Introduction Computer Networks

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Computer Networks

- A network consists of two or more computers that are linked in order to share resources (such as printers and CDs), exchange files, or allow electronic communications.

- The computers on a network may be linked through cables, telephone lines, radio waves, satellites etc.

- A popular example of a computer network is the Internet, which allows millions of users to share information.

Computer Network

Every Network Includes:

1. At least two computers that have something to share.

2. A cable or wireless pathway, called **Transmission Media**, for computers to signal each other.

3. Rules, called **Protocols**, so that computers can use the unified principle of data communication.

4. Networking Interface Cards (NIC)

Types of Networks

- The Networks are classified according to the following types:

  - Internet, -Telecommunication providers,

  - Companies, - Universities, - and Home.

- Certain multimedia applications only work well in certain network types.
- Each network type is characterized by the following elements:

  - Administration: Organization of the administration

  -Redundancy/stability: Network is constructed to fulfill certain stability goals

  -Service quality: Availability of service classes guaranteeing traffic quality

  -Monitoring: Extent of network monitoring

  - Standards: Standards on which the network is based

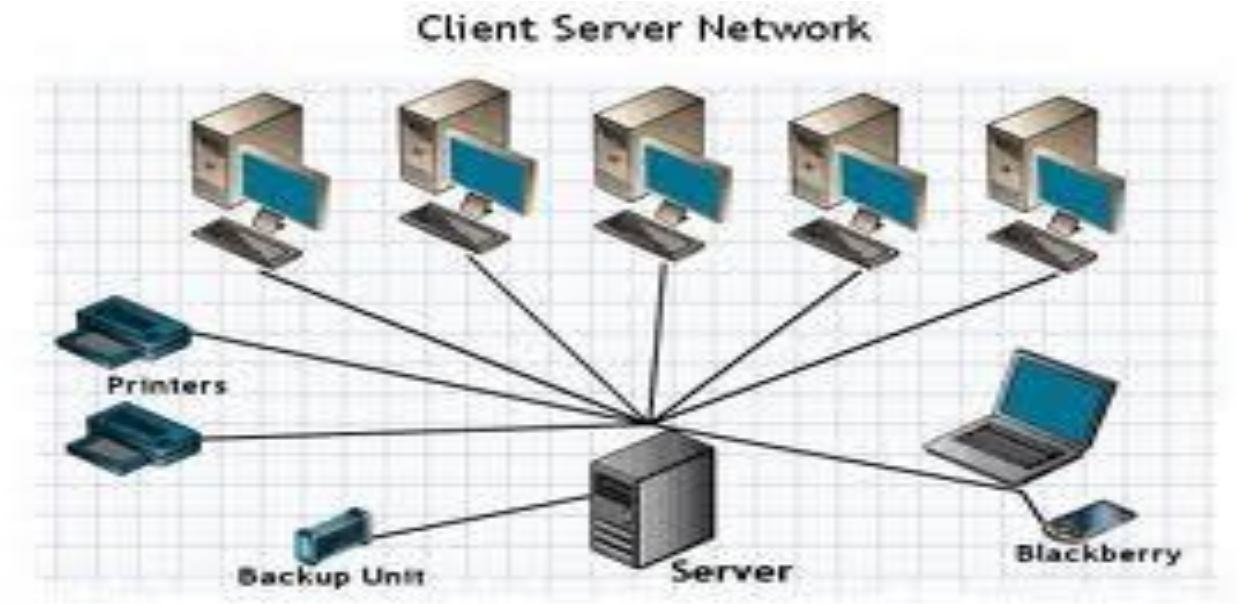
  - Operator: Who operates the network.

Advantages of Computer Networks

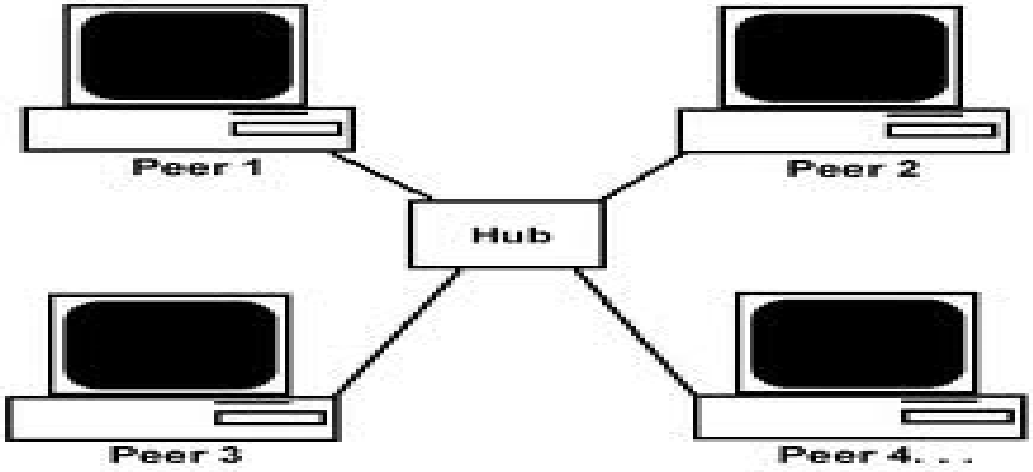
- **File Sharing:** Networks offer a quick and easy way to share files directly.
- **Resource Sharing:** All computers in the network can share resources such as printers, fax machines, modems and scanners.
- **Communication:** Those on the network can communicate with each other via e-mail, instant messages etc.
- **Flexible Access:** Networks allow their users to access files from computers throughout the network.
- **Sharing of Information**: Computer networks enable us to share data and information with the computers that are located geographically large distance apart.

Network Computing Models

- Centralized Computing **(Client-Server Network)**
  - A client-server network is where every client is connected to the server .
  - Server or mainframe computer has huge storage and processing capabilities.



- Distributed Computing (Peer-to-Peer Network)
  - All devices have same power.
  - It interconnects one or more computers.
  - Centralized backup is not possible.



Uses of Computer Network

- Simultaneous Access
- Shared Peripheral Devices
- Personal Communication
- Easier Backup

What is Ethernet?

- A group of standards for defining a local area network that includes standards in cabling and the structure of the data sent over those cables as well as the hardware that connects those cables.

- Independent of the network architecture.

