

Unit-1:
Introduction to Computer
Networks & Internet

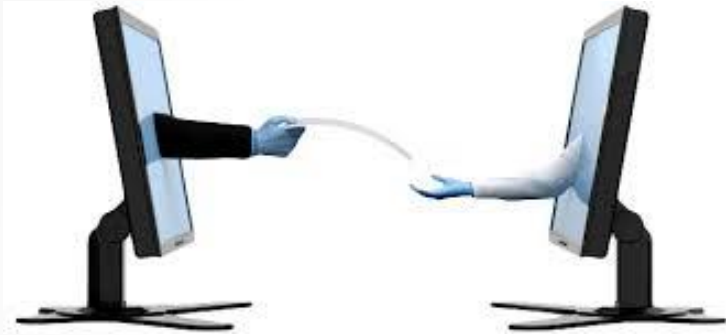
What is Computer Network?

- ▶ Computer Network is a system in which multiple computers are **connected** to each other to **share information** and **resources**.



Advantages of Computer Network

File Sharing



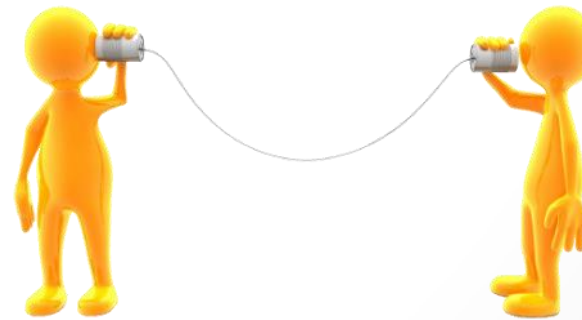
Flexible Access



Entertainment



Better Communication

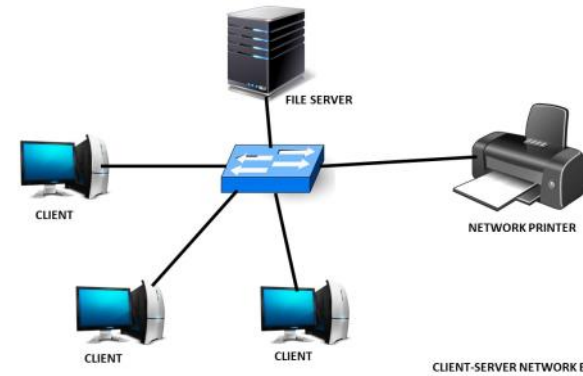


Advantages of Computer Network

Internet Access



Inexpensive System



Instant and Multiple Access



Resource Sharing



Applications of Computer Network

Email Services



Teleconferencing



Business & Finance



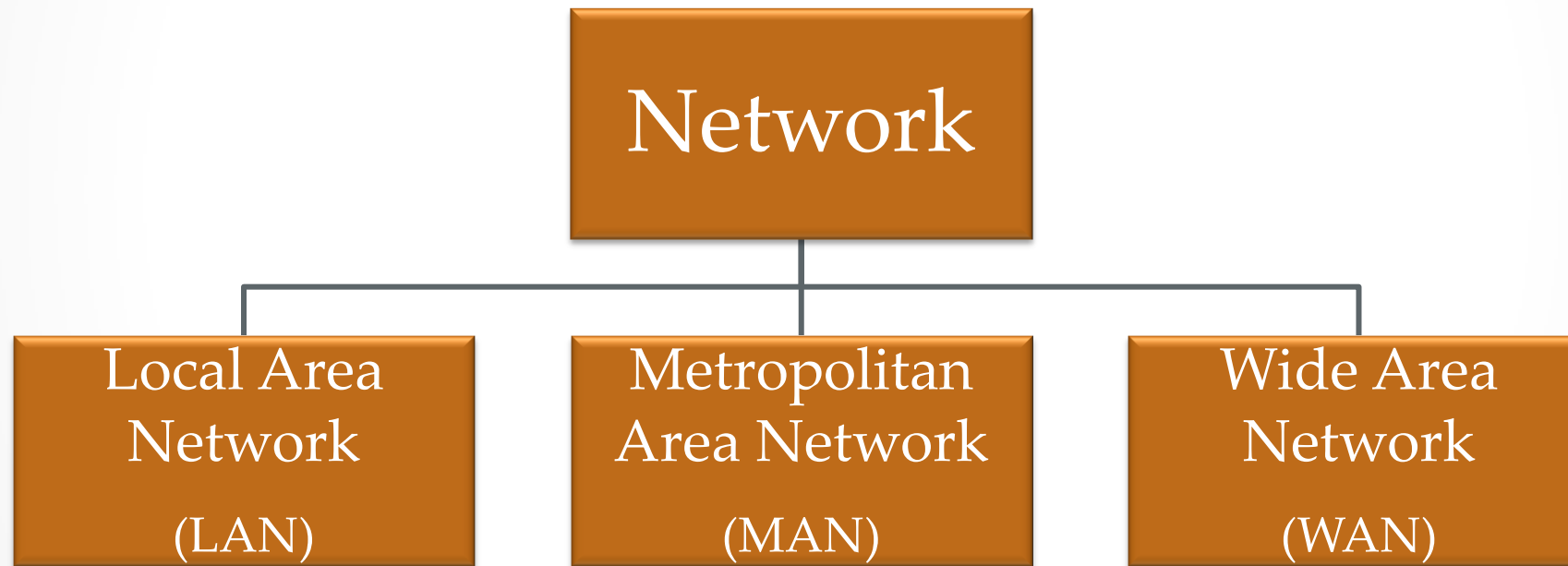
File & Directory Services



& Many More....

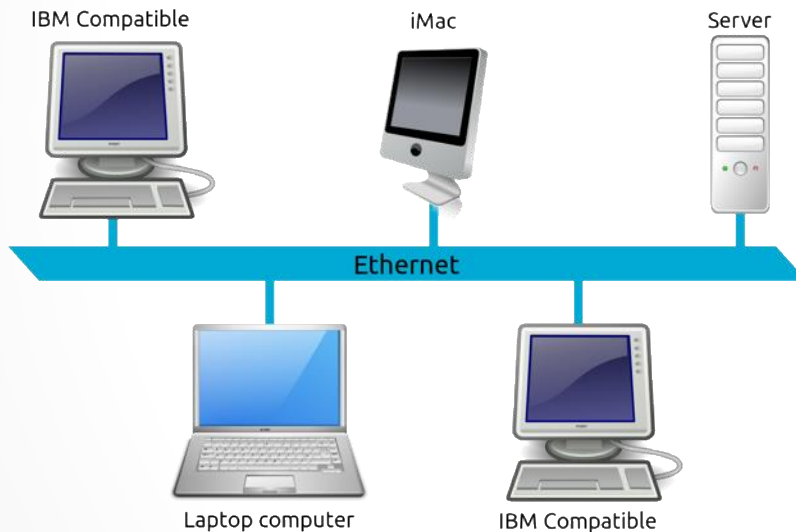
Types of Computer Network

- ▶ Computer networks can be categorized by their size as well as their purpose.
- ▶ The size of a network can be expressed by the geographic area.
- ▶ Some of the different networks based on size are:



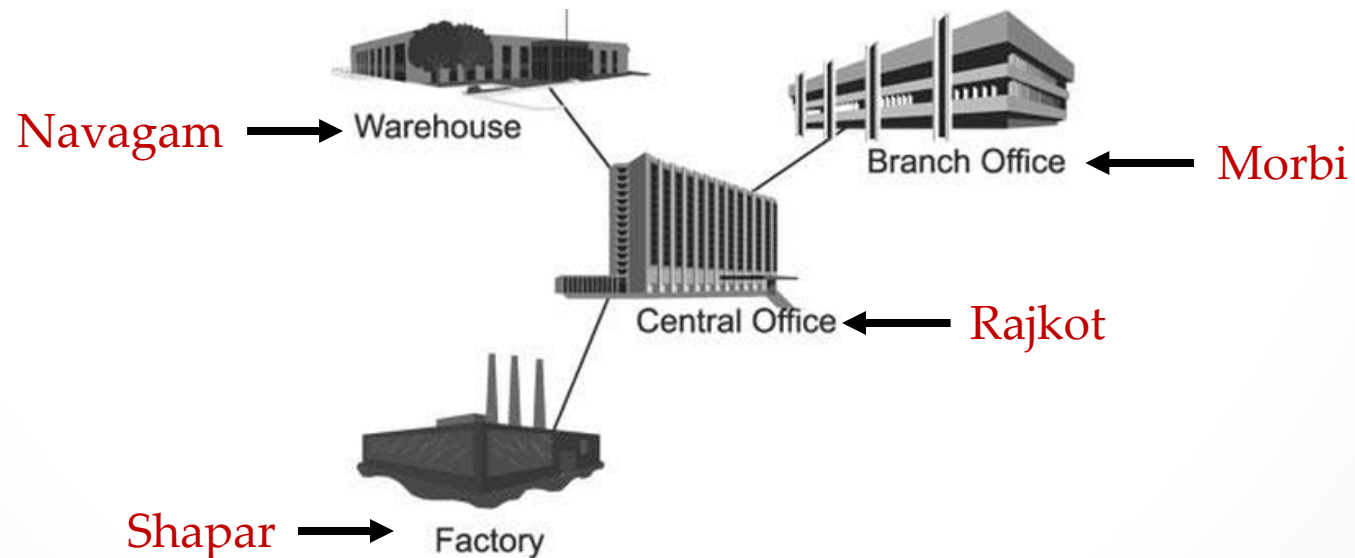
Local Area Network

- ▶ A local area network (LAN) is a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building.



