Lecture 18

Internetworking Models

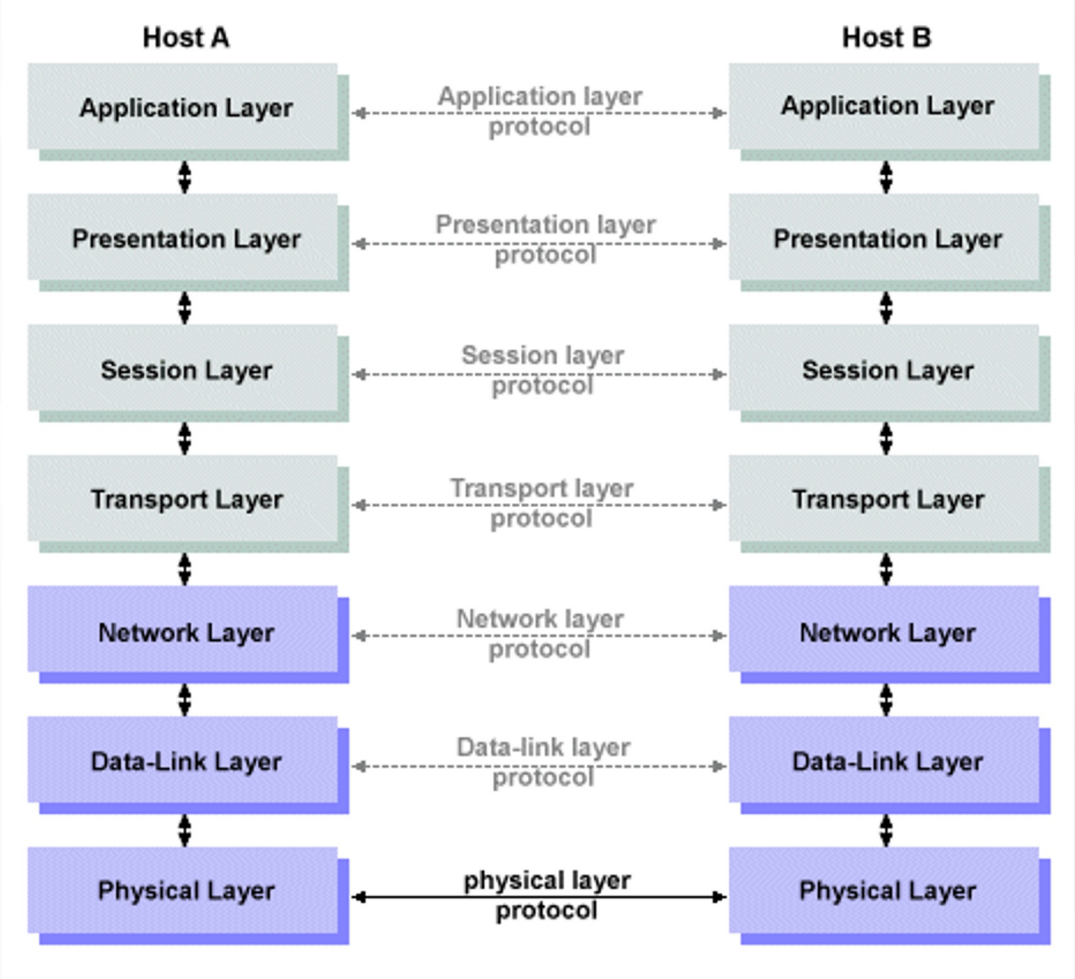
Internetworking Models

- Communication was not open in the earlier days.
- ISO developed the Open System Interconnection (OSI) model in late 1970s.
- This model uses the Layered Approach for communication between different computer hardware.
- This approach divides the network communication process into smaller and simpler components.
- This also aids in component development, design and troubleshooting

The OSI Reference Model

- The OSI model assists in data transmission between different hosts.
- It is also a set of guidelines that application developers can use to create and implement applications that run on a network.
- The OSI model is divided into two groups and seven different layers.
- Internetworking between devices of different vendors is possible because of this reference model.

