadband. Leased Lines cost a lot more to rent. To get a quote, use the pricing tool above.

2. Maximum Speeds

Leased lines offer speeds of up to 10Gbps (10,000 Mbps) throughout most of the UK. Maximum broadband speeds are far lower.

ADSL2+ broadband is typically described as providing 'up to 24Mbps' downstream and FTTC was said to provide 'up to 80Mbps' downstream. The maximum speeds upstream are far slower - 'up to 1.4Mbps' and 'up to 20Mbps.'

3. Symmetric Connection Speeds

Leased line connections have identical connection speeds upstream and downstream. Broadband connections usually have different speeds - with the upstream connection speed being far lower than the downstream speed mentioned in the ads.

4 . Customer Profiles - Businesses, Not Consumers

Leased lines are sold to businesses - typically to connect their offices to the Internet, their other offices or to data centres. Broadband tends to be sold mainly to consumers (e.g. as a home broadband service). A minority of broadband subscriptions are sold to businesses - typically micro-businesses/smaller SMEs that can't afford a leased line. Broadband is also sold to larger businesses as a backup connection for offices that primarily use a leased line to connect to the Internet.

One consequence of these different customer profiles is that aside from a few big players, different organisations dominate the leased line and non-business broadband markets. Consumer broadband tends to be provided by big consumer brands - mobile phone companies, pay TV firms, residential phone companies. Leased lines tend to be sold by more

tech-savvy organisations that sell a different set of services - leased lines, wide area networks and IP telephony typically.

5. Data Sent Over Fibre Not Copper, Generally

One general difference between leased lines and broadband connections is that the former tend to be full fibre connections (there are a few exceptions), whereas the latter tend to run over copper wiring for part of their data transmission path.

To be specific, ADSL Broadband uses copper wiring between the customer site and the local telephone exchange. FTTC broadband uses copper wiring between the customer site and local cabinet. G.Fast uses copper to a nearby distribution point. FTTP broadband doesn't use copper wiring.

Most leased lines are provided over fibre-optic cables. The only exception are those based on uncontended 'Ethernet First Mile (EFM) over copper' services and 'Generic Ethernet Access over FTTC' (aka EoFTTC) services. The former uses 2, 4, 6 or 8 pairs of copper wiring.

6. Static IP Addresses, Generally

This is not a technical difference, merely a commercial one.

Most non-business broadband services give customers a dynamic IP address, i.e. one that changes. Leased lines and many business broadband services come with a fixed IP address, or a small range of fixed IP addresses. This makes it easier for customers to connect to their business via the Internet as the IP addresses they have to connect to don't keep changing.

7. Contract length

Leased line contracts tend to last 36 months, or failing that 12, 24, 48 or 60 months. Broadband tends to be sold on 1 month, 12 month, 18 month or 24 month contracts.

The shorter leased line contract lengths (12 months, 24 months) tend to involve paying a hefty installation charge, in a way that isn't true for broadband.

Switched Line

A switched line is a communications link established through the use of switching equipment which allows a connection to be established between two transmission devices. The switched line provides a temporary connection between two user terminals or machines and only lasts

for a certain period. Switched lines minimize the line costs while maintaining the advantages of interconnected systems. They are less expensive compared to leased lines and are often appropriate when there is low traffic, as well as for connecting several remote sites.

Telephone Line

A telephone line or telephone circuit (or just line or circuit industrywide) is a single-user [circuit](#) on a [telephone communication](#) system. This is the physical [wire](#) or other signaling medium connecting the user's telephone apparatus to the [telecommunications](#) network, and usually also implies a single [telephone number](#) for [billing](#) purposes reserved for that user. Telephone lines are used to deliver [landline](#) telephone service and [Digital subscriber line](#) (DSL) phone cable service to the premises. Telephone overhead lines are connected to the [public switched telephone network](#).

Baseband & Broadband

Comparison Chart

BASIS FOR COMPARISON	BASEBAND TRANSMISSION	BROADBAND TRANSMISSION
Type of signalling used	Digital	Analog
Application	Work well with bus topology.	Used with a bus as well as tree topology.
Encoding Used	Manchester and Differential Manchester encoding.	PSK encoding.
Transmission	Bidirectional	Unidirectional
Signal range	Signals can be travelled over short distances	Signals can be travelled over long distances without being attenuated.