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# Introduction to Computer Science



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## Network and Internet

Introduction to Network, Types of Networks, Introduction to Internet, ISP, URL, IP Address, Web Page, Web Site, Web Server, Web Browser, Internet Services (WWW and Electronic Mail – Creating E-Mail Account, Sending and Receiving E-Mails).

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### Data Communication

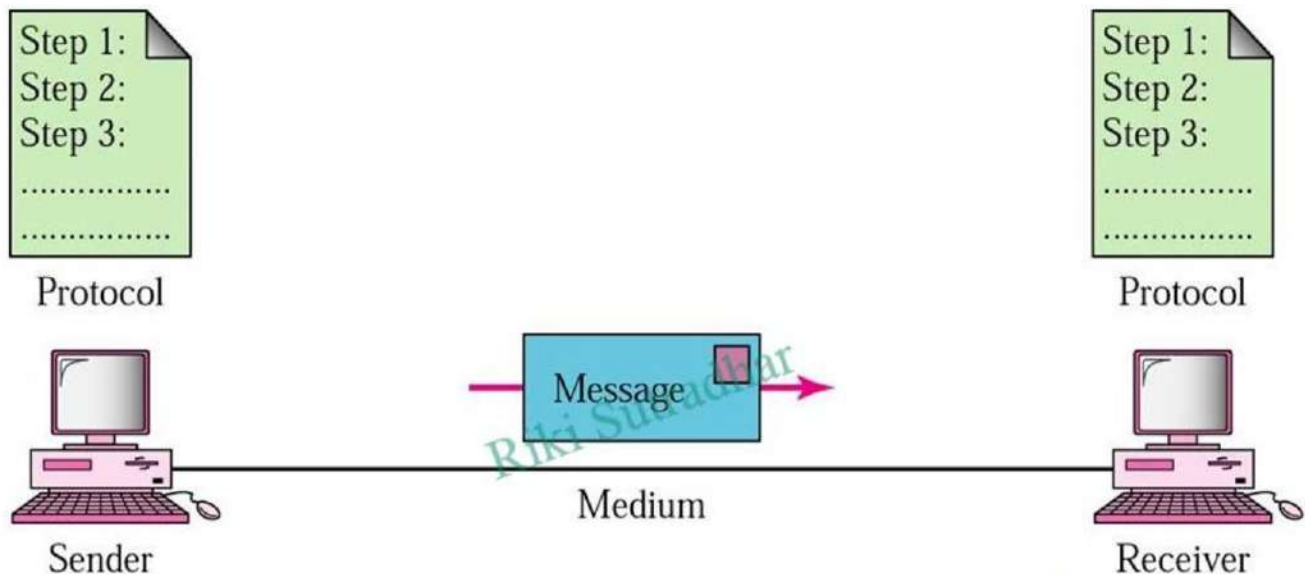
Data communication is the exchange of data between two devices via some form of transmission medium (or, *Channel*) such as guided media (e.g., twisted pair cable, co-axial cable and fiber optic cable) and unguided media (e.g., radio wave, micro wave, infrared, etc.).

The effectiveness of a data communication system depends on four fundamental characteristics–

- (i) **Delivery:** The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.
- (ii) **Accuracy:** The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.
- (iii) **Timeliness:** The system must deliver in a timely manner. Data deliver late are useless.
- (iv) **Jitter:** Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets.

### Data Communication Model

A data communication model is used to exchange data between two parties, e.g., communication between a computer, server, mobile handset, printer, video camera, etc. A data communication model has five components.



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

(ii) **Sender:** The sender is the device that sends the message. It can be computer, server, mobile handset, printer, video camera, etc. Before placing the message onto the transmission medium, the sender encodes the message. Encoding is the process of converting the message or a given sequence of characters, symbols, alphabets etc., into a specified format (such as electromagnetic waves or signals), for efficient transmission of message.

(iii) **Receiver:** The receiver is the device that receives the message. It can be computer, server, mobile handset, printer, video camera, etc. After picking up the message from the transmission medium, the receiver decodes the message. Decoding is the opposite process of encoding – the conversion of an encoded format back into the original sequence of characters, symbols, alphabets etc.

(iv) **Medium:** The transmission medium is the physical path by which a message travels from sender to receiver. It could be guided media (e.g., twisted pair cable, co-axial cable and fiber optic cable) or unguided media (e.g., radio wave, micro wave, infrared, etc.).

(v) **Protocol:** A protocol is a set of rules that governs data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.

## Introduction to Network

A collection of autonomous devices (or, *Nodes*) interconnected by a single technology is turned as a *Computer Network*. Two or more devices are said to be interconnected if they



are able to exchange information via some form of *Transmission Medium* (or, *Channel*) such as guided media (e.g., twisted pair cable, co-axial cable and fiber optic cable) and unguided media (e.g., radio wave, micro wave, infrared, etc.).