- Flavors of Ethernet:
  - IEEE 802.3 Ethernet Specification
  - Great detail specifying cable types, data formats, and procedures for transferring that data through those cables
  - IEEE 802.5 Token Ring Specification

APPLICATIONS OF NETWOKS

- E-mail
- Searchable Data (Web Sites)
- E-Commerce
- News Groups
- Internet Telephony (VoIP)
- Video Conferencing
- Chat Groups
- Instant Messengers
- Internet Radio

Different Types of Networks

- Depending upon the geographical area covered by a network, it is classified as:
  - Local Area Network (LAN)
  - Metropolitan Area Network (MAN)
  - Wide Area Network (WAN)
  - Personal Area Network (PAN)

Local Area Network (LAN)

- *A LAN is a network that is used for communicating among computer devices, usually within an office building or home.*
- LAN's enable the sharing of resources such as files or hardware devices that may be needed by multiple users
- Is limited in size, typically spanning a few hundred meters, and no more than a mile
- Is fast, with speeds from 10 Mbps to 10 Gbps
- Requires little wiring, typically a single cable connecting to each device
- Has lower cost compared to MAN's or WAN's

- LAN's can be either wired or wireless. Twisted pair, coax or fibre optic cable can be used in wired LAN's.
- Every LAN uses a protocol – a set of rules that governs how packets are configured and transmitted.
- Nodes in a LAN are linked together with a certain topology. These topologies include:
  - Bus
  - Ring
  - Star
- LANs are capable of very high transmission rates (100s Mb/s to G b/s).

Advantages of LAN

- Speed
- Cost
- Security
- E-mail
- Resource Sharing

Disadvantages of LAN

- Expensive To Install
- Requires Administrative Time
- File Server May Fail
- Cables May Break

Metropolitan Area Network (MAN)

- A **metropolitan area network** (**MAN**) is a large computer network that usually spans a city or a large campus.
- A MAN is optimized for a larger geographical area than a LAN, ranging from several blocks of buildings to entire cities.
- A MAN might be owned and operated by a single organization, but it usually will be used by many individuals and organizations.
- A MAN often acts as a high speed network to allow sharing of regional resources.
- A MAN typically covers an area of between 5 and 50 km diameter.
- Examples of MAN: Telephone company network that provides a high speed DSL to customers and cable TV network.

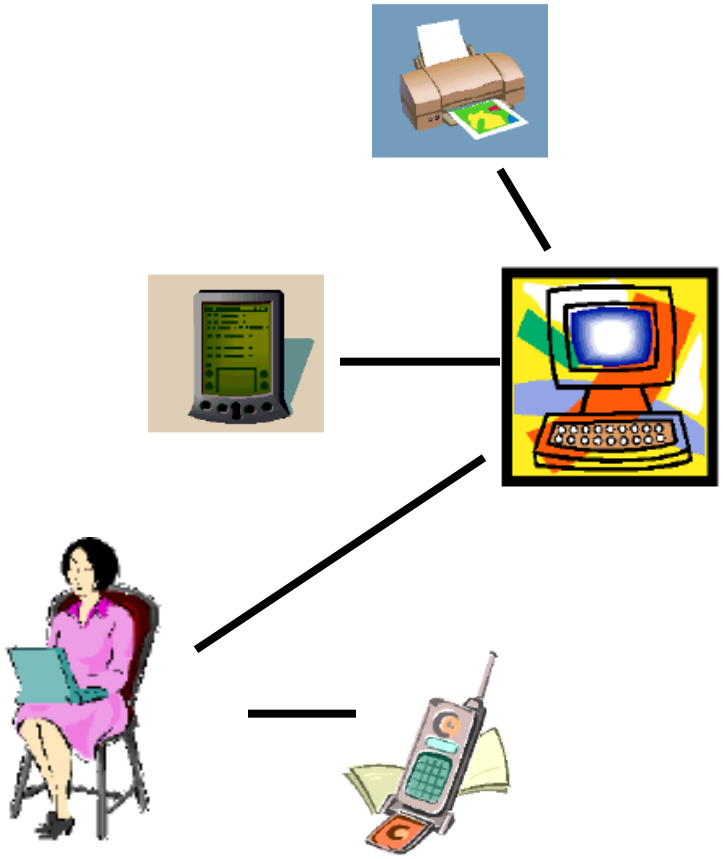
Wide Area Network (WAN)

- WAN covers a large geographic area such as country, continent or even whole of the world.
- A WAN is two or more LANs connected together. The LANs can be many miles apart.
- To cover great distances, WANs may transmit data over leased high-speed phone lines or wireless links such as satellites.
- Multiple LANs can be connected together using devices such as bridges, routers, or gateways, which enable them to share data.
- The world's most popular WAN is the Internet.

Personal Area Network (PAN)

- A PAN is a network that is used for communicating among computers and computer devices (including telephones) in close proximity of around a few meters within a room
- It can be used for communicating between the devices themselves, or for connecting to a larger network such as the internet.
- PAN's can be wired or wireless
- A **personal area network** (**PAN**) is a computer network used for communication among computer devices, including telephones and personal digital assistants, in proximity to an individual's body.
- The devices may or may not belong to the person in question. The reach of a PAN is typically a few meters.

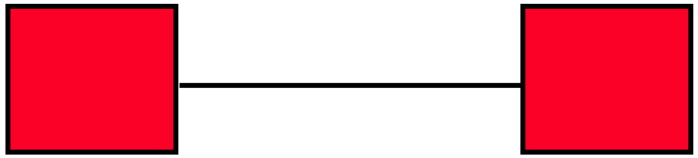
Personal Area Network (PAN)



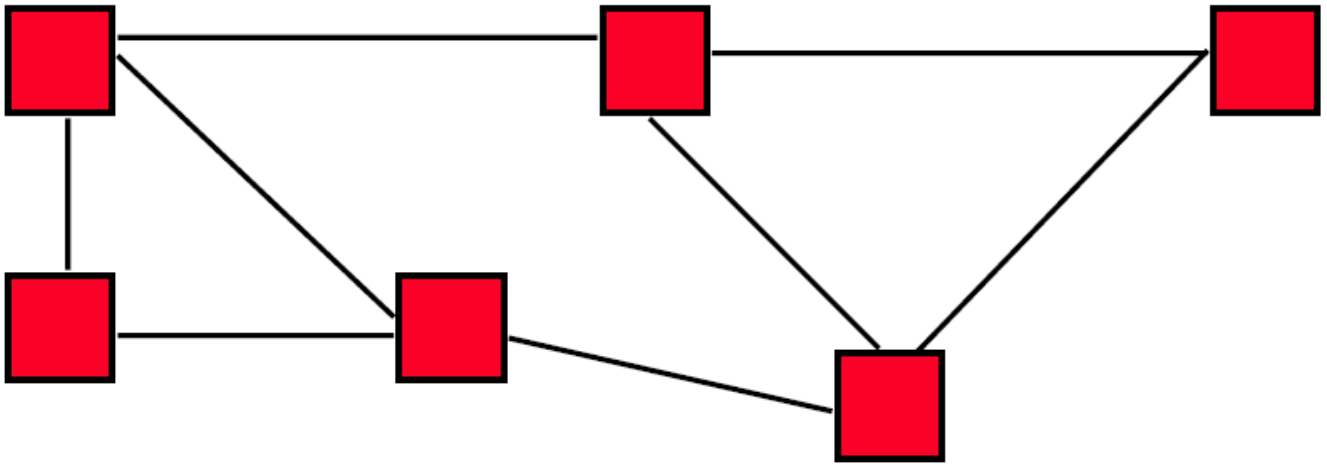
Data Communications and Networking Overview

Data Communication vs Networking

- Communication: Two Nodes. Mostly EE issues.



