Telecommunication Networks

Definition

- **TELECOMMUNICATIONS**
- Telecommunications can be defined as a communication of information by electronic means, usually over some distance.
- Technology has made the world a small place. Today, it is easy to *"reach out and touch someone";* no matter where in the world that person lives.
- Automated Teller Machines, airline reservations, live broadcasts, remote health care, space exploration, medical research, and learning at a distance are made possible through telecommunications.

Definition cont.....

- *Some definitions about Telecommunications are as follows:*
- **According to *Uma G. Gupta*,**

"Telecommunications refers to transmitting different forms of data (i.e. text, images, voice, graphics, etc.) over different media from one set of electronic devices that are geographically separated."

- **According to *James A O'Brien*,**

"Telecommunications is the sending of information in any form (e.g. voice, data, text and images) from one place to another using electronic media."

- **According to Loudon and Loudon**

"A Telecommunications system is a collection of compatible hardware and software arranged to communicate information from one location to another."

INFORMATION SUPERHIGHWAY

- In recent years, the term Information Superhighway has been used frequently in the media and in the computer literature.

- In this concept, local, regional, nationwide, and global networks will be integrated into a vast, “network of networks” The information superhighway system would connect individuals, households, businesses, government agencies, libraries, universities, and all other institutions and would support interactive voice, data, video, and multimedia communications.

COMPONENTS OF A TELECOMMUNICATIONS NETWORK/A TELECOMMUNICATIONS NETWORK MODEL

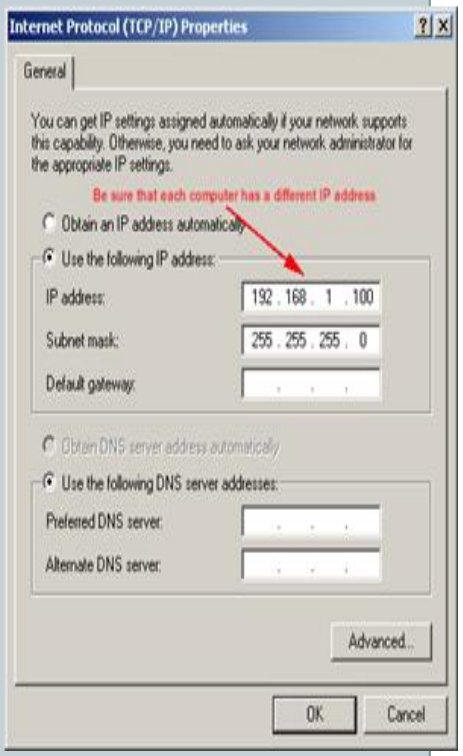
- A communication network is any arrangement where a sender transmits a message to a receiver over a channel consisting of some type of medium. The essential components of a Telecommunications system are:
  - ***Computers*** to process information
  - ***Terminals*** or any input/output devices that sends and receives data
  - ***Communication channels***, the links by which data or voice are transmitted between sending and receiving devices in a network.
  - ***Communication processors*** such as modems, controller, and front-end processor which provide support functions for data transmissions and receptions.
  - ***Communication software*** which control input and output activities and manages other functions of the communication networks

FUNCTIONS OF A TELECOMMUNICATIONS SYSTEM

- The functions of telecommunications are:
  - A telecommunication system **transmits information**
  - Establishes the **interface** (line) between the **sender and the receiver**
  - **Route** (way/road) messages along the **most efficient paths**
  - Performs elementary processing of the information to ensure that the **right message gets to the right receiver**
  - Performs editorial tasks on the data (**such as checking for errors** and **rearranging the format**),
  - **Converts messages from one speed** (say, the speed of a computer) into the speed of a communications line or from one format to another, and
  - The telecommunications system **controls the flow of information**.

NETWORK PROTOCOL

- This set of rules and procedures governing transmission between two points in a network is called a **protocol**.
- **IP** - is responsible for moving packet of data from node (lump) to node. IP forwards each packet based on a four-byte destination address (the IP number).
- **TCP (Transmission Control Protocol)** - is responsible for verifying the correct delivery of data from client to server. Data can be lost in the intermediate network. TCP adds support to detect errors or lost data and to trigger retransmission until the data is correctly and completely received.



TYPES OF TELECOMMUNICATIONS SIGNAL

Data travels through a telecommunication system in the form of electromagnetic signals. Signals are represented in two ways: analog and digital signals.

1. An analog signal is represented by a continuous waveform that passes through a communication medium. Analog signals are used to handle voice communications and to reflect variations in pitch.