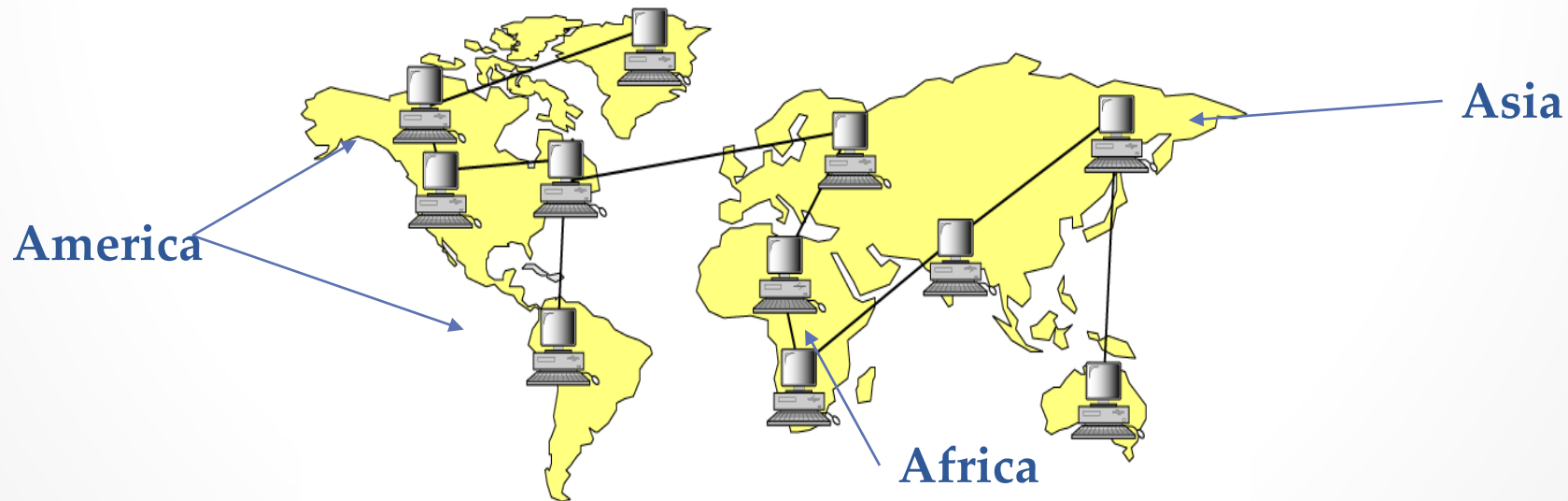
Metropolitan Area Network

- ▶ A metropolitan area network (MAN) is a computer network that interconnects with computer in a metropolitan area like city.
- ▶ MAN is a larger than LAN but smaller than the area covered by a WAN.
- ▶ It is also used to interconnection of several local area network.

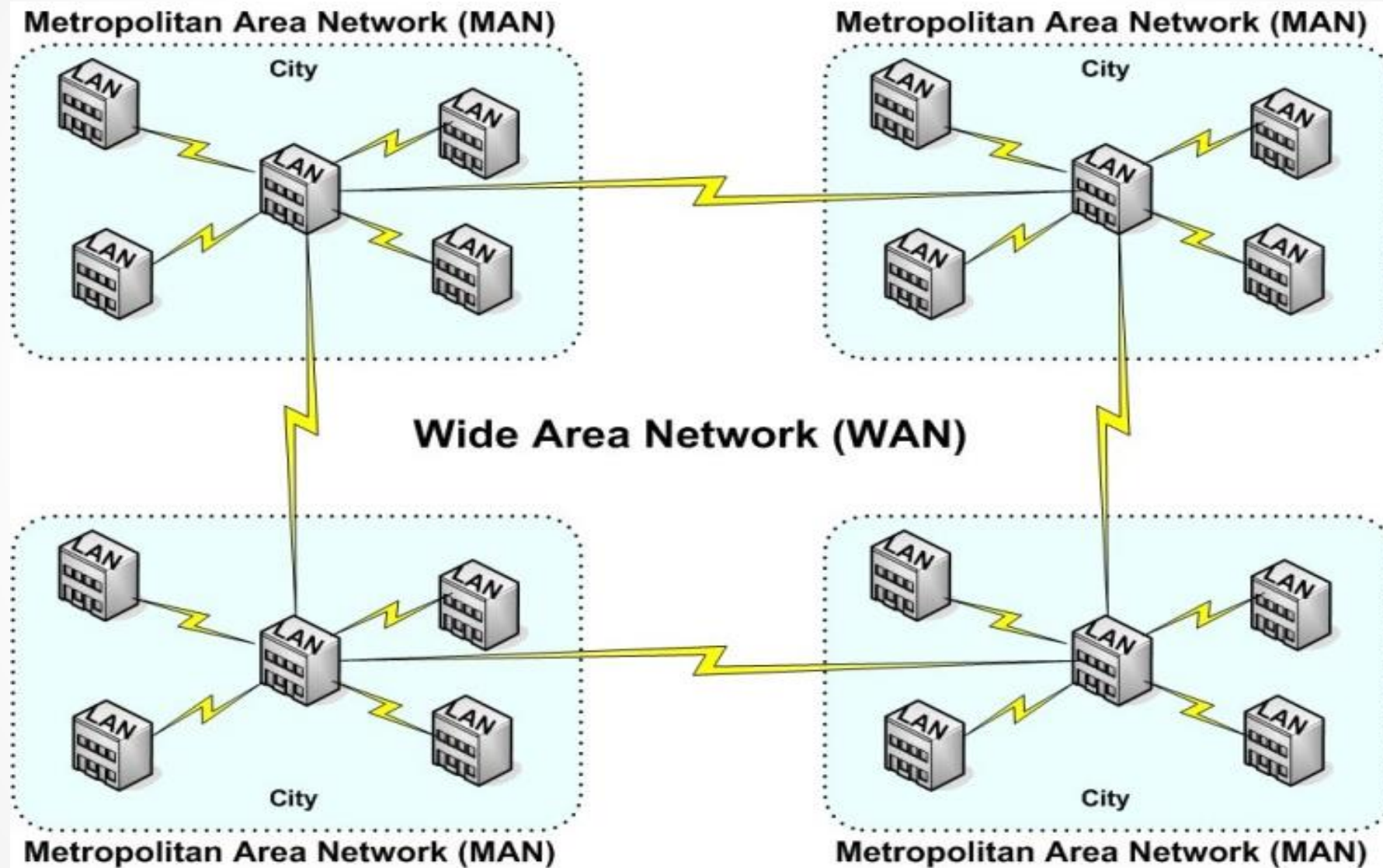


Wide Area Network

- ▶ A wide area network (WAN) is a computer network that exists over a large-scale geographical area.
- ▶ A WAN connects different networks, including local area networks (LAN) and metropolitan area networks (MAN).
- ▶ It may be located within a state or a country or it may be interconnected around the world.



Types of Computer Networks - Summary

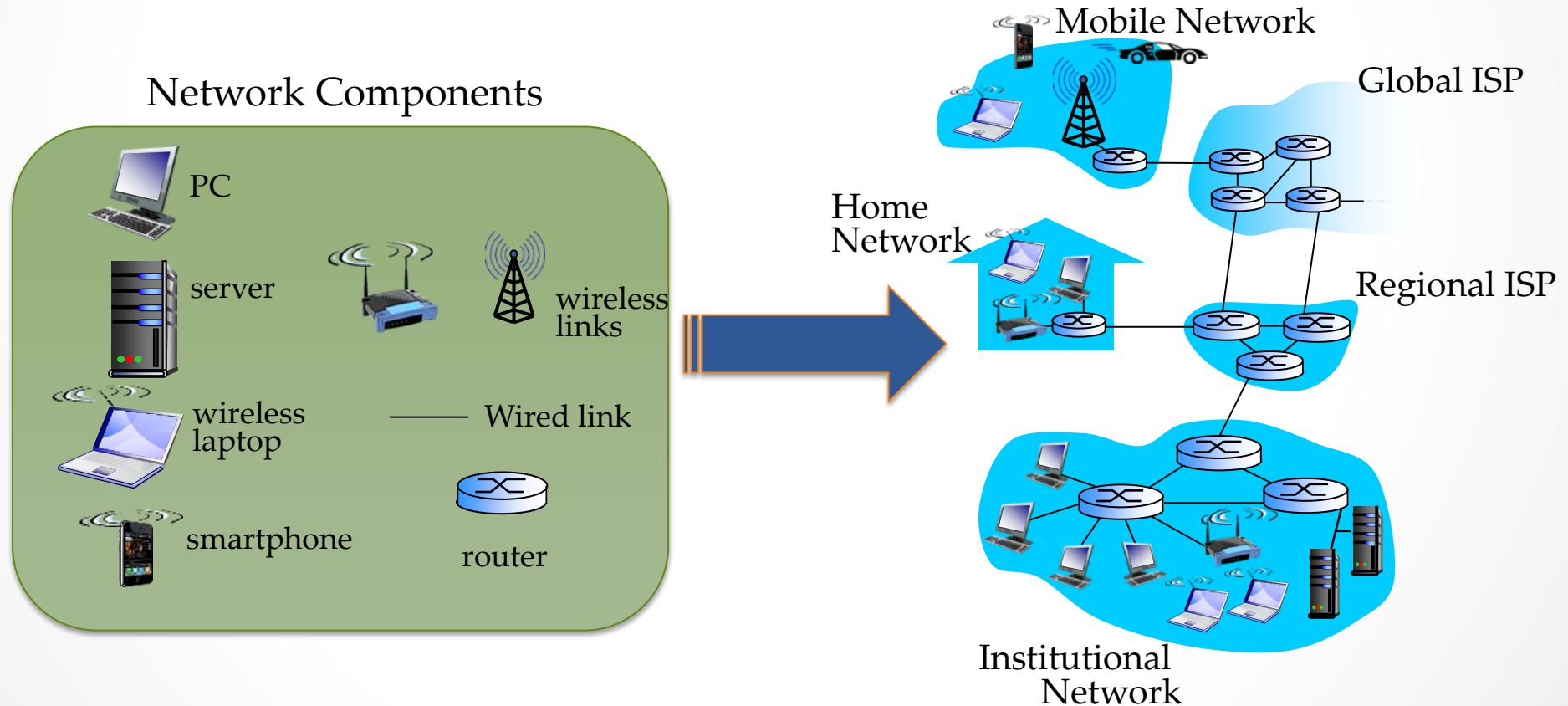


Types of Computer Networks - Summary

| Comparison | LAN | MAN | WAN |
|------------------------|---|---|--|
| Full Name | Local Area Network | Metropolitan Area Network | Wide Area Network |
| Meaning | A network that connects a group of computers in a small geographical area | It covers relatively large region such as cities, towns | It spans large locality & connects countries together. e.g. Internet |
| Ownership of Network | Private | Private or Public | Private or Public (VPN) |
| Design and Maintenance | Easy | Difficult | Difficult |
| Propagation Delay | Short | Moderate | Long |
| Speed | High | Moderate | Low |
| Equipment Used | NIC, Switch, Hub | Modem, Router | Microwave, Radio Transmitter & Receiver |
| Range(Approximately) | 1 to 10 km | 10 to 100 km | Beyond 100 km |
| Used for | College, School, Hospital | Small towns, City | State, Country, Continent |