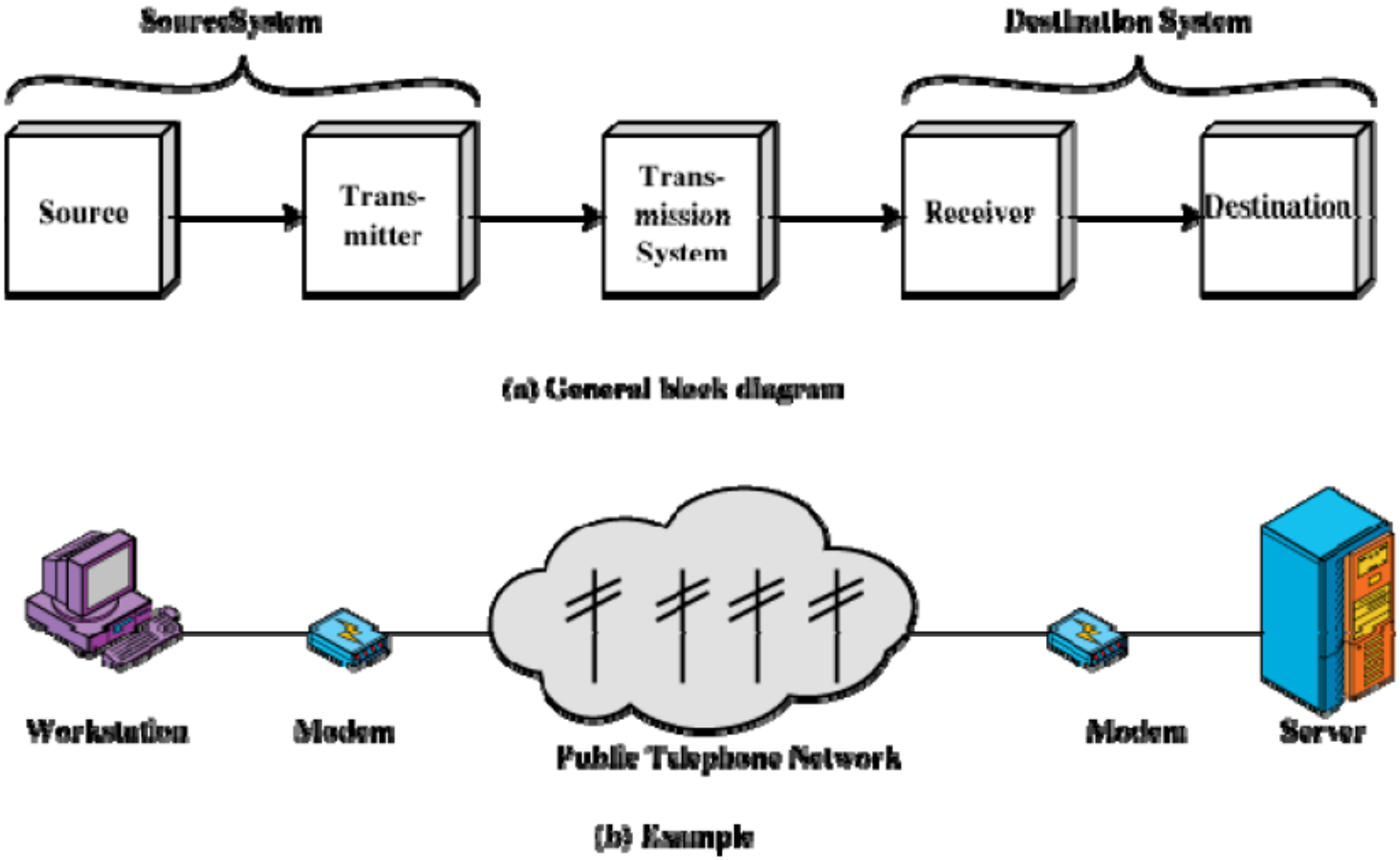
- Networking: Two or more nodes. More issues, e.g., routing



Distributed Systems vs Networks

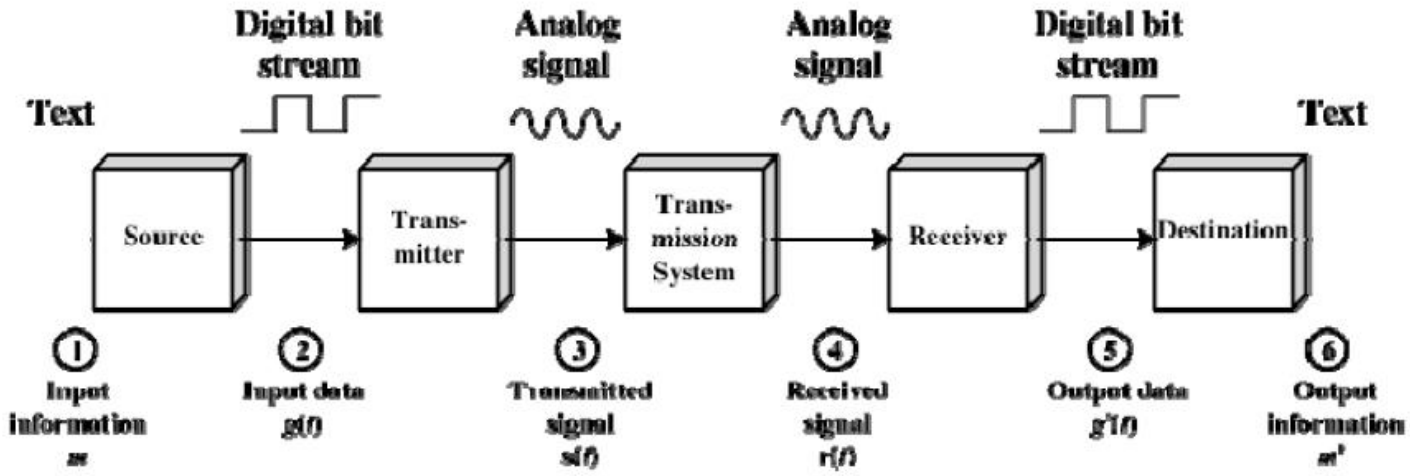
- Distributed Systems:
  - Users are unaware of underlying structure.
  - E.g., trn instead of \n\bone\0\trn
  - Mostly operating systems issues.
  - Nodes are generally under one organization's control.
- Networks: Users specify the location of resources.
  - Nodes are autonomous.