2. A digital signal is a separate rather than a continuous waveform. It transmits data coded into two discrete states: 1-bits and 0-bits, which are represented as on-off electrical pulse.

COMMUNICATION CHANNEL /MEDIA

A telecommunication channel makes use of a variety of **telecommunications media**. These include **twisted-pair wire, coaxial cable, fiber optics, terrestrial microwave, satellite, and wireless transmission**.

- **Twisted-Pair Wire:** Ordinary telephone wire, consisting of copper wire twisted into pairs. Thus, twisted-pair wiring is used extensively in home and office telephone system and many local and wide area networks.

- **Coaxial Cable:** Coaxial cable consists of thickly insulated copper wire, which can transmit a larger volume of data than twisted wire can. They allow high-speed data transmission (200 megabits per second). Coaxial cables are also used extensively in office building and other work sites for local area networks.

- 8 bits = 1 byte.
- 1024 bytes = 1KB
- 1024 KB = 1 MB
- 1024 MB = 1 GB
- 1024 GB = 1 terabyte

COMMUNICATION CHANNEL /MEDIA cont…

- **Fiber optic cable** consists of strands of glass or transparent plastic fiber, each the thickness of a human hair, which are bound into cables. Data are transmitted into pulse of light, which are sent through the fiber optic cable by a laser device at a rate from 500 kbps to several billion bits per second. This is about 60 times greater than coaxial cable and 3,000 times better than twisted pair lines.

- **Terrestrial Microwave:** It involves earthbound system, which transmit high-speed radio signals in a line-of-sight path between relay stations spaced approximately 30 miles apart. Microwave antennas are usually placed on top of buildings, towers, hills and mountain peaks, and they are a familiar sight in many sections of the country.

COMMUNICATION CHANNEL /MEDIA cont….

- **Wireless transmissions:** Wireless transmission sends signal through air or space without being tied to a physical line. This medium has been very popular for sending data to long distance. The most popular wireless transmission system is land based or satellite based microwave system. This is why land-based transmission stations are positioned 37 miles apart.

- **What is the difference between 2G, 3G, 4G, mobile networks?**
- G in 2G, 3G and 4G stands for the "Generation" of the mobile network. Today, mobile operators have started offering 4G services in the country. A higher number before the 'G' means more power to send out and receive more information and therefore the ability to achieve a higher efficiency through the wireless network.
- **Understanding the mobile networks:**
- As the name would suggest, **1G was the first generation of mobile networks**. Here basically, radio signals were transmitted in 'Analogue' form and expectedly, one was not able to do much other than sending text messaging and making calls. But the biggest disadvantage, however came in the form of limited network availability, as in the network was available only within the country.

- **2G networks on the other hand, were based on narrow band digital networks**. Signals were transmitted in the digital format and this dramatically improved the quality of calls and also reduced the complexity of data transmission. The other advantage of the 2G network came in the form of Semi Global Roaming System, which enabled the connectivity all over the world.
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- **Between 2G and 3G there** was a short phase in between where mobile phones became sleeker and more 'pocket able' if we can call it that. This is popularly referred to as 2.5G where the quantity of radio waves to be transmitted was much lower. This in turn had an effect on the shape and structure of mobile phones. But most of all, 2.5G helped in the ushering of GPRS (General Pocket Radio Service).
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- **The 3rd generation** of mobile networks has become popular largely thanks to the ability of users to access the Internet over devices like mobiles and tablets. The speed of data transmission on **a 3G network ranges between 384KBPS to 2MBPS.** This means a 3G network actually allows for more data transmission and therefore the network enables voice and video calling, file transmission, internet surfing, online TV, view high definition videos, play games and much more. 3G is the best option for users who need to always stay connected to Internet.
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- **4th Generation** mobile networks are believed to provide many value added features. In addition to all the 3G facilities, data transmission is believed to go through the roof with speeds ranging between 100MBPs to 1GBPS. Phew! Happy talking, surfing, conferencing, chatting, networking, partying, or whatever you want to do on your mobile phone.

