Answer on Question #54812-Engineering-Other

Discuss the significant characteristics of a Modem.

Answer

The modems can be classified according to their characteristics as

Range - Short Haul, Voice Grade (VG), Wide band

Line Type - Dial-up, Leased, Private

Operation Mode - Half Duplex, Full Duplex, Simplex

Synchronization - Asynchronous, Synchronous

Modulation - AM, FM/FSK,PM

Transmission Media - Radio, Optical and Dial up.

Modem Based on Range

Short Haul. Short haul moderns use private lines and are not part of a public system. These are economical solutions to systems of short ranges up to 15 km. Short haul modems can also be used, even if the end-to-end length of the direct connection is longer than 15km, when both ends of the line are served by the same exchange in the telephone system. These lines are called local loops. Short haul modems are distance-sensitive because signal attenuation occurs as the signal travels through the line. The transmission rate must be reduced to ensure consistent and error-free transmission on longer distances.

There are two main types of short haul modems:

Analog modems. They use a simple modulation method. Sophisticated devices for error control or equalizers are not employed. These modems usually operate at a maximum rate of9600 bps, but there are some, which support higher rates (up to 64,000 bps).

Line drivers. They increase the strength of the digital signal. Unlike conventional modems, they do not transmit carrier signal to the communication channel. Line drivers are very cheap, tiny and do not have power supply. Power supply to line driver is provided through the RS232 connector of the terminal.

Voice Grade (VG). Voice grade modems use a moderate to high data rate. There is no distance limitation in this case. They may be used for unlimited destination. These modems are expensive and their maintenance and tuning are sophisticated. Communication channels are leased lines and dial-up. A telephone network is used for data transmission. A terminal-to-terminal Connection may be either dedicated or dialed. The links in the connection are the same in the two cases, and the only difference for the user is that for some impairment (particularly attenuation and delay distortion), a dedicated (private or leased) line is guaranteed to meet certain specifications, whereas a dialed connection can only be described statistically.

Wideband. Wide-band modems are used in large-volume telephone-line multiplexing, and in dedicated computer-to-computer links. These modems use high data rates.

Modem Based on Line

Leased Line. Leased, private or dedicated lines (usually 4-wire) are for the exclusive use of leased-line modems. It uses either pair (in a simple point-to-point connection) or several (on a multi-drop network for polling or a contention system), If the medium is the telephone network, their transmission characteristics are usually guaranteed to meet certain specifications, but if the link includes any radio transmission, the quality of it may be as variable as that of a switched line.

Dial-up. Dial-up modems can establish point-to-point connections on the PSTN by any combination of manual or automatic dialing or answering, The quality of the circuit is not guaranteed, but all telephone companies establish objectives. The links established are almost always 2-wire because 4-wire dialing is tedious and expensive.

A four-wire line is a pair of two-wire lines, one for transmitting and one for receiving, in which the signals in the two directions are to be kept totally separate. Perfect separation can be maintained only if the four-wire configuration is sustained from transmitter to receiver. The lines may be combined in a 4-wire/2-wire network (often called a hybrid or a hybrid transformer) at any point in the signal path. In this case impedance mismatches will cause reflections and Interference between the two signals.

Modem Based on Operation Mode

Half Duplex. Half duplex means that signals can be passed in either direction, but not in both simultaneously. A telephone channel often includes an echo-suppressor, allowing transmission in only one direction, which renders the channel half duplex. Echo suppressors are slowly being replaced by echo cancellers, which are theoretically full duplex devices. When a modem is connected to a two-wire line, its output impedance cannot be matched exactly to the input impedance of the line, and some part of its transmitted signal will always be reflected back. For this reason half duplex receivers are disabled when their local transmitter is operative. Half duplex modems can work in full duplex mode,

Full Duplex. Full duplex means that signals can be passed in either direction, simultaneously. Full duplex operation on a two-wire line requires the ability to separate a receive signal from the reflection of the transmitted signal. This is accomplished by either FDM (Frequency Division Multiplexing) in which the signals in the two directions occupy different frequency bands and are separated by filtering, or by echo canceling. The implication of the term full-duplex is usually that the modem can transmit and receive simultaneously at full speed.

Modems that provide a low-speed reverse channel are sometimes called split-speed or asymmetric modems. Full duplex modems will not work on half duplex channels.

