Chapter 03 : Data Communication

3.0 / 3.1   Overview / Components of Data Communication

Q   :   03-01-01   :   Define Data Communication and Describe its Five Components ?

Answer :

Data Communication : [Movement of encoded information by means of electrical transmission systems from one computer or device to the other].

Five Components of Data Communication :

Message : The message is the information (data) to be communicated. It may consist of text, numbers, pictures, sound, video or any combination of these.

Sender : It is the device that sends the data. It can be computer, workstation, telephone, video camera and so on.

Receiver : It is the device that receives the data. It may be computer, workstation, telephone, television and so on.

Communication Channel : It is the physical path by which a data travels from sender to receiver. It cab be a twisted pair wire, coaxial cable, fiber optic cable, or microwave etc.

Encoder and Decoder : The encoder converts digital signals to a form which can pass through transmission medium and decoder again coverts signal from encoded form into digital form, which is understandable for receiver.

3.2   Signals

Q   :   03-02-01   :   Define Signal, explain Analog and Digital Signals ?

Answer :

Signals : [The electromagnetic or light waves representing data are called signals]. These are used to transfer data from one device to another device through a communication medium.

Analog Signal : The analogue data signals are continuous electrical signal in the form of wave. This wave is called a carrier wave. Two characteristics of analogue carrier waves that can be altered are frequency and amplitude. [**Frequency** is the number of times a wave repeats during a specific time interval]. [**Amplitude** is the height of wave within a given period of time].
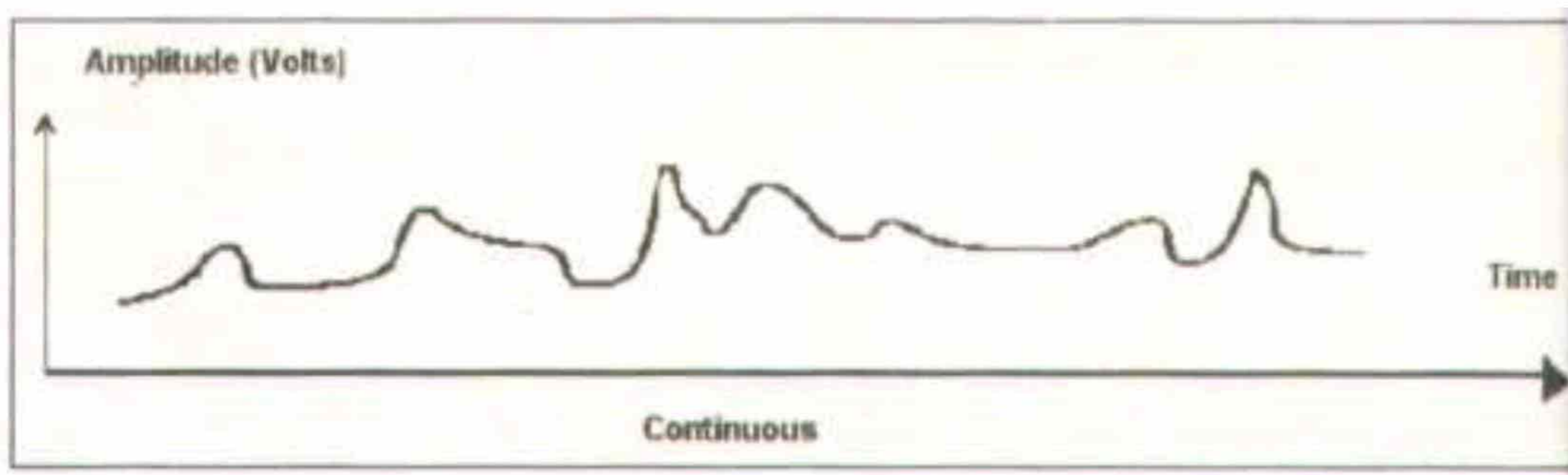
Digital Signal : A digital signal uses on-off electrical pulses in discontinuous, or discrete form. Most computers are digital in nature, represent data as patterns of binary numbers.
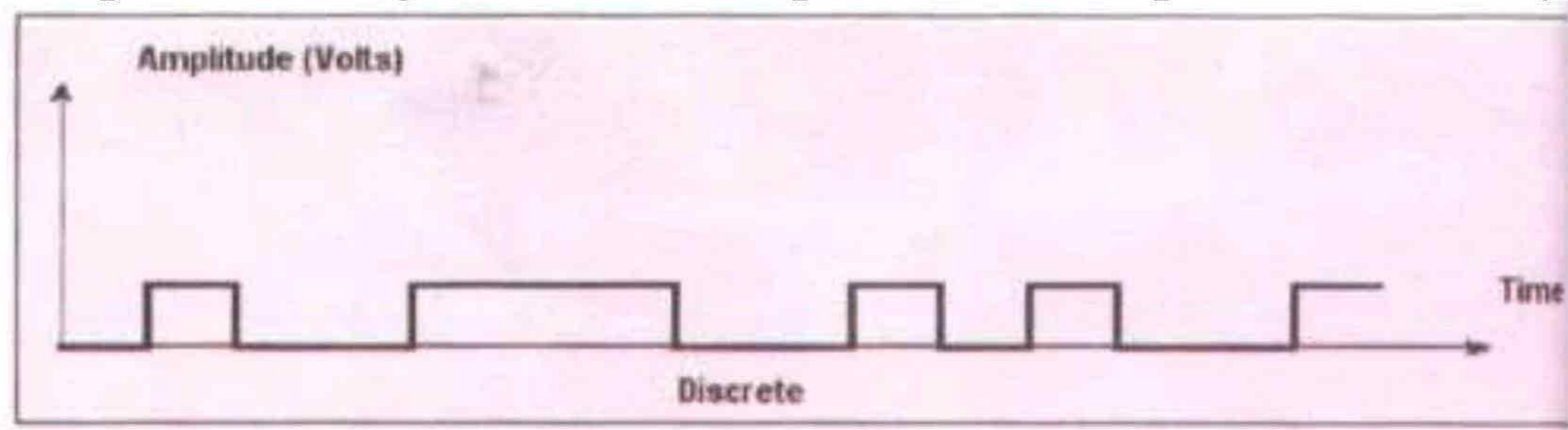
3.3   Types of Data