Generation	Speed	Technology	Features
2G	9.6/14.4 kbps	TDMA, CDMA	2G capabilities are achieved by allowing multiple users on a single channel via multiplexing. 2G enabled mobile phones can be used for data along with voice communication.
3G	3.1 Mbps (peak) 500-700 Kbps	CDMA 2000 (1XRTT, EVDO) UMTS, EDGE	3G provides amazing internet browsing speeds. Opens the door to a whole bag of oppurtunities with video calling, video streaming, etc. In 3G, universal access ad portability across different device types are made possible. (Telephone & PDA's)
3.5G	14.4 Mbps (peak) 1-3 Mbps	HSPA	3.5G supports even higher speeds and enhances higher data needs.
4G	100-300 Mbps (peak) 3-5 Mbps	WiMAX LTE	Speeds for 4G are increased to lightning fast in order to keep up with data access demand used by various services. It also supports HD streaming. HD phones can be fully utilized on a 4G network.

- TDMA time division multiple access
- Code division multiple Access (CDMA)
- High Speed Packet Access (HSPA)
- **WiMAX** (**Worldwide Interoperability for Microwave Access**) is a wireless communications standard designed to provide 30 to 40 megabit-per-second data rates,

Medium	Speed	Cost	
Twisted Wire	300 BPS- 10 MBPS	Low	BPS = Bits Per Second
Microwave	256 KBPS- 100 MBPS		MBPS = Megabits Per Second
Satellite	256 KBPS- 100 MBPS		KBPS = Kilobits Per Second
Coaxial Cable	56 KBPS – 200 MBPS		GBPS = Gigabits Per Second
Fiber Optic cable	500 KBPS – 10 GBPS	High	

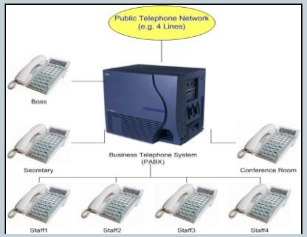
Typical Speed and Cost of Telecommunications Transmission Media

TYPES OF TELECOMMUNICATIONS NETWORK

There are many different types of telecommunications networks. However, main telecommunications networks are:

a) Private Branch Exchange (PBX): A Private branch exchange is an electronic switching device (or a special computer); located within the company that automatically switches calls between the company's telephone lines and those of a local telephone company. It is a small telephone exchange that is owned by the organization, as opposed to the large public telephone exchange owned by telephone companies.

a.



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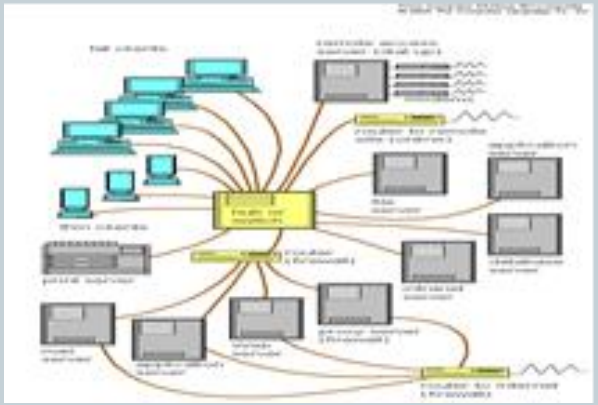
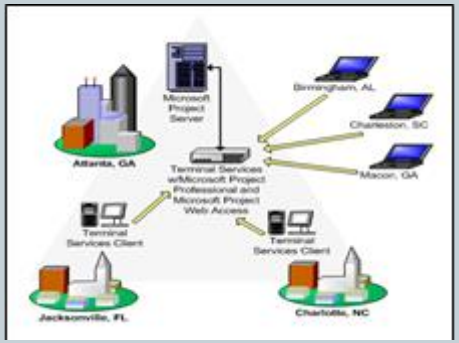
b) **Local Area Networks:** Local Area Networks (LANs) connect computers and other information processing devices within a limited physical area, such as an office, a building, manufacturing plant, or other work site so that knowledge workers can share data, information, messages, software, and even peripherals, such as printer.

LANs generally have higher transmission capabilities than PBXs, a very fast PBX can have a maximum transmission capacity of over 2 megabits per second, LANs typically transmit at a rate of 256 kilobits per second to cover 100 megabits per second.



c) Wide Area Networks (WAN) : Telecommunications networks covering a large geographical area are called *remote networks, long-distance networks,* or, more popularly, ***wide area networks***. Network that covers a large city or metropolitan area can also be included in this category. Thus, WANs are used by



manufacturing firms, banks, retailers, distributors companies, and government agencies to transmit and receive information among their employees, customers, suppliers, and other organizations across cities, regions, countries, or the world. The primary difference between a LAN and a WAN is that a WAN covers greater geographical distance than a LAN**.**

Value Added Networks (VAN): VANs are public data networks that add value to the basic communication services, such as access to commercial databases and software, correction of transmission errors, establishing compatibility between previously incompatible computers and terminals, E-mail, and videoconferencing. **A subscriber to a VAN service pays a monthly fee depending on its level of use.**

- For example:
- IBM Sterling B2B Integrator: This is a VAN that provides secure and reliable communication between trading partners, along with value-added services such as data mapping, translation, and transformation.