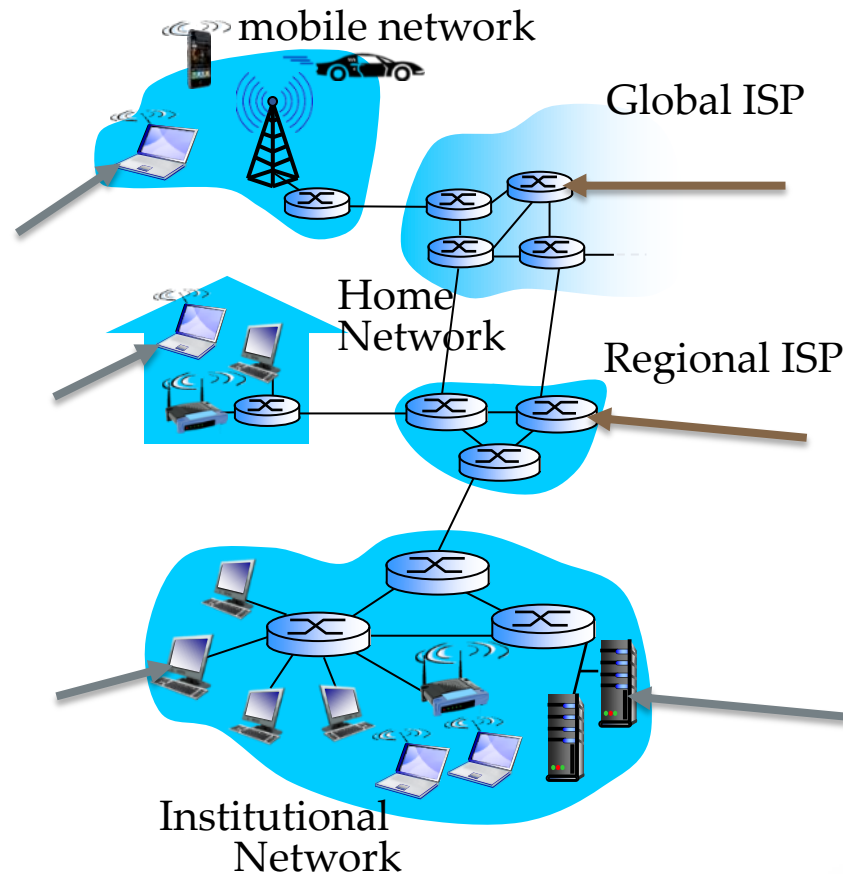
What is Internet?

- ▶ The internet is a type of world-wide computer network.
- ▶ The internet is the collection of infinite numbers of connected computers that are spread across the world.



The Network Edge

- ▶ Computers and other devices are connected at the **edge** (end) of the network.
- ▶ These computers are known as **hosts** or **end systems**. Router is known as **edge router**.

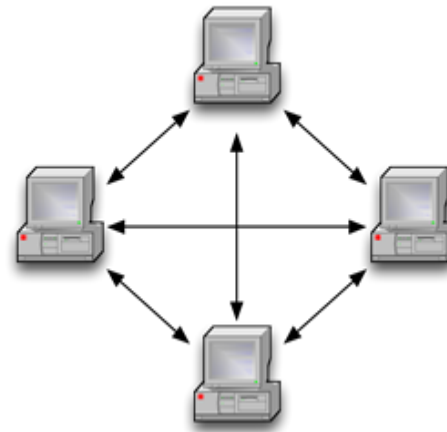


Peer to Peer Network

- ▶ Computers are connected together so that users can share resources and information.



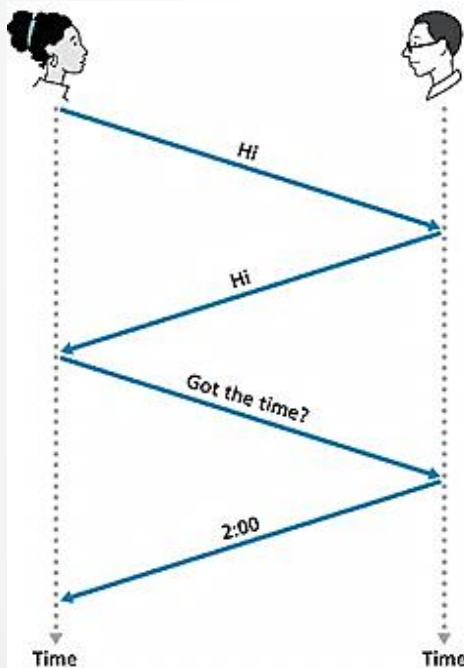
- ▶ There is no central server for authenticating users, each of them works as both client and server
- ▶ e.g. Bit Torrent



What is Protocol?

► Human Protocol(Language)

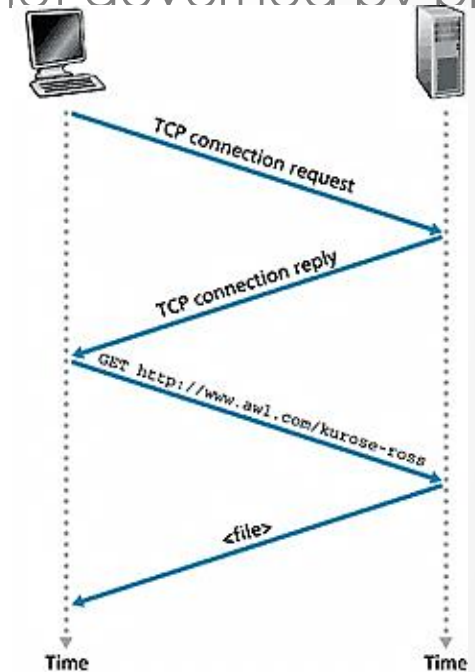
- “what’s the time?”
- “I have a question”
- Introduction Talk



*Protocol is define **format**,
order of message that **sent**
and received among
network entities, and
actions taken on message
transmission and reception.*

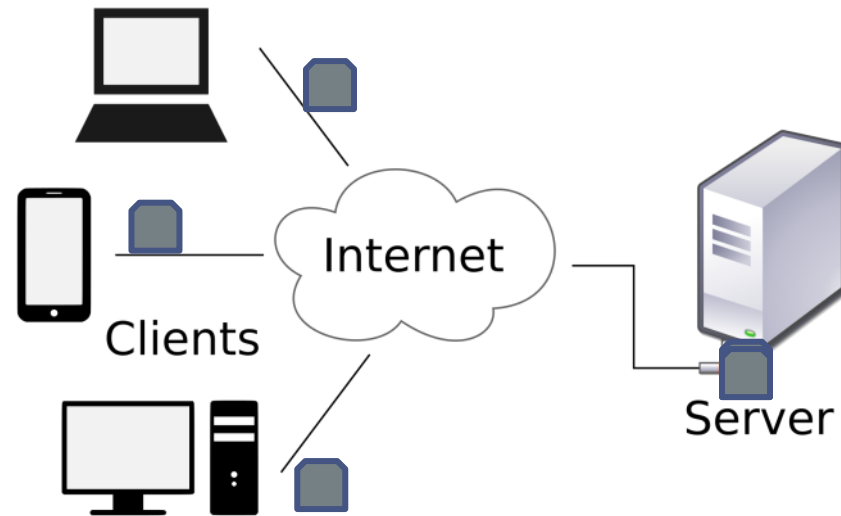
► Network Protocol

- Set of rules
- Machines rather than humans.
- All communication activity in Internet aoverned by protocols.



Client – Server Network

- ▶ **Client:** Request servers for a task.
 - ↳ Generally called desktop PCs or workstations.
- ▶ **Server:** Receive requests from the clients. Process and response them.
 - ↳ e.g. Web Server, Email Server



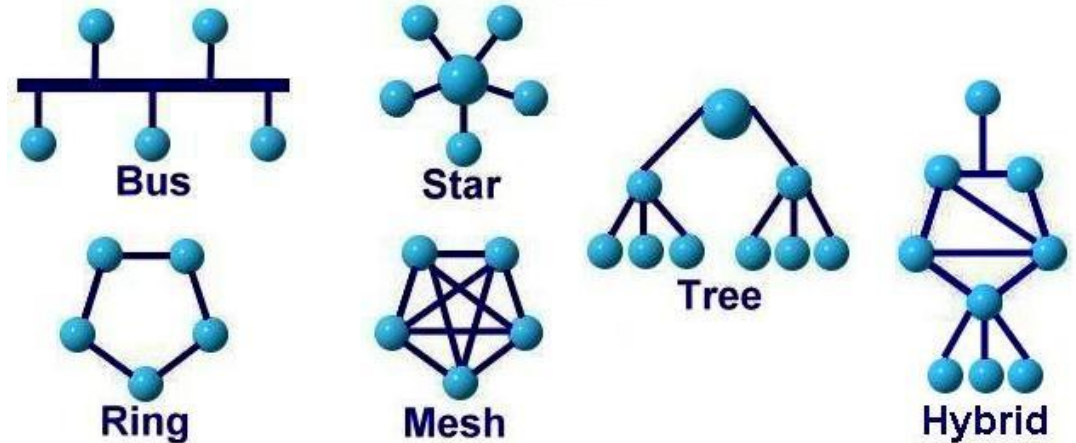
Network Topologies

Network Topologies

► Network topology is the arrangement of the various components (links, nodes, etc.) of a computer network.