The OSI Reference Model



The OSI Reference Model

- The upper layers are the Application layer, Presentation layer and Session layer.
- The lower layers are the Transport layer, Network layer, the Data Link layer and the physical layer.
- Network hosts operate in all seven layers of the OSI model.
- Web and application servers also operates in all seven layers of the OSI model.

The Application Layer

- This is the seventh layer of the OSI model.
- User actually communicates with a host.
- Provides a user interface.
- Determines whether sufficient resources for intended communication exists or not.
- Application layer provides services such as:
  - File transfer.
  - Web clients.
  - Email clients.

The Presentation Layer

- This is the sixth layer of the OSI Model.
- This layer presents data to the application layer and is responsible for data translation and code formatting.
- This layer ensures that the data transferred from the Application layer of one system can be read by the Application layer of the another system.
- Data Compression and decompression, also encryption and decryption are associated with this layer.

The Session Layer

- This is the fifth layer of the OSI model.
- Helps to keep different applications' data separate.
- This layer is responsible for setting up, managing and then tearing down sessions.
- This layer serves to offer communication between systems by offering three different modes, simplex, half duplex and full duplex.
- This layer basically keeps different application's data separate from other applications' data.

The Transport Layer

- This is the fourth layer of the OSI model.
- Provides reliable or unreliable delivery of data.
- The transport layer segments data at the sending stream and then reassembles that data at the receiving stream.
- They establish logical connection between the sending hosts and the destination hosts.
- Transport layer can be either connection-oriented or connection-less.
- Connection-oriented communication sessions are established by using the Three-Way-Handshake.

The Network Layer

- This is the third layer of the OSI model.
- Provides logical addressing which routers used for path detection.
- Manages device addressing which can be used to track the location of devices of the network.
- This layer also determines the best way to move the data.
- Routers work on this layer of the OSI model.
- There are two types of packets which are used in the Network layer, Data packets and Route update packets.