Simplified Communications Model



Transmitter: encodes the information

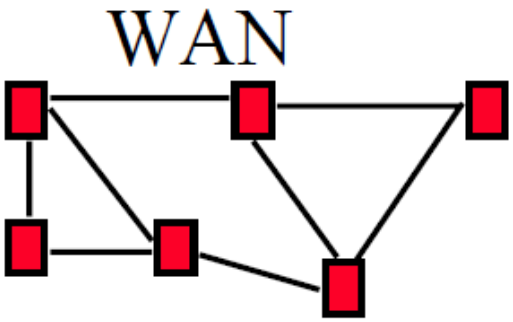
Data Communications: Example

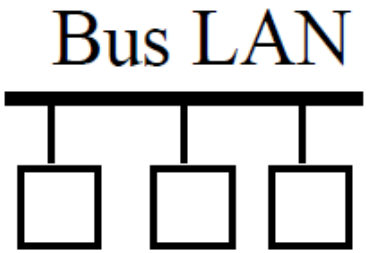


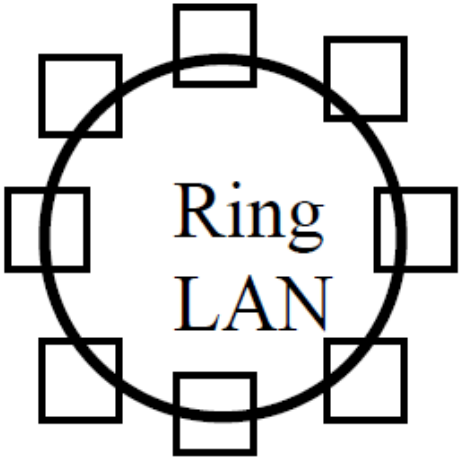
Modem is used to transmit/receive digital information over analog phone system