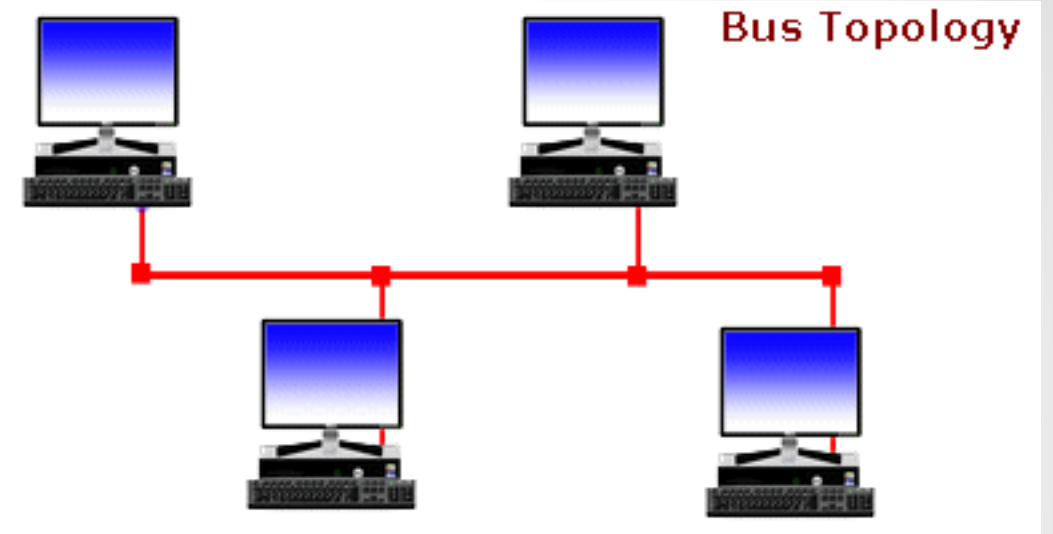
► Types of network topologies :

1. Bus
2. Ring
3. Star
4. Mesh
5. Tree
6. Hybrid



Bus Topology

- ▶ Every computer and network device is connected to single cable
- ▶ It transmits data only in one direction.
- ▶ Cost effective
- ▶ Used in small networks
- ▶ Easy to expand joining two cables together
- ▶ It is used in early LAN connection



Ring Topology

- ▶ It forms a **ring** as each computer is connected to another computer, with the last one connected to the first.
- ▶ Transmission is **unidirectional** & **sequential** way that is bit by bit.
- ▶ Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having **tokens** can transmit data.
- ▶ **Cheap** to install and expand.



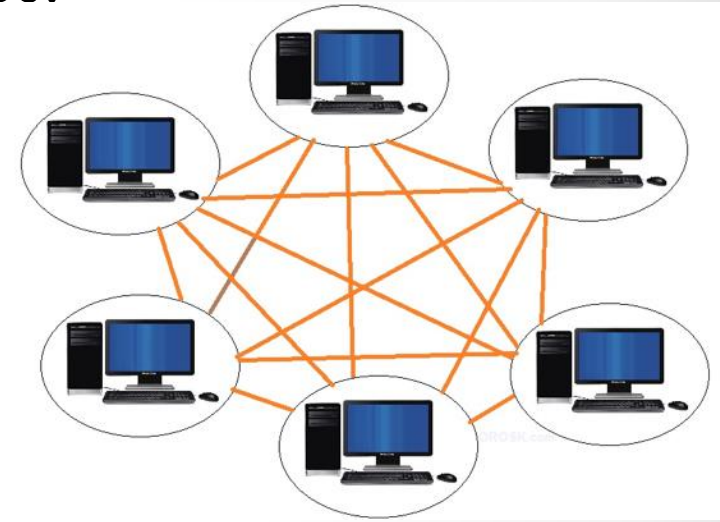
Star Topology

- ▶ Computers are connected to a single central hub through a cable.
- ▶ Fast performance with few nodes and low network traffic.
- ▶ Easy to troubleshoot & Easy to setup and modify.
- ▶ Only that node is affected which has failed rest of the nodes can work smoothly.
- ▶ Hub can be upgraded easily.

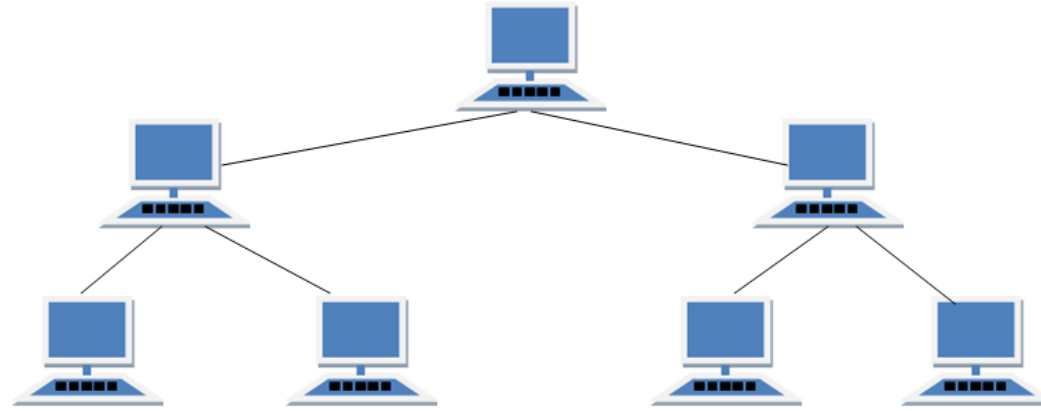


Mesh Topology

- ▶ Point-to-point connection to other devices or fully connected.
- ▶ Traffic is carried only between two connected devices.
- ▶ Robust, costly but not flexible.
- ▶ Fault is diagnosed easily.
- ▶ More cable resource used in setup.

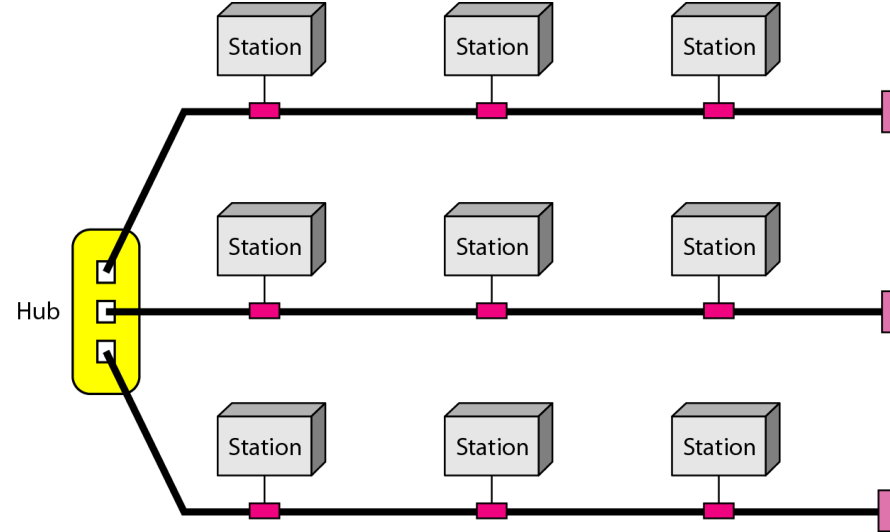


Tree Topology



- ▶ It has a root node and all other nodes are connected to it forming a hierarchy.
- ▶ Also called hierarchical topology.
- ▶ Mostly used in Wide Area Network – WAN.
- ▶ Expansion of nodes is possible and easy.
- ▶ Easily managed and maintained.

Hybrid Topology



- ▶ A network structure whose design contains more than one topology is said to be hybrid topology.
- ▶ It is a combination of two or more topologies.
- ▶ Flexible & reliable as error detection and easy to troubleshoot.
- ▶ Scalable as size can be increased easily.

Comparison of Topologies

| | Bus | Ring | Star | Mesh | Tree |
|---------------------|---|--|--|---|---|
| Means | every computer and network device is connected to single cable. | Each computer is connected to another, with the last one connected to the first. | All the computers are connected to a single hub through a cable. | All the network nodes are connected to each other. | It has a root node and all other nodes are connected to it forming a hierarchy. |
| Cost | Average | Cheap | High | High | High |
| Used in | Small Network | Expand Network | Small Network | Expand Network | Expand Network |
| Troubleshoot | Easy, But Cables fail then whole network fails. | Difficult; Failure of one computer disturbs the whole network. | Easy; If the hub fails then the whole network is down. | Difficult; Installation and configuration is difficult. | Easy; Central root hub fails, network fails. |

Protocol Layers

Protocols Layers

- ▶ To deals with connecting systems that are open for communication with other systems.
- ▶ OSI Layer Model (Open Systems Interconnection)
- ▶ Developed by the International Standards Organization (ISO) with seven different layers.
 1. Physical Layer
 2. Data Link Layer
 3. Network Layer
 4. Transport Layer
 5. Session Layer
 6. Presentation Layer
 7. Application Layer