Simplex. Simplex means that signals can be passed in one direction only. A remote modem for it telemeter system might be simplex and a 2-wire line with a common unidirectional amplifier is simplex.

Echo Suppressor and Echo Canceller

Echoes can occur at the junction between the local loop, which is usually a 2-wire circuit, and the trunk which is a 4-wire circuit. The effect of the echo is that a person speaking on the telephone hears his own words after a short delay. To eliminate the problem of echoes, echo suppressors are installed on lines longer than 2000 km. In case of short lines the echoes come back so fast that people cannot detect them. An echo suppressor is a device that detects human speech coming from one end of the connection and suppresses all signals going the other way. The device compares the levels at its two input ports and if it

decides, for example, that the other end is talking it inserts an attenuator in the return path to suppress echo and vice versa.

Echo suppressors have several properties that are undesirable for data communication. They prevent full duplex data transmission which would otherwise be possible even over the 2-wire local loop. Sometimes, in the 2-wire local loop a part of the bandwidth is allocated in forward direction and other in the reverse direction. Even if half duplex transmission is adequate, these are a nuisance because the time required switching directions could be substantial. Double-talking totally confuses them and the attenuation may be switched in and out repeatedly. Furthermore, they are designed to reverse upon detecting human speech and not digital data.

To reduce these problems, when echo suppressors detect a specific tone they shut down and remain shut as long as the carrier is present. Echo suppressors are slowly being replaced by echo cancellers which allow a certain amount of double-talking and do not require capture time for anyone talker to assume control of the connection.

Modems Based on Synchronization

Asynchronous Modems. Most of the modems that operate in slow and moderate rates, up to 1800 bps are asynchronous. Asynchronous modems operate in FSK (Frequency Shift Keying) modulation.

They use two frequencies for transmission and another two for receiving. Asynchronous modems can be connected in different options to the communication media.

They may use:

2-wire or 4-wire interface

switched lines or leased lines

interface to call unit/automatic answer, when dialing-up.

Synchronous Modems. Synchronous modems operate in the audio range at rates up to 28.8 Kbps in audio lines. They are used in the telephone systems. The usual modulation methods are the phase modulation and integrated phase and amplitude modulation at higher rates than 4800 ,bps.

In synchronous modems, equalizers are used in order to offset the mismatch of the telephone lines. These equalizers are inserted in addition to the equalizers that sometimes already exist in the telephone lines.

These equalizers can be classified into three main groups as:

Fixed/Statistical equalizer. These equalizers offset the signal according to the average of the known attenuation in each frequency. Tuning of the equalizer is sometimes done in the factory for a fixed value. They usually are used to operate at low rates in a dial up line.

Manually adjusted equalizer. These equalizers can be tuned to optimal performance to a given line. These equalizers should be re-tuned when the line is replaced periodically. Specially, it should be tuned frequently when the line is of a low quality and its parameters are changed frequently. Tuning is done using a button inside the modem or on the external board.

Automatic equalizer. These equalizers are tuned automatically when the connection is established. Depending on the line quality in a specific moment, in a process of about 15 m to 25 ms after the first tuning the equalizer samples the line continually and adjusts itself to the changed conditions. So, the modem operates at each moment under optimal conditions. The fitness process operates in some modems at the rate of 2400 times in a second.

The operation of synchronous modems is similar to the asynchronous modems. Since the requirements to transmit at higher rates are increasing most of the researches are oriented for synchronous modems. In synchronous modems the channel can be split for several users at various speeds. Modems which have this ability are called SSM (Split System Modem). These modems can use a simple split or a split using multipoint connection.

Modems Based on Transmission Media

In addition to the dedicated wires, modems are also used with other media including RF transmission, glass fibers, and conventional telephone connection. Therefore, modems can also be classified based on the media used for example, RF transmission, and glass fibers. Basically, three types of modems are in use.

Radio Modems. Are used to send data across a pair of glass a radio frequency signal.

Optical Modems. Are used to send data across a pair of glass fibers using light. Such modems use entirely different technology than modems that operate over dedicated wires.

Dial up Modems. Dial up modems contain a circuitry that mimics a telephone. That is, modem can simulate lifting the handset, dialing, or hanging up the telephone. Second, telephone system is designed to carry sound, a dial up modem uses a carrier that is an audible tone. Third, although they send all data through a single voice channel, a pair of dialup modems offer full duplex communication. That is, a single telephone connection between two dial up modems usually allows data to flow in both directions.