Q   :   03-03-01   :   Describe FIVE Types of Data ?

Answer :

Text : The text consists of words, sentences, and paragraphs. Text processing refers to the ability to manipulate words, lines, and pages. Typically, the term text refers to text stored as ASCII codes that is, without any formatting. Objects that are not text include graphics, numbers and program code.

Numeric : Numeric data consist of digits from 0 to 9, + (positive) or - (negatives) signs and a decimal point. It can be integer type or real type.

Image : This type of data includes chart, graph, pictures and freehand drawings. The information in this form is more comprehensive. The data are sent as contiguous bits, which, for transfer, are packed into the 8-bit transfer bytes. The receiving site must store the data as contiguous bits.

Audio : Sound is a representation of audio. It is converted into digital code by sampling the sound waves 44,056 times per second and converting each sample into a 16- hit number.

Video : Video can be produced either as a continuous entity (by a camera), or it can be a combination of images, each one a discrete entity, arranged to convey the idea of motion. Video creates actions and movements.

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Q   :   03-03-01   :   Describe Data Representation ?

Answer :

Data Representation : The computer works with binary numbers, binary means two digits. These are 0 and 1. An electrical pulse inside the computer represents each binary number. 1 is represented by a pulse of electrical inside the computer and 0 by an absence of a pulse. Each binary digit is called bit and it is the smallest element of data.

3.4   Encoding of Data

Q   :   03-04-01   :   Define Data Encoding ? Describe Five Data Encoding Schemes ?

Answer :

Data Encoding : The computer works with binary digits only. Therefore, all data, numeric or non-numeric, must be converted into binary digits before the computer can understand it. Computers transmit data in the form of binary codes. Both sender and receiver of the data should have same standard rules for both to understand it. Some coding schemes to represent data are :

BCD Code : (Binary Coded Decimal) is 4 bits code. A few early computers processed BCD numbers but were slower and more complicated than a modern computer, which are able to process alphanumeric (alphabet letters, numbers and other symbols).

EBCIDIC Code : Extended Binary Coded Decimal Interchange Code is an 8-bit code primarily used by International Business Machine (IBM). This type is intended for efficient transfer between hosts, which use EBCDIC for their internal character representation. For transmission, the data are represented as 8-bit EBCDIC characters. The character code is the only difference between the functional specifications of EBCDIC and ASCII types.

ASCII Code (American Standard Code for Information ¶ Interchange) : It is a 7-bit code and makes 128 character combinations, whereas an 8-bit can make 256 combinations. It was developed by American National Standards Institute (ANSI) and can handle alphanumeric data. It is intended primarily for the transfer of text files, except when both hosts would find the EBCDIC type more convenient.