Example – Air Plane Travel

Departure

ticket (purchase)

baggage (check)

gates (load)

runway takeoff

airplane routing

Arrival

ticket (complain)

baggage (claim)

gates (unload)

runway landing

airplane routing



airplane routing

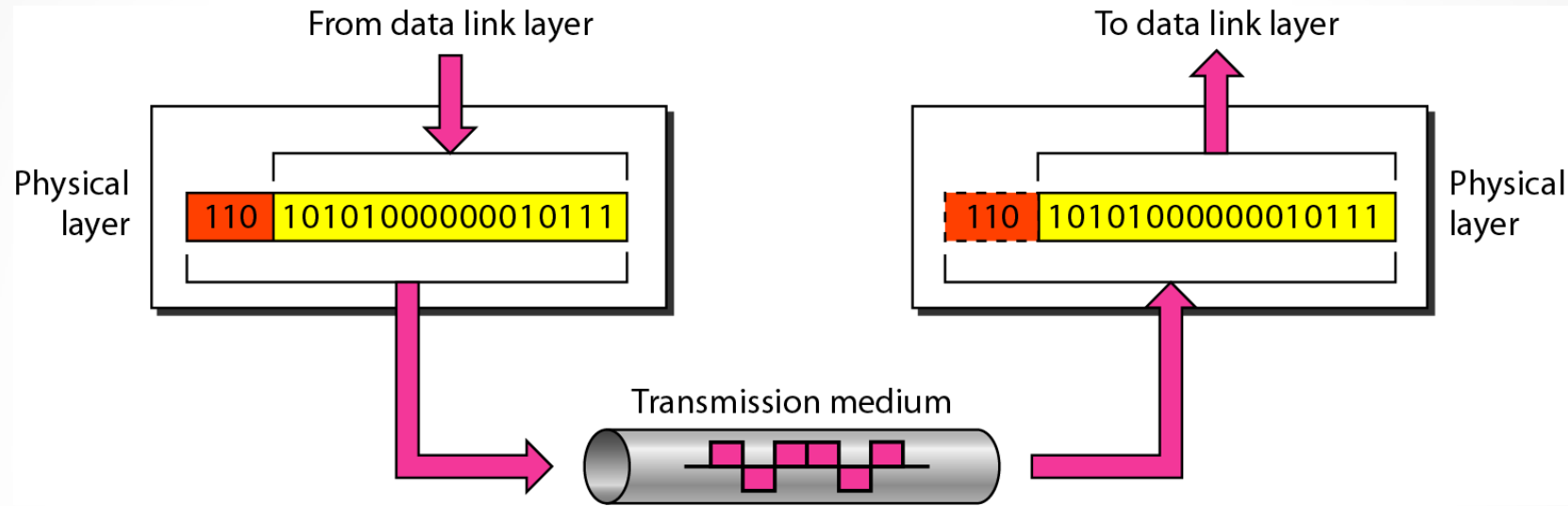
How OSI Layer Works?

| | |
|---|--------------|
| 7 | Application |
| 6 | Presentation |
| 5 | Session |
| 4 | Transport |
| 3 | Network |
| 2 | Data Link |
| 1 | Physical |

| | |
|---|--------------|
| 7 | Application |
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| 1 | Physical |



Physical Layer

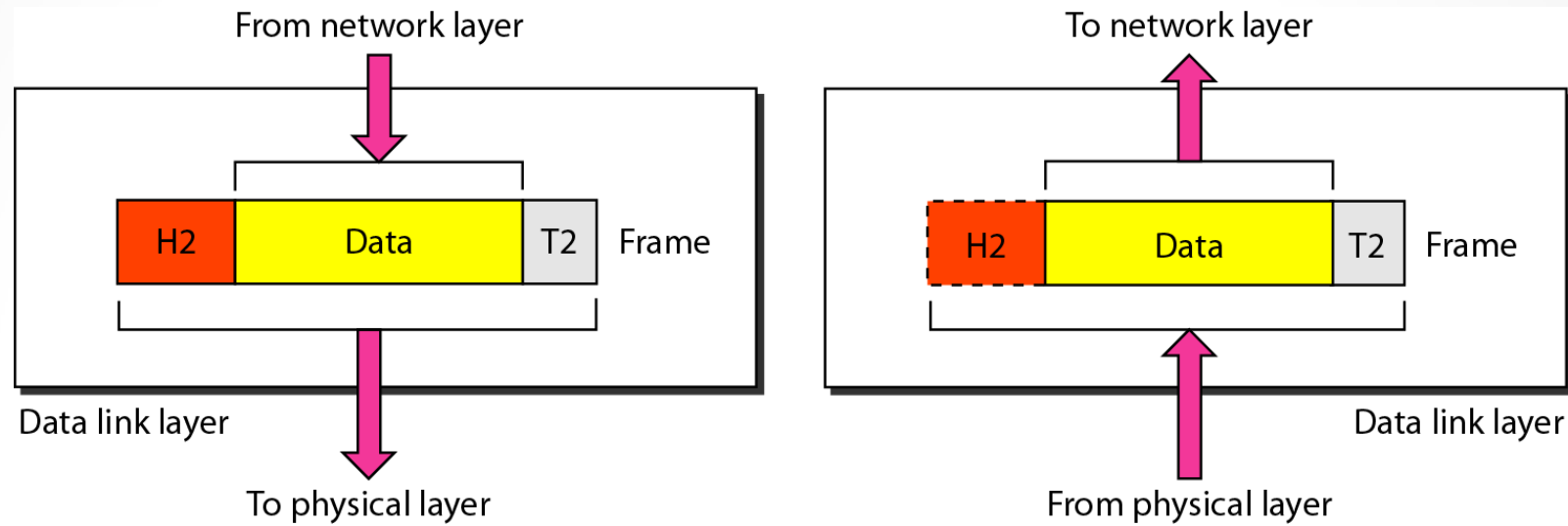


- The physical layer is responsible for movements of individual bits from one hop (node) to the next.

Physical Layer – Cont....

- ▶ Carries the bit stream over a physical media.
- ▶ Physical Layer is concerned with:
 - ↳ Interface and Medium like guided cables
 - ↳ Representation of bits
 - ↳ Data rate
 - ↳ Synchronization of bits
 - ↳ Line configuration
 - ↳ Physical topology
 - ↳ Transmission mode

Data Link Layer

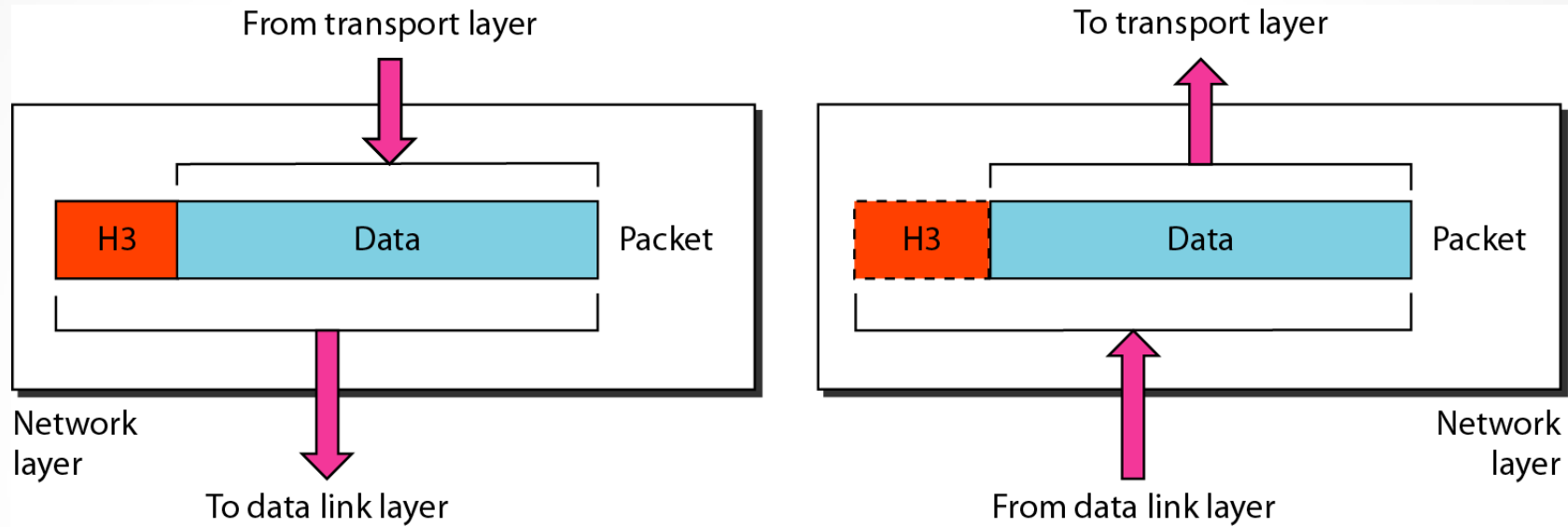


- The data link layer is responsible for **moving frames** from one hop (node) to the next.

Data Link Layer – Cont...