## Types of Networks

A computer network can be categorized by the geographical area it covers. Different types of computer networks in use today are explained below:

(i) **Personal Area Network (PAN):** It is the smallest and most basic type of computer network. It is a network managed by one person or organization from a single device, typically within a range of 10 meters. A PAN is made up of a wireless modem, one or two computers, mobile phones, printers, tablets, media player, play stations etc., and revolves around one person. These types of networks are typically found in small offices or residences.

(ii) **Local Area Network (LAN):** It is a group of computers connected to each other in a small geographical area such as residence, school, laboratory, university campus, office building, etc. LANs are also typically owned, controlled, and managed by a single person or organization. The group of computers and devices are connected together by a switch, or stack of switches, using a private addressing scheme as defined by the TCP/IP protocol. It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables. Routers are found at the boundary of a LAN, connecting them to the larger WAN (Wide Area Network). Data transmits at a very fast rate as the number of computers linked is limited. The fault tolerance of a LAN is more and there is less congestion in this network. One example of LAN is playing Counter Strike in the same room without internet.

(iii) **Wireless Local Area Network (WLAN):** It is a wireless computer network that links two or more devices using wireless communication to form a LAN (Local Area Network) within a small geographical area such as residence, school, laboratory, university campus, office building, etc. This gives users the ability to move around within the area and remain connected to the network. Routers are found at the boundary of a LAN, connecting them to the larger WAN (Wide Area Network). Data transmits at a very fast rate as the number of computers linked is limited. The fault tolerance of a WLAN is more and there is less congestion in this network. Most modern WLANs are based on IEEE 802.11 standards and are marketed under the Wi-Fi brand name. One example of LAN is playing Counter Strike in the same room without internet.



**(iv) Metropolitan Area Network (MAN):** It is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network such as a town, city, sometimes a campus, etc. A MAN is typically owned and operated by a single entity such as a government body or large corporation. Devices used for transmission of data through MAN are modems and cables. Data transmits at a moderate rate as the number of computers linked is large. The fault tolerance of a MAN is less and there is more congestion in this network. One example of MAN is the cable TV network in a city.

**(v) Wide Area Network (WAN):** It is a network that extends over a large geographical area such as states or countries. A WAN can contain multiple smaller networks, such as LANs (Local Area Network) or MANs (Metropolitan Area Network). A WAN is difficult to design and maintain. Devices used for transmission of data through WAN are telephone line, fiber optic cable or satellite link. Data transmits at a low rate as it involves increased distance and increased number of servers and terminals etc. The fault tolerance of a WAN is less and there is more congestion in this network. Due to long distance transmission, the noise and error tend to be more in WAN. One example of WAN is the 4G network that is widely used across a region or country.

**(vi) Storage Area Network (SAN):** It is a computer network which provides access to consolidated, block-level data storage. SANs are primarily used to access storage devices, such as disk arrays and tape libraries from servers so that the devices appear to the operating system as direct-attached storage. A SAN typically is a dedicated network of storage devices not accessible through the LAN (Local Area Network). SANs are typically composed of hosts, switches, storage elements, and storage devices that are interconnected using a variety of technologies, topologies, and protocols. Some examples of SAN are increase storage utilization and effectiveness, and improve data protection and security.

**(vii) System Area Network (SAN):** It is a high-performance, connection-oriented network that can link a cluster of computers. A SAN delivers high bandwidth (1 Gbps or greater) with low latency. A SAN is typically switched by hubs that support eight or more nodes. The cable lengths between nodes on a SAN range from a few meters to a few kilometers. Unlike existing network technologies such as LAN, a SAN offers a reliable transport service; that is, a SAN guarantees to deliver uncorrupted data in the same order in which it was sent. This technology is used since the advent of Windows 2000. Some examples of SAN are Microsoft SQL Server 2005, Microsoft SQL Server 2008, Microsoft SQL Server 2008 R2, Microsoft SQL Server 2012, and Microsoft SQL Server 2014.

**(viii) Passive Optical Local Area Network (POLAN):** It is a fiber-optic telecommunications technology for delivering broadband network access to end-customers. Its architecture implements a point-to-multipoint topology, in which a single optical fiber serves multiple endpoints by using unpowered fiber optic splitters to divide the fiber



bandwidth among multiple access points. A POLAN consists of an optical line terminal (OLT), an optical splitter, and optical network terminals (ONTs) to transmit voice, video and data services at gigabit speeds.

(ix) **Enterprise Private Network (EPN):** These types of networks are built and owned by businesses that want to securely connect its various locations to share computer resources.

(x) **Virtual Private Network (VPN):** By extending a private network across the internet, a VPN lets its users send and receive data as if their devices were connected to the private network – even if they're not. Through a virtual point-to-point connection, users can access a private network remotely.

## Introduction to Internet

*Internet* is a global network that connects billions of autonomous devices (or, *Nodes*) across the world with each other and to the World Wide Web (WWW). It allows exchange of information between two or more autonomous devices on a network.