Unicode (Universal Code) : It is a 16-bit code and can represent up to 65,536 symbols. Unicode has started to replace ASCII at all levels. It supports a comprehensive set of mathematical and technical symbols to simplify scientific information. With the UTF-8 (Unicode Transformation Format-8) encoding, Unicode can be used in a convenient and backwards compatible way in environments that were designed entirely around ASCII.

3.5   Modes of Data Communication

Q   :   03-05-01   :   Describe THREE Modes of Data Communication ?

Answer :

Modes of Data Communication : When data is transmitted between two pieces of equipment, three types of data transmission modes can be used :

Simplex : [Simplex is a mode in which data flows in one direction only.] This is not popular as it once was. However, it is used in point-of-sale terminals, radio and T.V transmissions.


Simplex Channel Operation
one way only
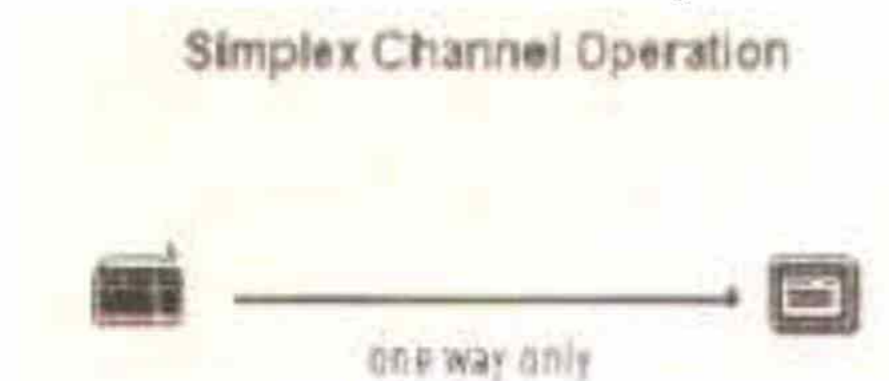
Half-Duplex : [In Half-Duplex transmission, data can be sent and received in both directions, but not at the same time.] It's like a one-lane bridge where two-way traffic must give way in order to cross. Only one end transmits at a time, the other end receives. It is possible to perform error detection.

Half Duplex Operation
TWO WAY BUT NOT AT
THE SAME TIME
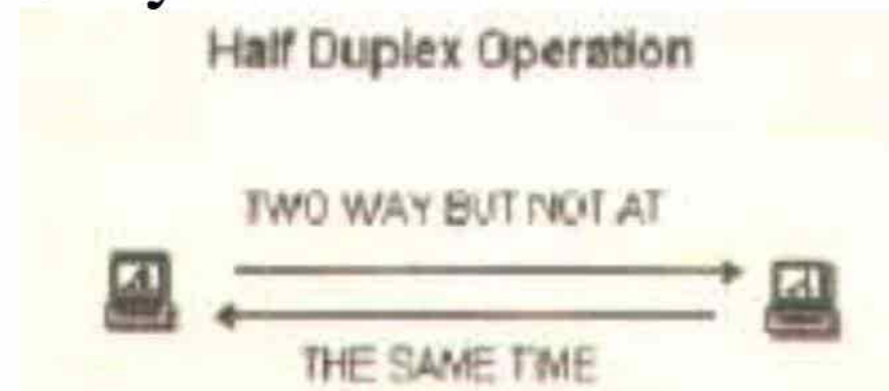
Full-Duplex : [The bidirectional mode of communication is Full-Duplex.] Data is transmitted in both directions simultaneously on the same channel. Full-duplex communication is made possible by devices called multiplexers.
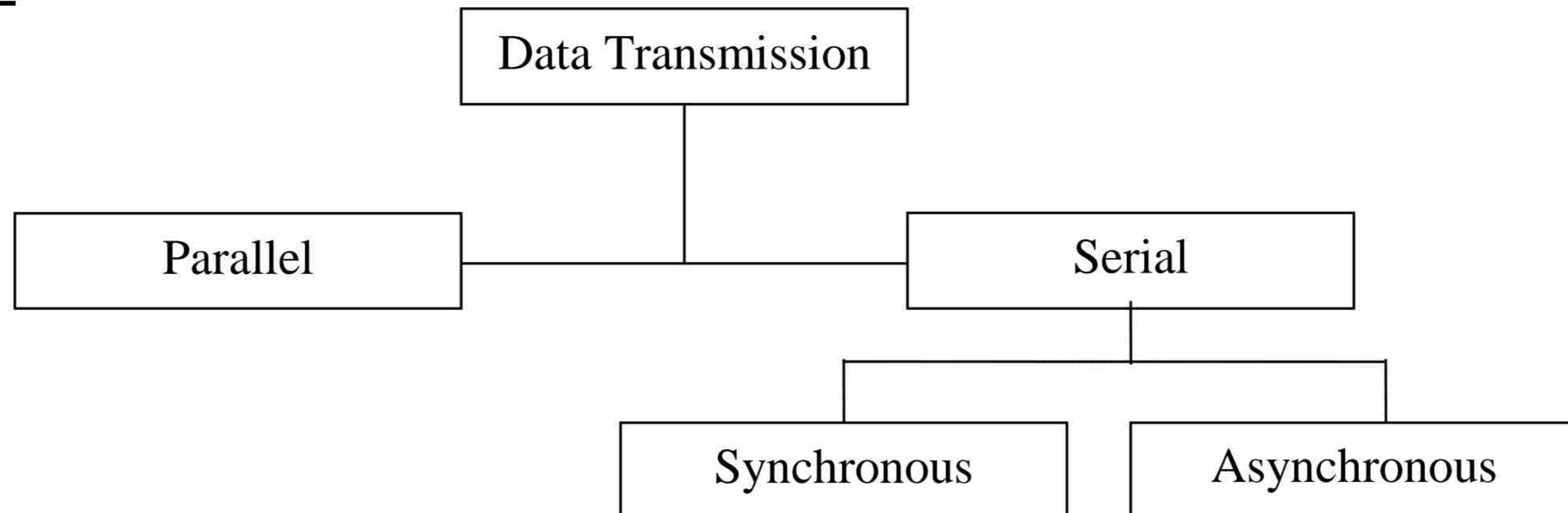
Full Duplex Operation