- ▶ Data link layer is concerned with:
 - ↳ Framing – divide bits stream into data unit (frame)
 - ↳ Physical addressing
 - ↳ Flow control – avoid over overwhelming
 - ↳ Error control – bit loses, retransmission
 - ↳ Access control
 - ↳ Classification into 1) MAC 2) LCC
 - ↳ Media Access Control
 - ↳ Logical Link Control

Network Layer

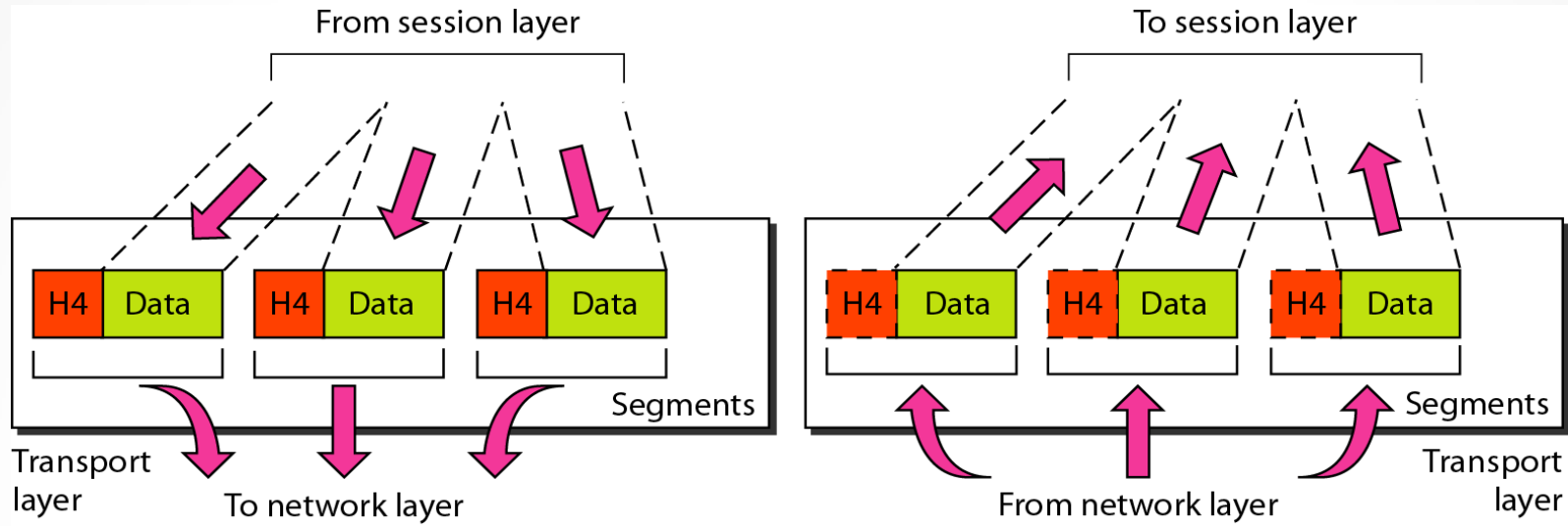


- The network layer is responsible for the **delivery of individual packets** from the source host to the destination host.

Network Layer – Cont....

- ▶ In this layer, packet is combined with header and data.
- ▶ In case of data link layer, packet delivers on the **same network**.
- ▶ If two **different networks** are connected then packet is concern with network layer.
- ▶ Network layer is concerned with:
 - ↳ Logical addressing e.g. 192.168.1.1 (IP Address)
 - ↳ Routing

Transport Layer

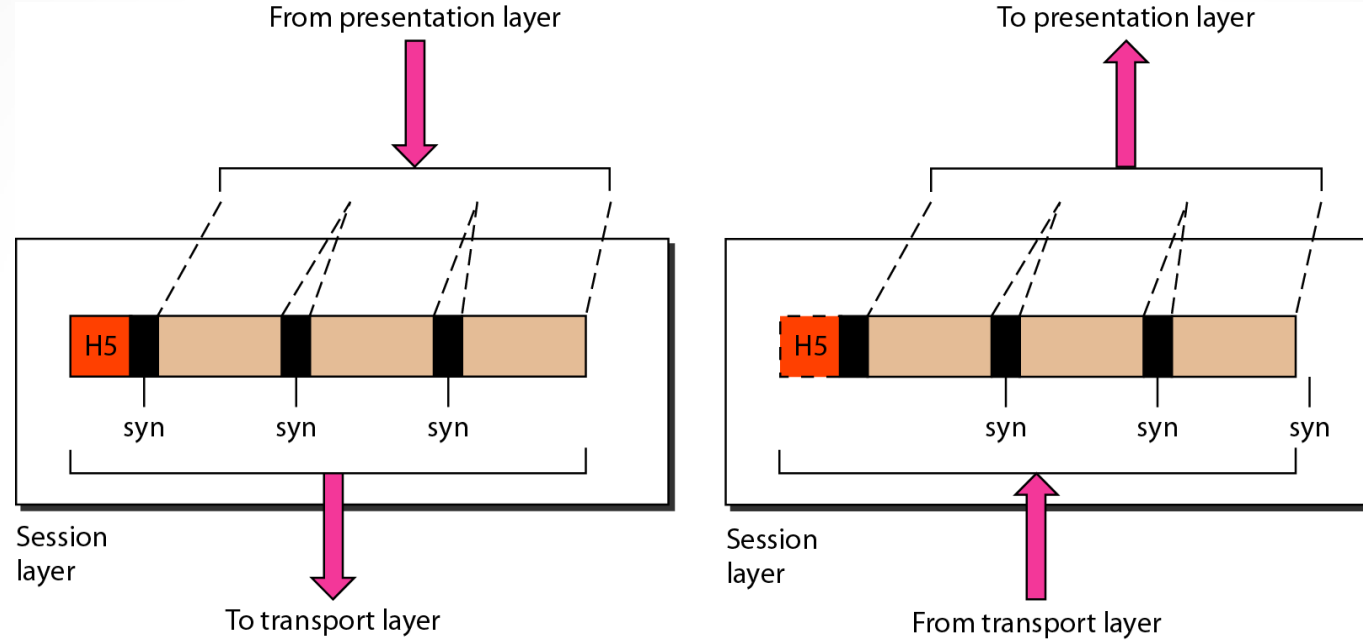


- The transport layer is responsible for the delivery of a message from one process to another.

Transport Layer – Cont...

- ▶ This layer ensures that the whole message arrives intact and in order.
- ▶ Transport layer is concerned with:
 - ↳ Service-point addressing (port address)
 - ↳ Segmentation and Reassembly
 - ↳ Connection Control
 - ↳ Flow and Error Control

Session Layer

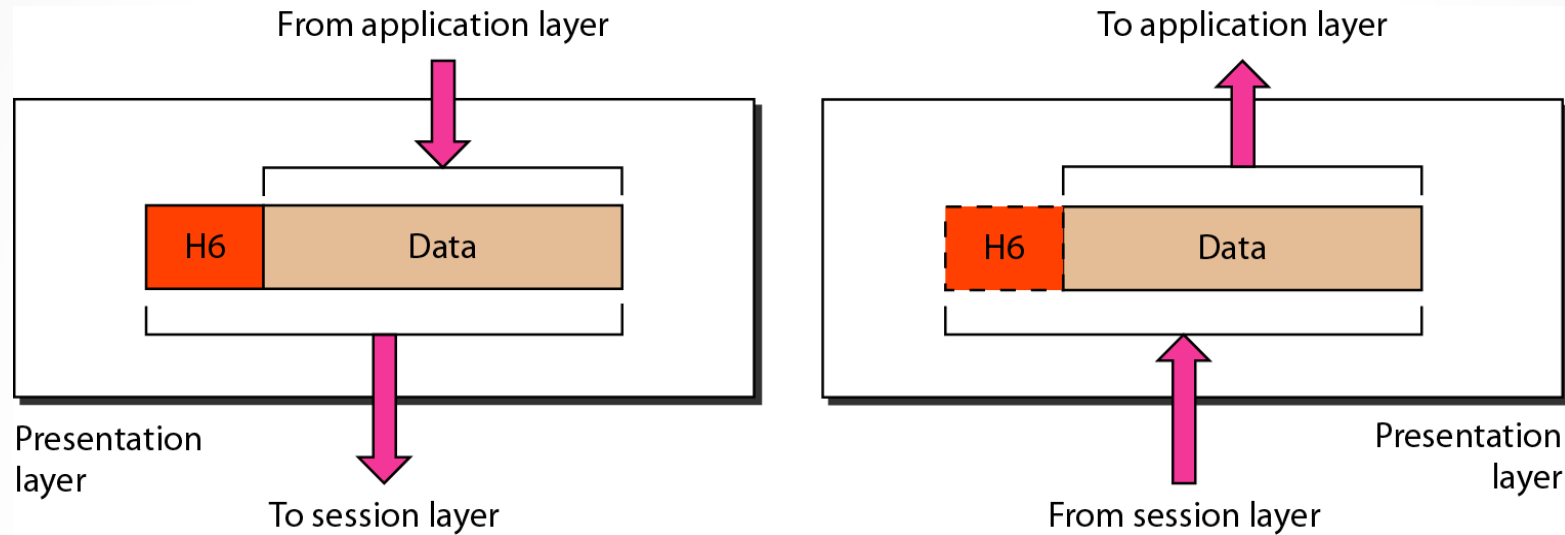


- The session layer is responsible for **dialog control and synchronization**.

Session Layer – Cont...

- ▶ This layer is network dialog controller – establishes, maintains, synchronizes the interaction among computers.
- ▶ Session layer is concerned with:
 - ↳ Dialog control
 - ↳ Synchronization