Types of Networks

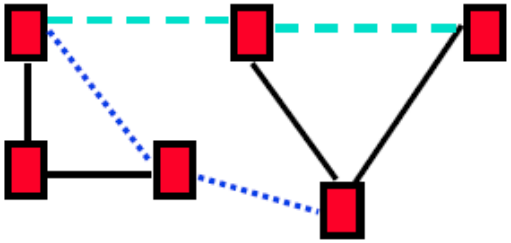
- Point to point vs Broadcast

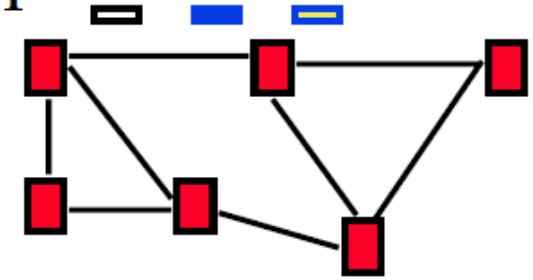






- Circuit switched vs packet switched

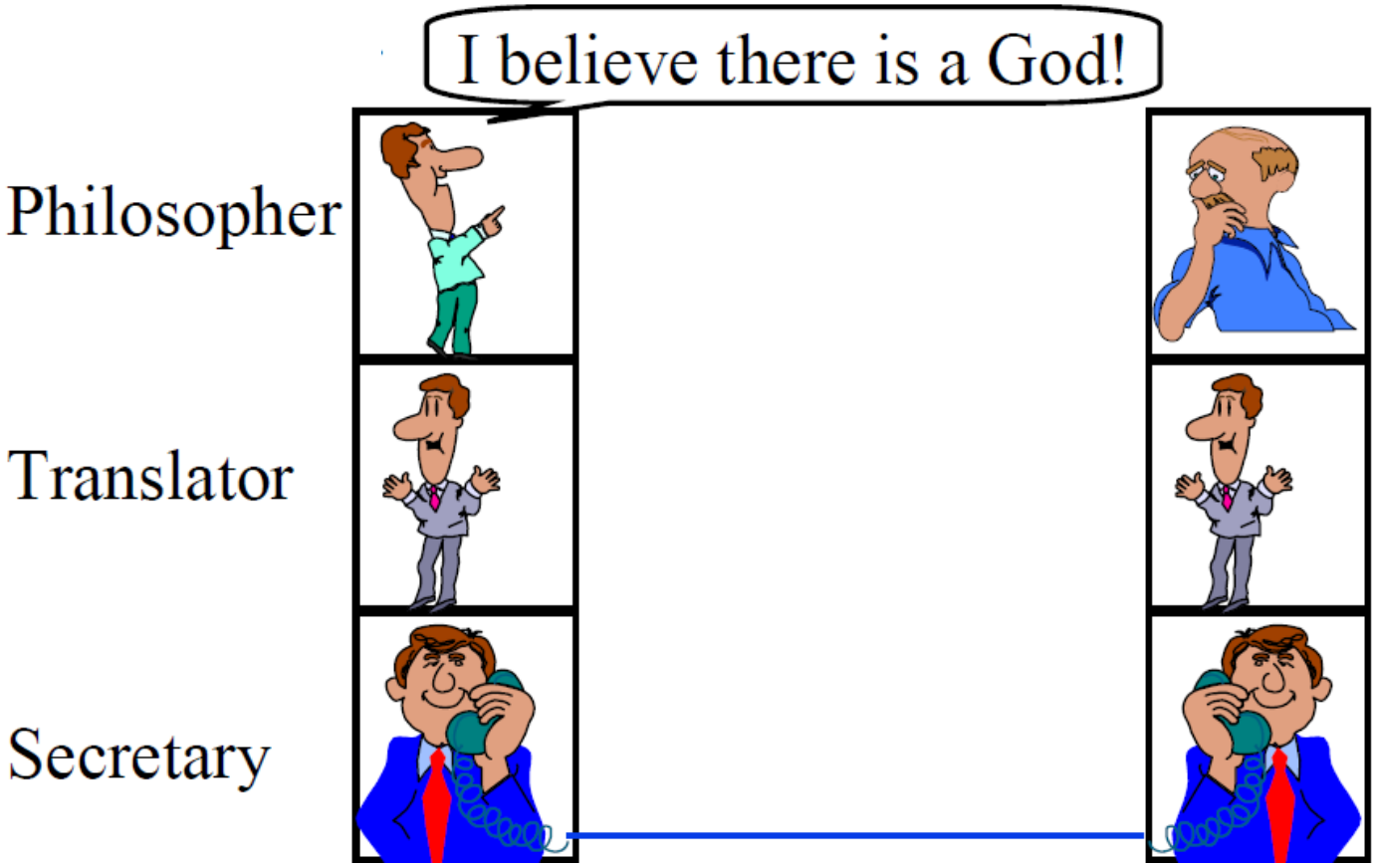




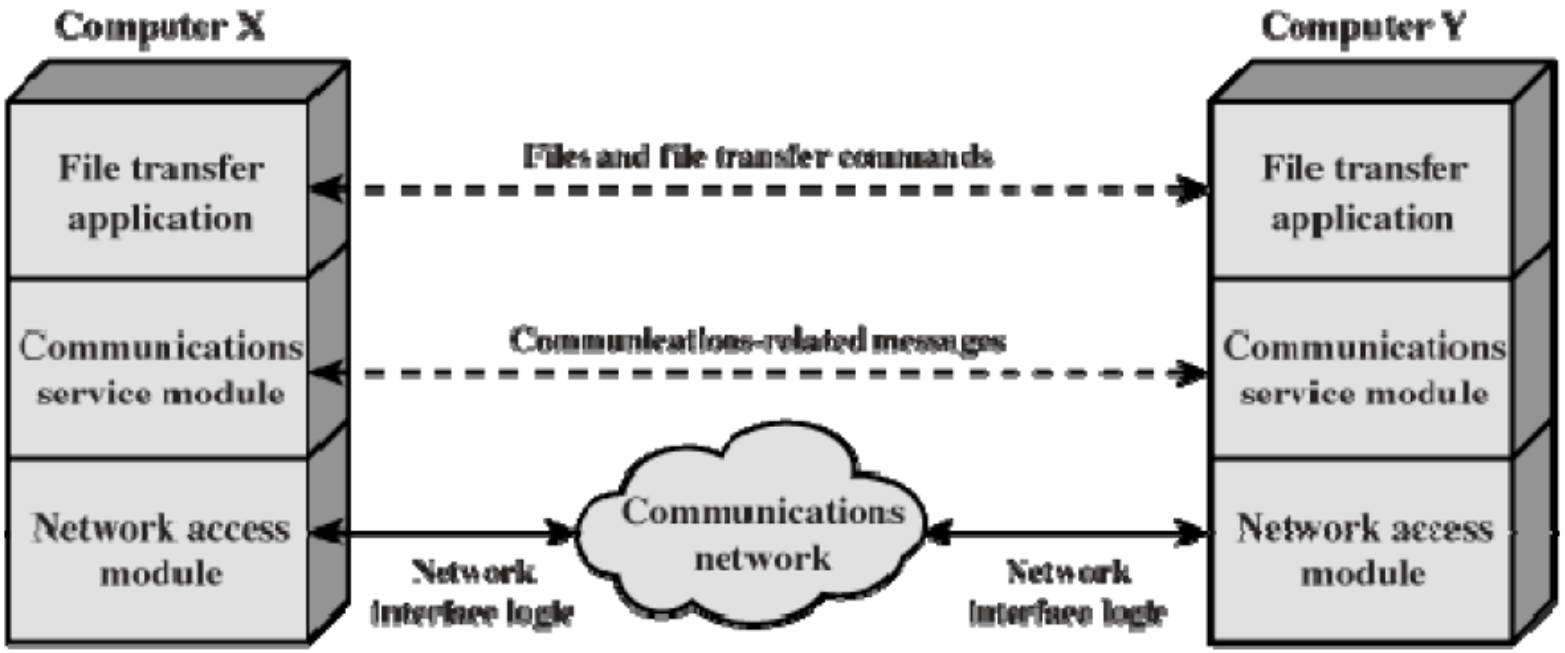
- Enterprise vs Telecom Networks
- Ethernet is the most common interface in Enterprise
- Frame relay and ATM are common in Telecom Networks
- ! Local Area Networks (LAN) 0-2 km, Single Ownership
- Metropolitan Area Networks (MAN) 2-50 km,
- Wide Area Networks (WAN) 50+ km
- Telecom Networks:
  - Access: Between subscriber and the service provider
  - Metro: Covering a city
  - Core: Between cities

Protocol Layers

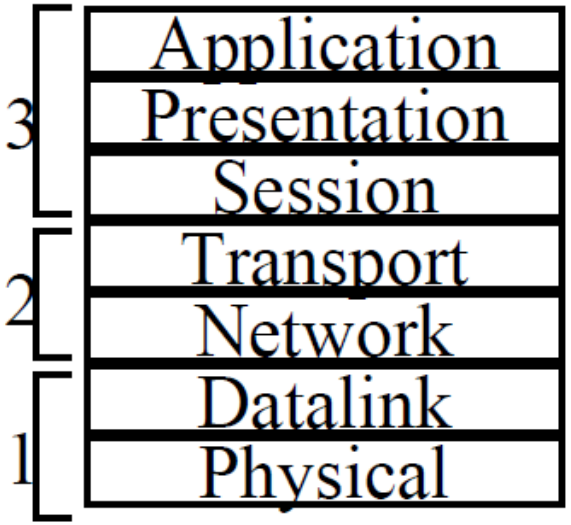
- Problem: Philosophers in different countries speak different languages. The Telex system works only with English.