**Working of the Internet:** The internet uses an *Internet Protocol (IP)* and *Transport Control Protocol (TCP)* based packet routing network. TCP and IP work together to ensure that data transmission across the internet is consistent and reliable, regardless of the device or location. Data is broken into smaller units called *Packets*, before it is transmitted. This process is known as *Packetizing*. This is done by IP.

IP is a set of rules that control how data is transmitted from one computer to another via the internet. The IP system receives further instructions on how the data should be transferred using a numerical address (*IP Address*). The TCP is used with IP to ensure that data is transferred in a secure and reliable manner. This ensures that no packets are lost, that packets are re-assembled in the correct order at the receiving device, and that there is no delay that degrades data quality.

## ISP

An ISP (Internet Service Provider) is an organization that provides services for accessing, using, managing, or participating in the internet. ISPs can be organized in various forms, such as commercial, community-owned, non-profit, or otherwise privately owned.

ISPs provide typical internet services such as–



- (i) **Internet Access:** Internet access is the ability of individuals and organizations to connect to the internet using autonomous devices (or, *Nodes*).
- (ii) **Internet Transit:** Internet transit is the service of allowing network traffic to cross or “transit” a computer network; usually used to connect a smaller ISP to the larger computer network.
- (iii) **Domain Name Registration:** Domain name registration is the act of reserving a name on the internet for a certain period of time. The most important thing about a domain name registration is that it gives us personality and recognized identity. Once we register a domain name, the information about us is publicly available. Domain name will remain ours for as long as we renew it and there is no way to purchase a domain name forever.
- (iv) **Web Hosting:** Web hosting is an online service that enables us to publish our website or web application on the internet. When we sign up for a web hosting service, we basically rent some space on a physical server where we can store all the files and data (such as code, images, etc.) necessary for our website to work properly.
- (v) **Usenet Service:** Usenet is one of the oldest computer network communication systems. It was created in 1979 to exchange files and messages through the UUCP protocol. Usenet is similar to an online forum or discussion platform where users can discuss various topics in so-called “newsgroups”. Though it enjoyed popularity in the early 1990s, it is now mainly used to share large files between users.

USENET (User’s Network) is a worldwide distributed discussion system available on computers. It was developed before the WWW, from the general-purpose Unix-to-Unix Copy (UUCP) dial-up network architecture. Tom Truscott and Jim Ellis conceived the idea in 1979, and it was established in 1980. Users read and post messages (called articles or posts, and collectively termed news) to one or more topic categories, known as newsgroups. It is now one of the oldest computer network communication systems still in use.

USENET started off as a text-based decentralized discussion system, but over the years, it evolved to become much more than that. One of the major changes to the network was the employment of NNTP (Network News Transfer Protocol), which was much more efficient than UUCP.

Because of the anonymity it offers, USENET has attracted internet pirates who share copyrighted movies, software, and other data illegally.

- (vi) **Colocation:** A colocation center (or, Carrier Hotel), is a type of data centre where equipment, space, and bandwidth are available for rental to retail customers. Colocation facilities provide space, power, cooling, and physical security for the server, storage, and networking equipment of other firms and also connect them to a

variety of telecommunications and network service providers with a minimum of cost and complexity.

There are three levels of ISPs – Tier 1 ISP, Tier 2 ISP, and Tier 3 ISP.

(i) **Tier 1 ISP:** These ISPs are at the top of the hierarchy and they have a global reach. They do not pay for any internet traffic through their network instead Tier 2 ISPs have to pay a cost for passing their traffic from one geo-location to another which is not under the reach of Tier 2 ISPs. Generally, a Tier 1 ISP connects to other Tier 1 ISP and allows free traffic passes to each other. Such ISPs are called peers. Due to this, cost is saved. They build infrastructure to provide traffic to all other Tier 2 ISPs, not to end users. Example of tier 1 ISP in India is Tata Communications.

(ii) **Tier 2 ISP:** These ISPs are service providers who connect between Tier 1 and Tier 3 ISPs. Tier 2 ISPs are typically regional or national providers. Generally, a Tier 2 ISP connects to other Tier 2 ISP and allows free traffic passes to each other. Tier 2 ISPs deliver internet traffic to end customers through Tier 3 ISPs. Examples of tier 2 ISPs in India are Reliance Jio Infocomm Limited, Bharti Airtel, BSNL, etc.

(iii) **Tier 3 ISP:** These ISPs are the smallest of the three tiers. Tier 3 ISPs provide internet traffic to every household inside a block, area of a city, etc. These ISPs have to pay some cost to Tier 2 ISPs based on internet traffic generated. Examples of tier 3 ISPs in India are Reliance Jio Infocomm Limited, Bharti Airtel, BSNL, Spectra, MTNL, Tikona, Hathway, Speed Wi-Fi, etc.

**URL**

To be continued...