Presentation Layer

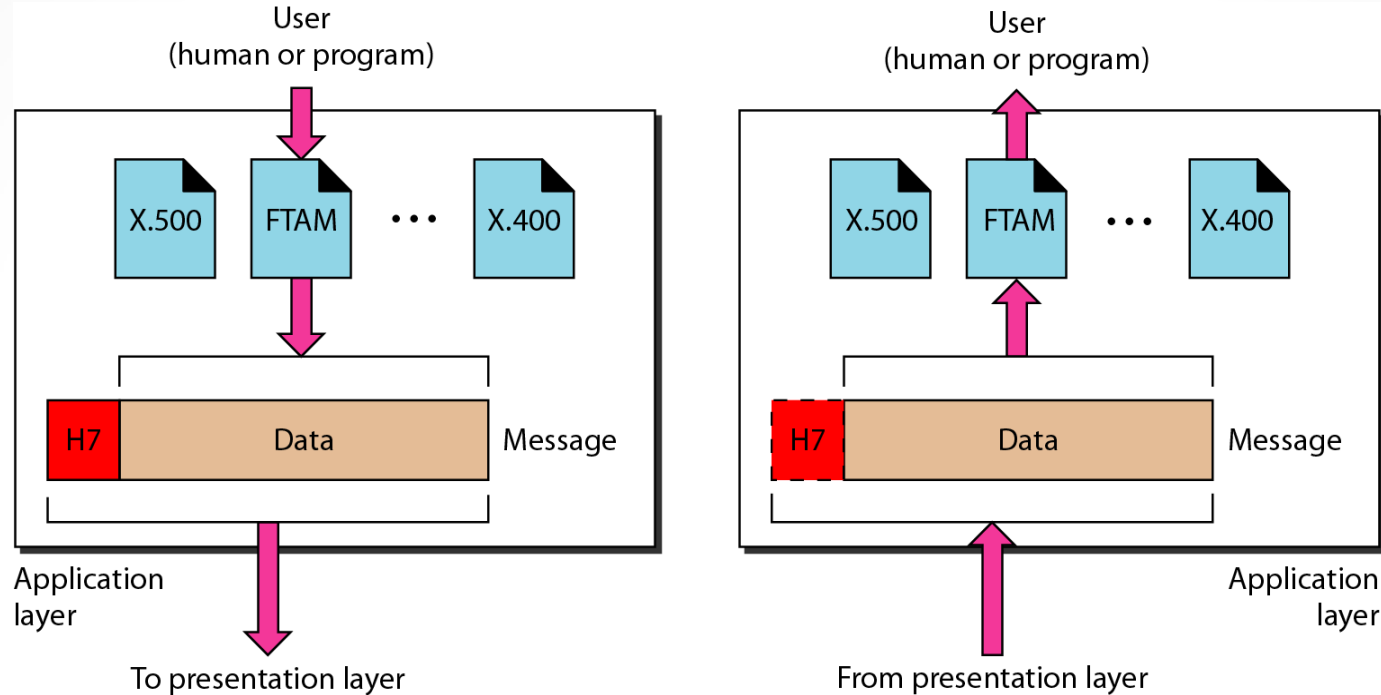


- The presentation layer is responsible for translation, compression, and encryption.

Presentation Layer – Cont...

- ▶ This layer is concerned with the syntax which refers to order in which data is presented and semantics helps in interpreting a particular pattern.
- ▶ Presentation layer is responsible for:
 - ↳ Translation
 - ↳ Encryption
 - ↳ Compression

Application Layer

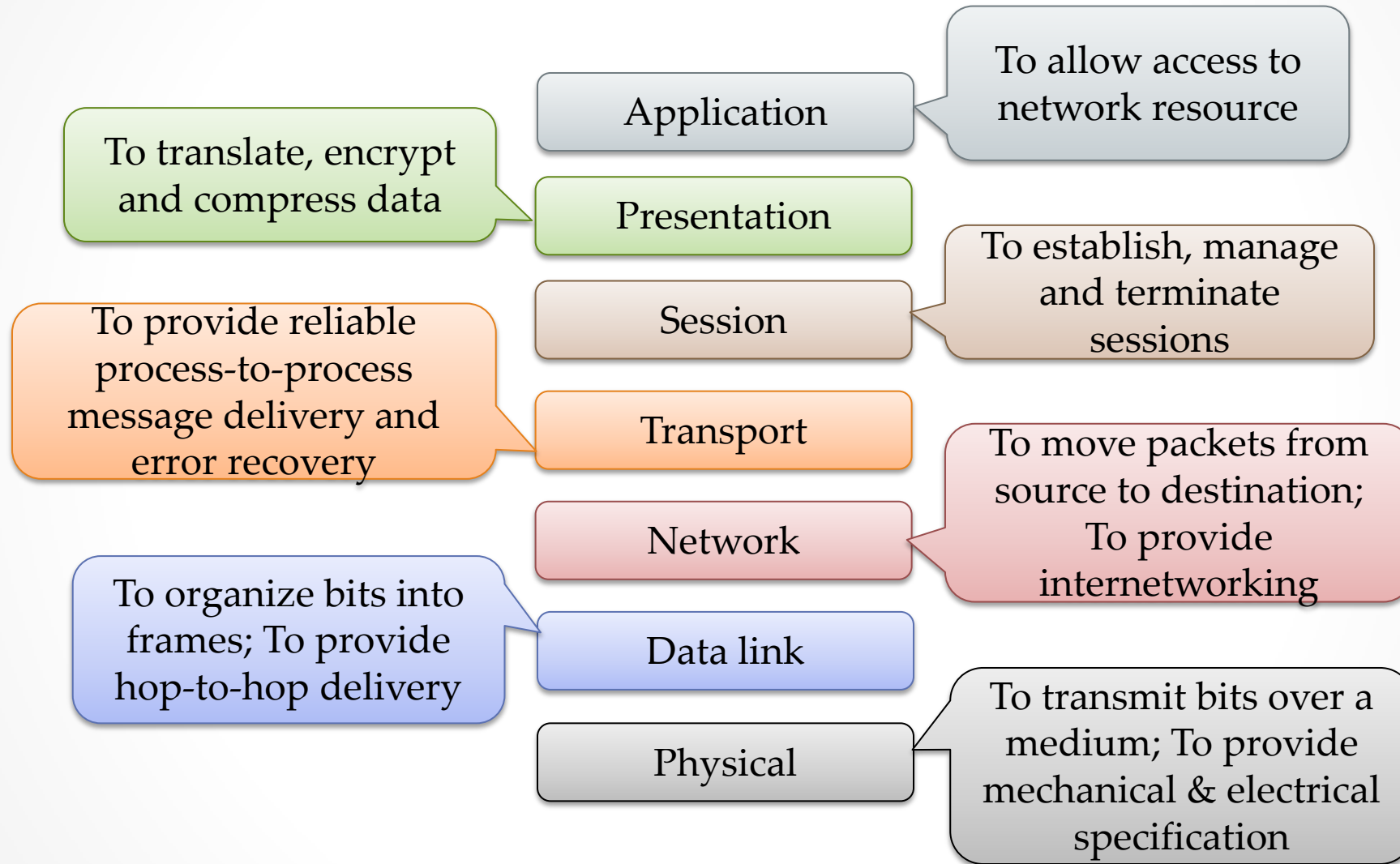


- The application layer is responsible for **providing services** to the user.

Application Layer – Cont...

- ▶ This layer provides various services like:
 - ↳ Network virtual terminal
 - ↳ File transfer, access and management
 - ↳ Mail services
 - ↳ Directory services