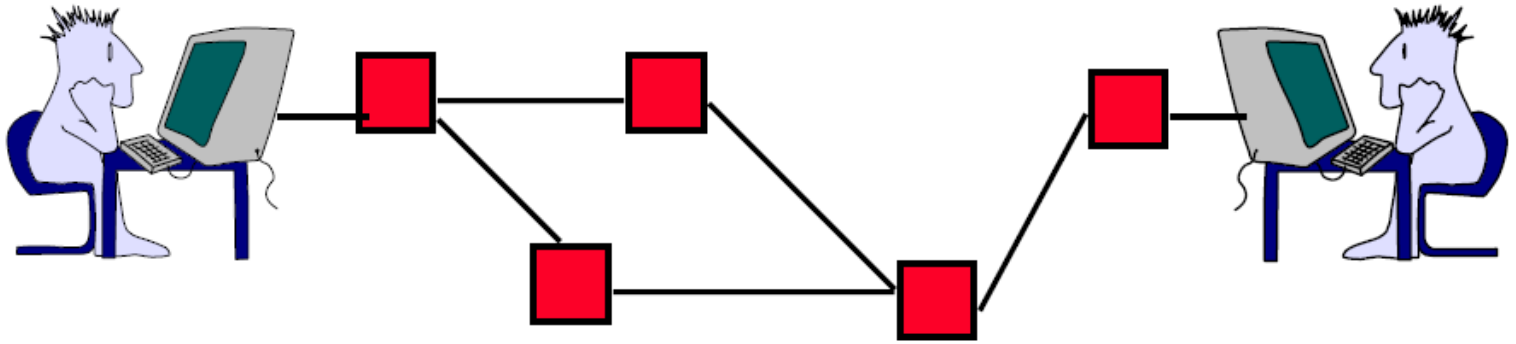
A Sample Protocol Architecture



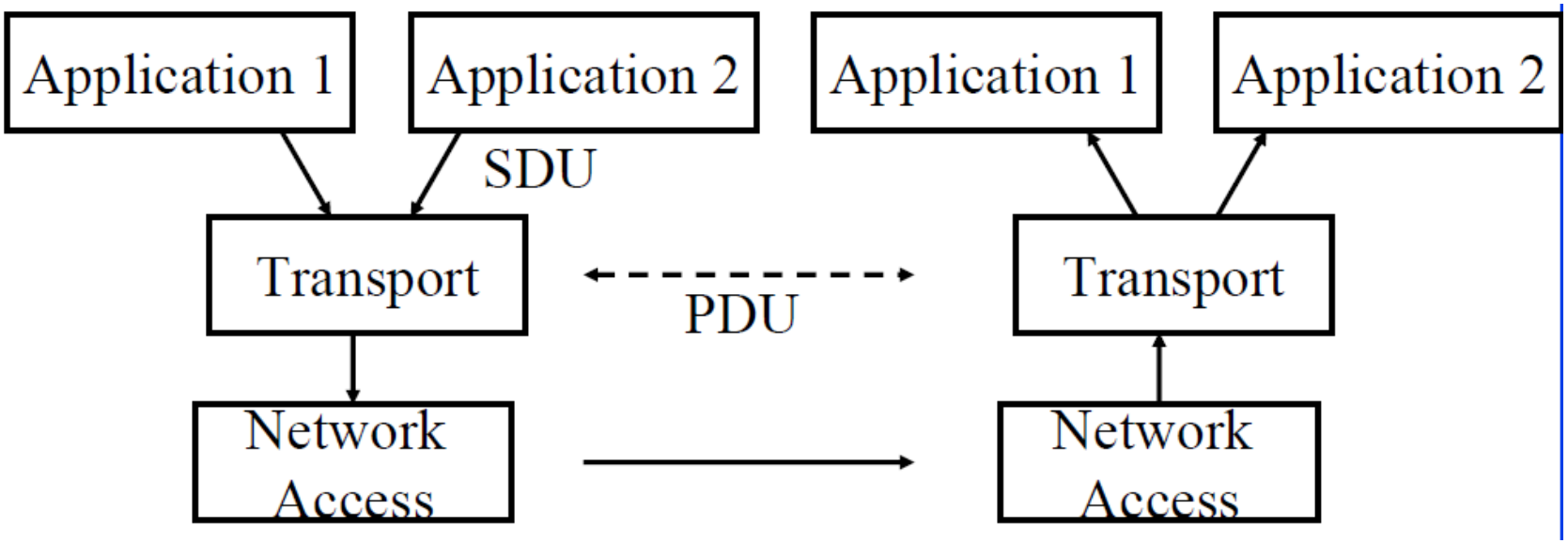
ISO/OSI Reference Model



File transfer, Email, Remote Login
ASCII Text, Sound
Establish/manage connection
End-to-end communication: TCP
Routing, Addressing: IP
Two party communication: Ethernet
How to transmit signal: Coding