BUSINESS VALUE OF TELECOMMUNICATIONS

- A manager, entrepreneur, or business professional may need to know what business value is created by the business applications of telecommunications?
- A good way to answer this question is shown by the figure. Information technology, especially in telecommunications based business applications, helps a company overcome **geographic**, **time**, **cost**, and **structural** barriers to business success.

Types of Network Topology

- Network Topology is the schematic description of a network arrangement, connecting various nodes(sender and receiver) through lines of connection.
- Term network topology refers to the way in which the nodes of a network are linked together
- Although number network topologies are possible, four major ones are:
  - Star network
  - Ring network
  - Completely connected network
  - Multi-access bus network

BUSINESS VALUE OF TELECOMMUNICATIONS cont…

Strategic Capabilities	EC Examples	Business Value
Overcome Geographic Barrier: Capture information about business transactions from remote locations.	Use the Internet and extranets to transmit customer orders from traveling salespeople to a corporate data center for order processing and inventory control	Provides better customer service by reducing delay in filling orders and improves cash flow by speeding up to the billing of customers.
Overcome Time Barrier: Information to remote locations immediately after it is requested.	Credit authorization at the point of sale using online POS network	Credit inquiries can be made and answered in seconds
Overcome Cost Barrier: The cost of more traditional means of communication.	Desktop videoconferencing between a company and its business partners using the Internet, intranets, and extranets.	Reduce expensive business trips, allows customers, suppliers, and employees to collaborate, thus improving the quality of decision reached.
Overcome Structural Barrier: Support linkages for competitive advantage	Electronic data interchange (EDI) of transactions data to and from suppliers and customers using extranets or other networks.	Fast, convenient service locks in customers and suppliers.

Examples of the business value of electronic commerce applications of telecommunications.

What is the difference between the internet and an intranet?

- The internet is accessible to anyone at any time, while an intranet is usually only available to people within a certain network (such as those within a workplace, an office or a school).
- An intranet is a powerful way to communicate directly with employees and to have employees collaborate and communicate with each other.

Internet

This is *the world-wide network* of computers accessible to anyone who knows their Internet Protocol (IP) address - the IP address is a unique set of numbers (such as 209.33.27.100) that defines the computer's location. Most will have accessed a computer using a name such as http://www.hcidata.com. Before this *named* computer can be accessed, the name needs to be resolved (translated) into an IP address. To do this your browser (for example Netscape or Internet Explorer) will access a Domain Name Server (DNS) computer to lookup the name and return an IP address - or issue an error message to indicate that the name was not found. Once your browser has the IP address it can access the remote computer. The actual server (the computer that serves up the web pages) does not reside behind a firewall - if it did, it would be an Extranet. It may implement security at a directory level so that access is via a username and password, but otherwise all the information is accessible. To see typical security have a look at a sample secure directory - the username is Dr and the password isWho (both username and password are case sensitive).

Intranet

This is a network that is not available to the world outside of the Intranet. If the Intranet network is connected to the Internet, the Intranet will reside behind a firewall and, if it allows access from the Internet, will be an Extranet. The firewall helps to control access between the Intranet and Internet to permit access to the Intranet only to people who are members of the same company or organization.

In its simplest form, an Intranet can be set up on a networked PC without any PC on the network having access via the Intranet network to the Internet.

For example, consider an office with a few PCs and a few printers all networked together. The network would not be connected to the outside world. On one of the drives of one of the PCs there would be a directory of web pages that comprise the Intranet. Other PCs on the network could access this Intranet by pointing their browser (Netscape or Internet Explorer) to this directory - for example U:\inet\index.htm.From then onwards they would navigate around the Intranet in the same way as they would get around the Internet.

Extranet

An Extranet is actually an Intranet that is partially accessible to authorized outsiders. The actual server (the computer that serves up the web pages) will reside behind a firewall. The firewall helps to control access between the Intranet and Internet permitting access to the Intranet only to people who are suitably authorized. The level of access can be set to different levels for individuals or groups of outside users. The access can be based on a username and password or an IP address (a unique set of numbers such as 209.33.27.100 that defines the computer that the user is on).