BOTH WAY AT
THE SAME TIME
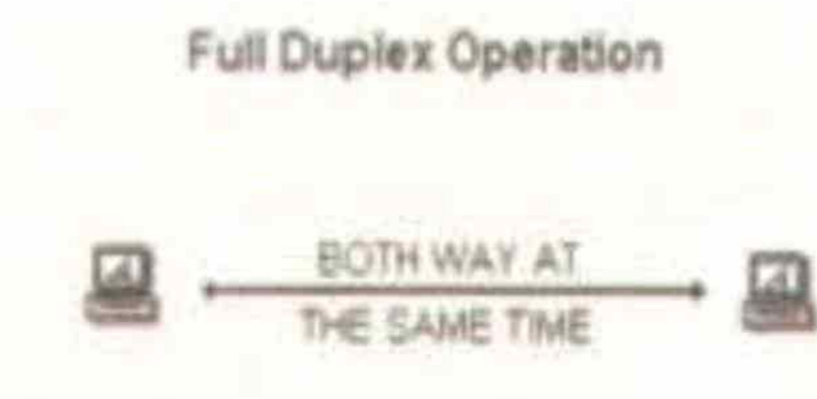
3.6   Types of Data Transmission

Q   :   03-06-01   :   Explain Types of Data Transmission ?

Answer :

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                    ┌──────────────────────┐
                    │  Data Transmission   │
                    └──────────────────────┘
                              │
            ┌─────────────────┴─────────────────┐
   ┌─────────────────┐              ┌─────────────────┐
   │     Parallel    │              │      Serial      │
   └─────────────────┘              └─────────────────┘
                                             │
                              ┌──────────────┴──────────────┐
                     ┌─────────────────┐        ┌─────────────────┐
                     │   Synchronous   │        │   Asynchronous   │
                     └─────────────────┘        └─────────────────┘
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Parallel Data Transmission : [Concurrent flow of bits of data through separate communications lines.] This pattern resembles the flow of automobile traffic on a multilane highway. Parallel data transmission is commonly used for interactions between a computer and its printer.

Serial Data Transmission : [Each individual bit of information travels along its own communications path; the bits flow in a continuous stream along the communications channel.] Pattern is analogous to the flow of traffic in one-lane street. Serial transmission is typically slower than parallel transmission, because data are sent sequentially in a bit-by-bit fashion.

Asynchronous Transmission : [A type of communication that sends data using flow control rather than a clock to synchronize data between the source and destination.] When asynchronous transmission (also called start / stop transmission) is used, a special start signal is transmitted at the beginning of each group of message bits.

Synchronous Transmission : [A type of transmission that uses a clock to control the timing of bits being sent.] Large volumes of information can be transmitted at a single time with synchronous transmission. This type of transmission involves the simultaneous flow of several bytes of data.

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Q   :   03-06-02   :   Define Bandwidth ? Describe Two Types of Bandwidth ?