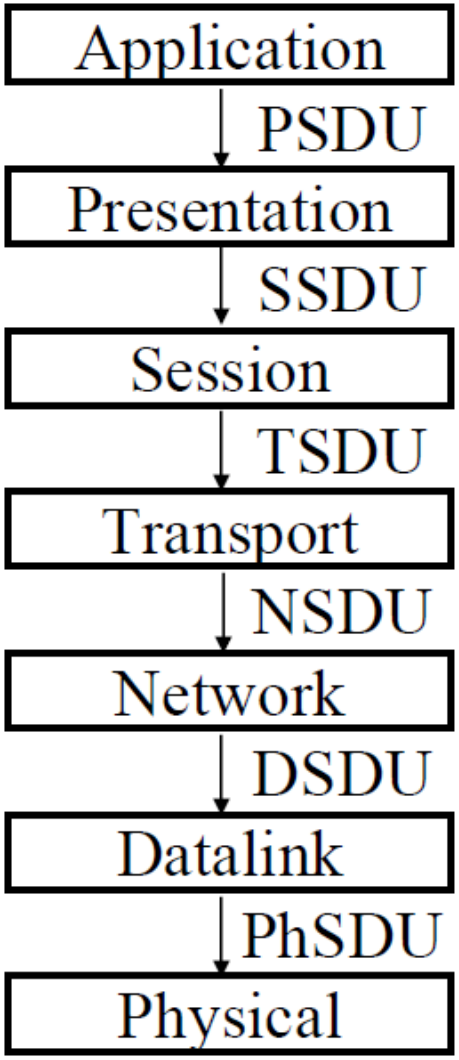


Service and Protocol Data Units

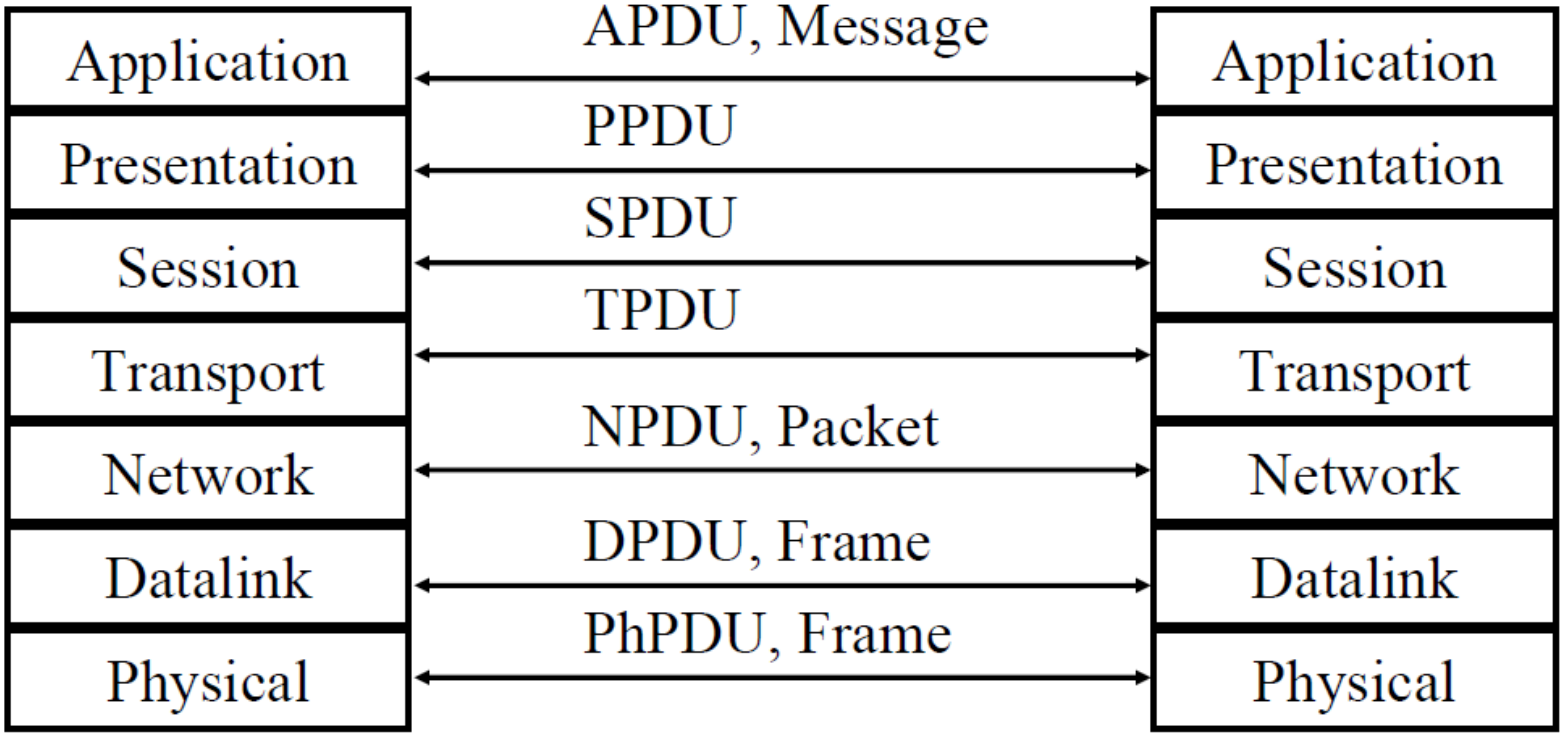


- Service Access Points (SAPs)
- Service Data Units (SDUs)
- Protocol Data Units (PDUs)

Service Data Unit (SDU)

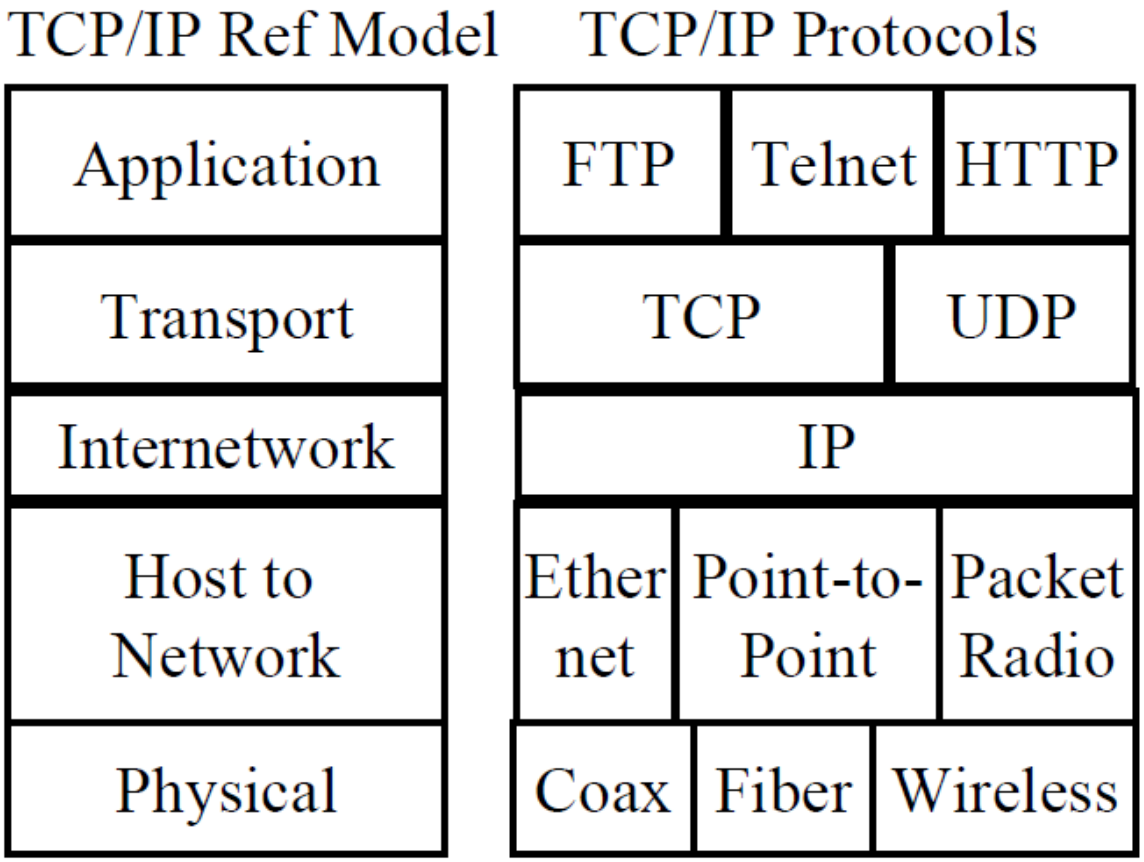


Protocol Data Unit (PDU)