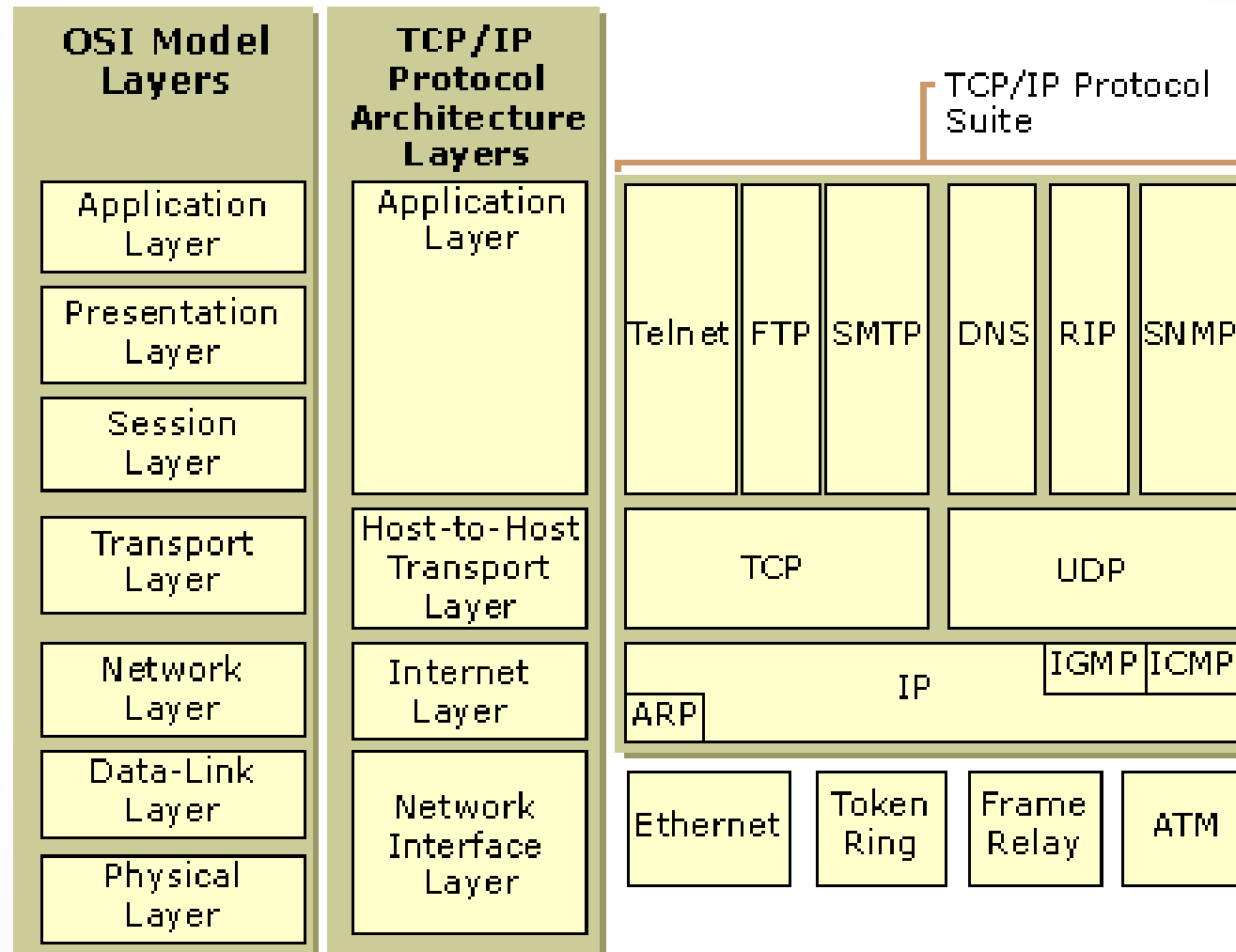
Summary – OSI Layer



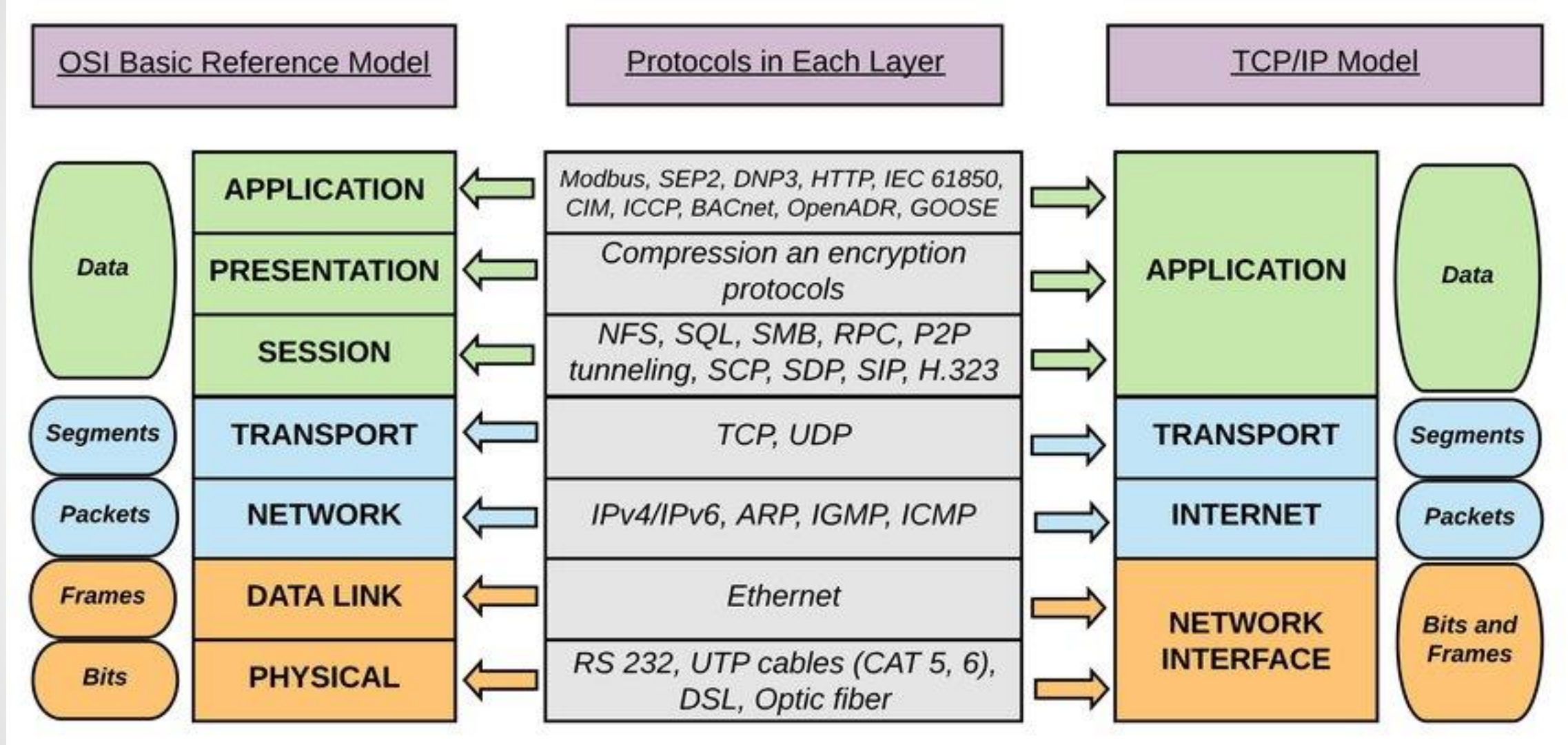
(Transmission Control Protocol/Internet Protocol)

- ▶ It was originally defined as having **five** layers:
- ▶ TCP/IP is a **set of protocols** developed to allow cooperating computers to share resources across the network.
 1. Application Layer
 2. Transport Layer
 3. Network Layer
 4. Data Link Layer
 5. Physical Network

TCP/IP Model Architecture



Comparison



Difference - OSI Model and TCP/IP Protocol Layers

OSI Model & TCP/IP Protocol Layer



OSI (Open System Interconnection)

Designed by ISO (International Standards Organization) in 1983.

✓ It has 7 layers

✓ OSI provides layer functioning and also defines functions of all the layers

✓ Follows horizontal approach

✓ OSI model has a separate presentation layer

✓ OSI model has a problem of fitting the protocols in the model

TCP/IP (Transmission Control Protocol/ Internet Protocol)

The ARPANET(Advanced Research Projects Agency Network)

✓ It has 5 layers

✓ TCP/IP model is more based on protocols and protocols are not flexible with other layers

✓ Follows vertical approach

✓ TCP/IP doesn't have a separate presentation layer

✓ TCP/IP model does not fit any protocol

Majors between OSI Model and TCP/IP Protocol Layers

OSI Model & TCP/IP Protocol Layer



OSI (Open System Interconnection)

TCP/IP (Transmission Control Protocol/ Internet Protocol)

✓ Network layer of OSI model provide both connection oriented and connectionless service

✓ The Network layer in TCP/IP model provides connectionless service

✓ OSI provides layer functioning and also defines functions of all the layers

✓ TCP/IP model is more based on protocols and protocols are not flexible with other layers

✓ Protocols are hidden in OSI model and are easily replaced as the technology changes

✓ In TCP/IP, replacing protocol is not easy

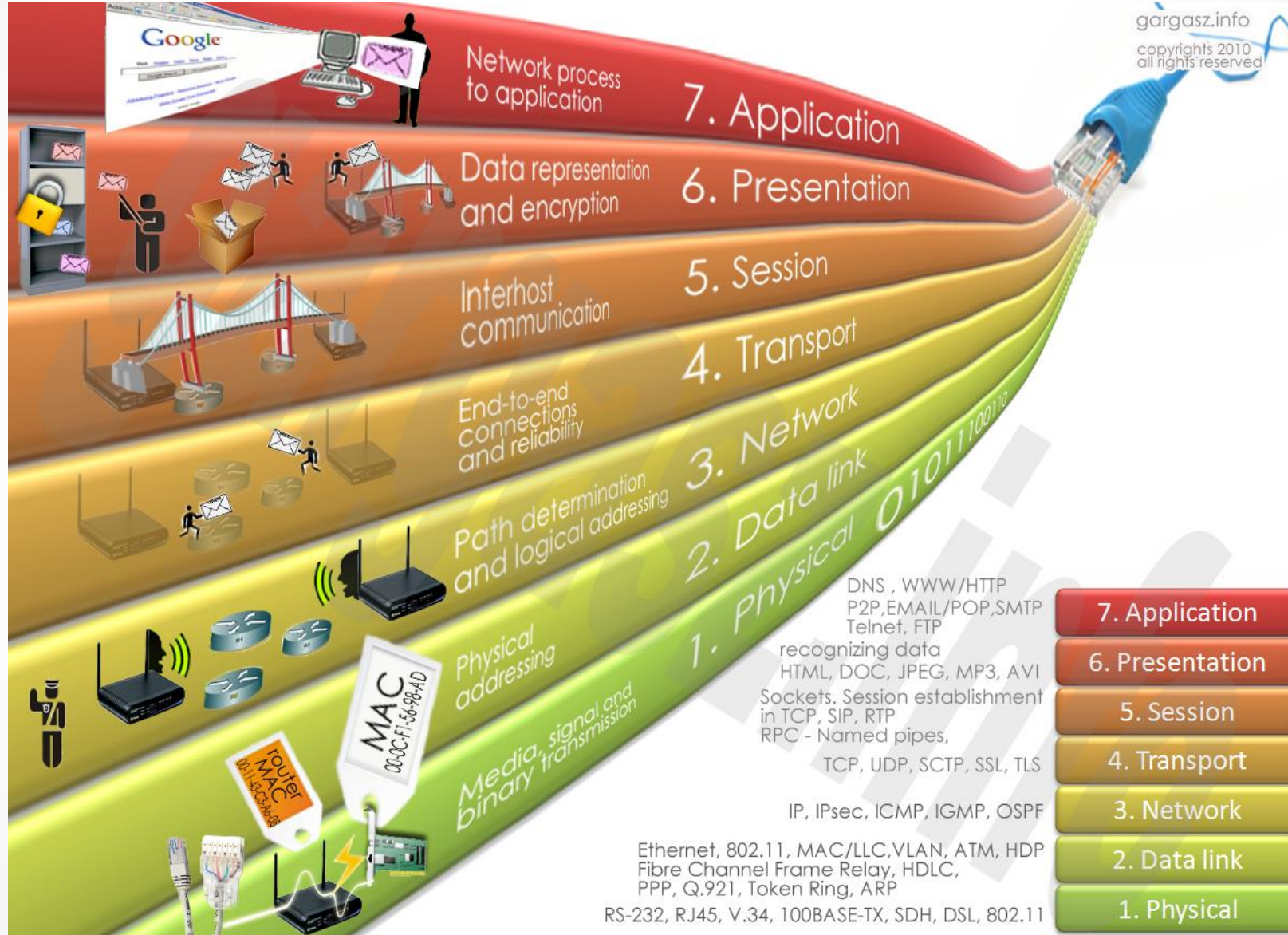
✓ OSI model defines services, interfaces and protocols very clearly and makes clear distinction between them

✓ In TCP/IP, it is not clearly separated its services, interfaces and protocols

✓ In OSI model the transport layer guarantees the delivery of packets

✓ In TCP/IP model the transport layer does not guarantees delivery of packets

Protocol Layers: Summary



Outline - Revised

- ▶ What is Computer Network? Connected each other
- ▶ Advantages of Computer Network
- ▶ Applications of Computer Network
- ▶ Type of Computer Network LAN, MAN, WAN
- ▶ What is Internet? Infinite nos. of connected computers across the world
- ▶ What is Protocol? Set of Rules
- ▶ Network Topologies Bus, Ring, Star, Mesh, Tree, & Hybrid
- ▶ Protocol Layers OSI Layer & TCP/IP Layer