Answer :

Bandwidth : Each type of communications media has different transmission speed. [The bandwidth is a measure of the transmission rate of communications channels].

Baseband : Digital signals are commonly called baseband signal. [Baseband is a communications technique in which digital signals are placed on to the transmission line without change in modulation.] It transmits up to a couple of miles, and does not require the complex modems. Typical Token Ring and Ethernet use baseband signals.

Broadband : [Broadband is a technique for transmitting large amounts of data, voice and video over long distances simultaneously by modulating each signal onto a different frequency.] Using the FDM

(Frequency Division Multiplexing) technique, several streams of data can be transmitted simultaneously. This bandwidth includes microwave, satellite, coaxial cable and fiber-optic media.

Q : 03-06-03 : Define and Classify Communication Media ?

Answer :

Communication Media : [For data to be transmitted from one location to another, pathway or medium must be used. These pathways are called communication channels]. The communication channels can be divided into two types of media :

Guided Media : Channels that allow transmission of data through a physical media i.e. twisted pair wire, coaxial cable or fiber-optic cable. These are also called bounded media.

   Twisted Pair : The telephone lines used to carry most of the voice and data communications consist of a pair of thin-diameter insulated copper wires (called twisted pairs).

   Coaxial Cable : Coaxial cable can be used for telephone lines for transmission at a high frequency. Coaxial cable consists of a sing core of solid copper. A coaxial cable can handle 80 times as many telephone transmissions as twisted pair media. Many computers in local area networks are linked by coaxial cables.

   A Fiber-Optic Cable : A fiber-optic cable consists of tubes of glass through which data are transmitted as pulses of light. Optical fiber consists of thin glass fibers that can carry information at frequencies in the visible light spectrum and beyond. The typical optical fiber consists of a very narrow strand of glass called the core.

Unguided Media : Those channels that transmit data and information in the form of wave. Unguided transmission media consists of a means for the data signals to travel but nothing to guide them along a specific path. The atmosphere and the space are examples of unguided media such as microwave, or satellite.

   Microwave : Microwave data transmission differs from the previously mentioned communications channels in that data is transmitted through the air instead of through cables or wires. Microwaves are high-frequency radio waves that can only be directed in straight lines. Consequently, microwave transmission is usually limited to communications occurring within the limits of a particular city or community usually twenty to thirty miles apart.

   Satellites : Instead of antennas, satellites can also be used to transmit microwave messages from one location to another. Satellites rotate approximately 23,300 miles above the earth in precise locations / orbits. Satellite transmission stations that can both send and receive messages are known as "Earth Stations". A major advantage of satellite transmission is that large volumes of data can be communicated once. A particular drawback is bad weather can severely affect quality of satellite transmissions. This wide range broadcasting ability has given rise to a multitude of different satellites carrying all kinds of information such as telephone calls, television channels, internet traffic, military communications, weather data, and even radio stations.

   Mobile Communications : It is radio-based networks that transmit data to and from mobile computers. Computer can be connected to the network through wired ports or through wireless connections.

3.7   Modem

Q : 03-07-01 : Define Modem ? Describe Transmission Rate and Speed ?

Answer :

Modem : Modem (Modulate / Demodulate) is a device that converts digital signals into analog form (modulation process) to send over phone lines, a receiving Modem at the other end of phone line then converts the analog signal back to a digital signal (demodulation process). It enables users to transmit data from one computer to another by using standard telephone lines and analogue signal.

Transmission Rate : Modems as high-speed or low speed to indicate how many bits per second a specific device is capable of transmitting or receiving.

Speeds : The specific techniques used to encode the digital bits into analog signals are called modulation process. The various modulation standards define the exact methods of encoding and the data transfer speed. The raw speed (the speed without data compression) of a modem is determined by the modulation standards.

Q   :   03-07-01   :   Describe Various Types of Modems ?

Answer :

Types of Modems : In terms of physical size and shape, modems can be divided into :

External : External modem is attached to the system unit as an external device by means of a telephone cable. It is connected to the telephone wall jack by another cable. The modem is a self contained unit which is connected to the PC using a serial cable to the COM1, COM2 port or USB port. It needs an external power supply and is easy to setup.

Internal Card : An internal modem is a circuit board (a modem card) that can be added to the system unit through an expansion slot. This can not be moved easily from one computer and is more difficult to setup.

Wireless Modem : Wireless (radio frequency) modems transmit data signals through air instead of a cable. This type of modem is designed to work with cellular technology, and wireless local area networks.