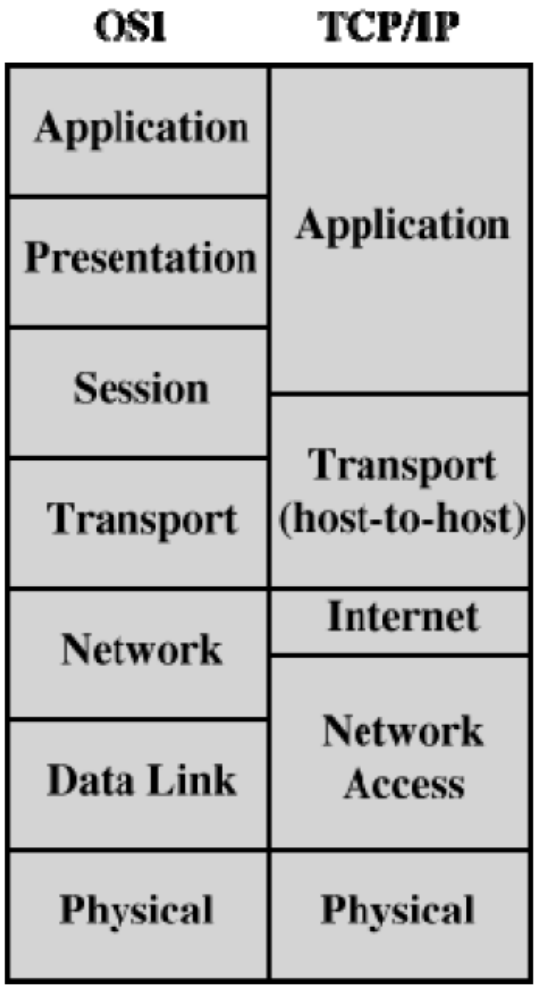


TCP/IP Reference Model

- TCP = Transport Control Protocol
- IP = Internet Protocol (Routing)



OSI vs TCP/IP


OSI
TCP/IP
Application
Presentation
Session
Transport
Network
Data Link
Physical
Application
Transport (host-to-host)
Internet
Network Access
Physical

Quiz

- 1. Which of this is not a constituent of residential telephone line?
  a) A high-speed downstream channel
  b) A medium-speed downstream channel
  c) A low-speed downstream channel
  d) An ultra-high speed downstream channel
  View Answer
- Answer: c
  Explanation: A low-speed downstream channel is not a constituent of a residential telephone line. But it might be just a two-way telephone channel. Internet can be provided through a high-speed downstream channel in a residential telephone line.

- 2. DSL telcos provide which of the following services?
  a) Wired phone access b) ISP
  c) Wired phone access and ISP
  d) Network routing and ISP
  View Answer
- Answer: c
  Explanation: DSL stands for Digital Subscriber Line and ISP stands for Internet Service Provider. In a Digital Subscriber Line system, the same company which provides phone connection is also an ISP. The internet is provided through the pre-installed telephone lines.

Quiz

- 3. The function of DSLAM is to _____
  a) Convert analog signals into digital signals
  b) Convert digital signals into analog signals
  c) Amplify digital signals
  d) De-amplify digital signals
  View Answer
- Answer: a
  Explanation: DSLAM stands for Digital Subscriber Line Access Multiplexer and it's used by Telcos to convert the analog signals to digital signals for the purpose of providing internet. The DSLAM located in a telco's Central Office does this function.

- 4. Which of the following terms is not associated with DSL?
  a) DSLAM
  b) CO
  c) Splitter
  d) CMTS
  View Answer
- Answer: d
  Explanation: CMTS stands for Cable modem termination system. It is used in cable internet access. In cable internet access, internet is not provided through telephone lines and the companies that provide such connections don't necessarily provide telephone access.

Quiz

- 5. HFC contains _____
  a) Fibre cable
  b) Coaxial cable
  c) A combination of Fibre cable and Coaxial cable
  d) Twisted Pair Cable
  View Answer
- Answer: c
  Explanation: Hybrid fiber-coaxial (HFC) is a telecommunications industry term for a broadband network that combines optical fiber and coaxial cable. It has been popularly used since the early 1990s. It is stronger than the optical fiber cables and faster than the co-axial cables.

- 6. Which of the following statements is not applicable for cable internet access?
  a) It is a shared broadcast medium
  b) It includes HFCs
  c) Cable modem connects home PC to Ethernet port
  d) Analog signal is converted to digital signal in DSLAM
  View Answer
- Answer: d
  Explanation: CMTS stands for Cable modem termination system. In cable access analog signal is converted to digital signal by CMTS. In cable internet access, internet is not provided through telephone lines. DSLAM is used by Telecom companies.

Quiz

- 7. Among the optical-distribution architectures that are essentially switched ethernet is _____
  a) AON b) PON c) NON d) MON
  View Answer
- Answer:a
  Explanation: AON stands for Active optical networks which are essentially switched Ethernets. Each user has his/her own dedicated optical fiber line connecting to the ISP in an AON.

- 8. StarBand provides _____
  a) FTTH internet access
  b) Cable access
  c) Telephone access
  d) Satellite access
  View Answer
- Answer: d
  Explanation: StarBand was a two-way satellite broadband Internet service available in the U.S. from 2000–2015. It was discontinued from September 30 2015 due to increasing competition from other ISPs.

Quiz

- 9. Home Access is provided by _____
  a) DSL
  b) FTTP
  c) Cable
  d) All of the mentioned
  View Answer
- Answer: d
  Explanation: Home Internet Access is provided by DSL, FTTP, and Cable. FTTP provides the fastest speeds followed by the cable connections and then the DSLs. FTTP is popularly used in modern connections.

- 10. ONT is connected to splitter using _____
  a) High speed fibre cable
  b) HFC
  c) Optical cable
  d) Twisted pair cable
  View Answer
- Answer: c
  Explanation: ONT stands for Optical Network Terminal. The ONT connects to the Termination Point (TP) with an optical fibre cable. It translates light signals from the fibre optic line to electric signals that the router can read.

Quiz

- 11. Which of the following factors affect transmission rate in DSL?
  a) The gauge of the twisted-pair line
  b) Degree of electrical interfernece
  c) Shadow fading
  d) The gauge of the twisted-pair line and degree of electrical interference
  View Answer
- Answer: d
  Explanation: Because DSL is made of twisted wire copper pair, the gauge of twisted pair line i.e. the protection and electrical interference would affect the transmission rate in DSL. Unlike DSL, FTTP is not really affected by these factors.

Thank You