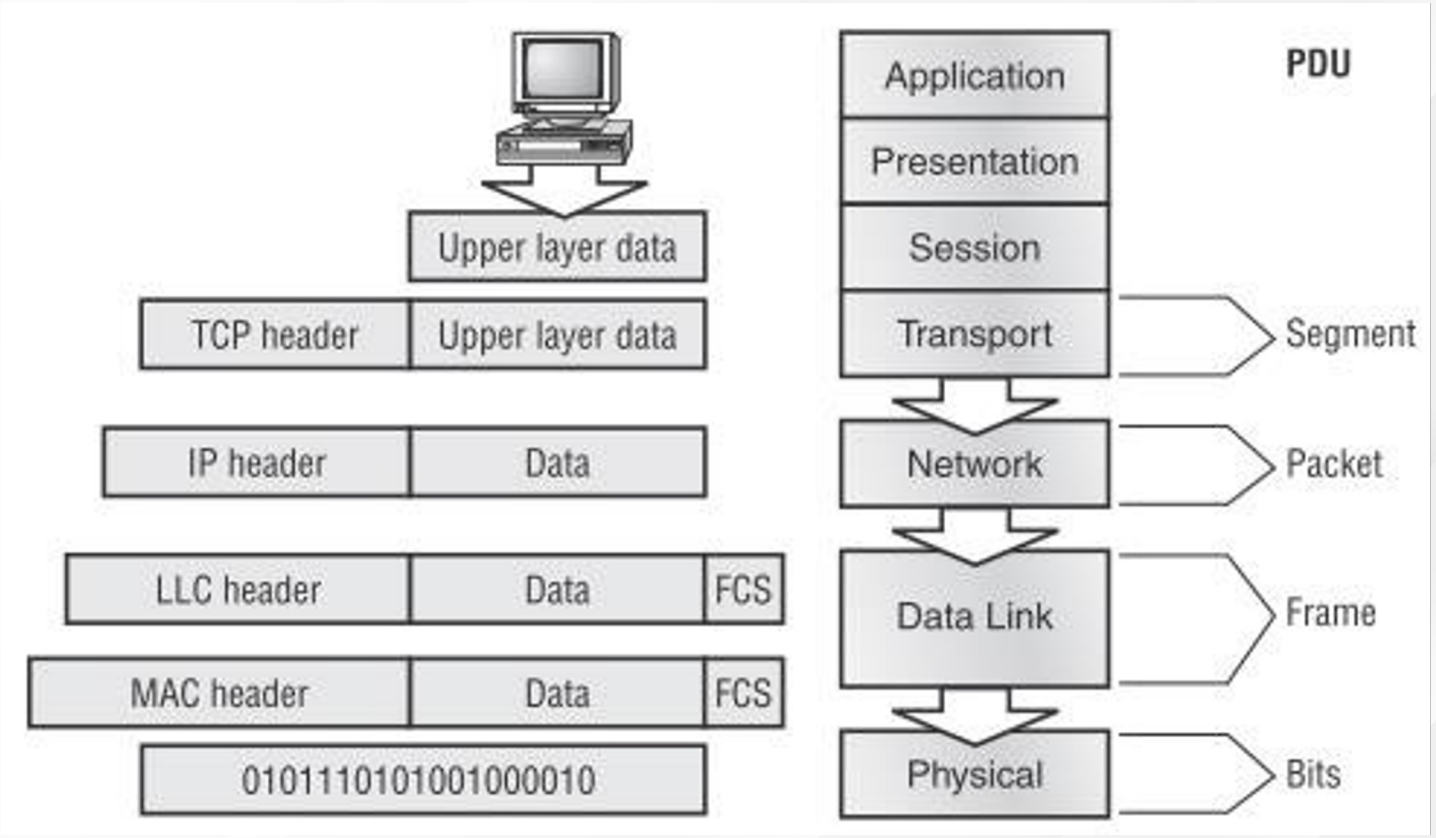
The Data Link Layer

- This is the second layer of the OSI model.
- Combines packets into frames.
- Provides access to media using MAC addresses.
- This layer ensures that messages are delivered to the proper device on a LAN using hardware addresses.
- Data Link Layer is responsible for uniquely identifying devices on a network.
- Switches and bridges work on this layer of the OSI model.

The Physical Layer

- This is the first layer of the OSI model.
- Moves bits of information between devices.
- Specifies wire speed and pin outs.
- It sends and receives bits, 0s and 1s.
- Transmission mediums fall under this layer of the OSI model.
- Hubs also work at the physical layer of the OSI model.

Data Encapsulation



Data Encapsulation

- At a transmitting device, the data encapsulation method works like this:
  - User information is converted into data for transmission on the network.
  - Data is converted into segments and reliable connection is set up between transmitting and receiving hosts.
  - Segments are converted into packets and logical addressing is placed in the header so that the packet can be routed in the network.
  - Packets are converted into frames for transmission on the local network.
  - Frames are converted into bits.

CSMA/CD

- Ethernet is scalable which makes it easier to integrate new technologies.
- Ethernet is a contention based media access method that allows all hosts on a network to share the same bandwidth of a link.
- Ethernet uses CSMA/CD.
- Carrier Sense Multiple Access with Collision Detection (CSMA/CD) is a protocol/algorithm, which helps devices share the bandwidth evenly without having two devices transmit data at the same time on the shared network
  transmission medium.
- CSMA/CD was created to overcome the problem of collisions

CSMA/CD

- When a host wants to transmit over the network, it first checks for the presence of a digital signal on the wire.
- If all is clear, the host will then proceed with its transmission.
- The transmitting host constantly monitors the wire to make sure no other hosts begin transmitting.
- If the host detects another signal on the wire, it sends out an extended jam signal that causes all nodes on the segment to stop sending data.
- Back-off algorithms determines when the colliding stations can retransmit.
  - If collisions keep occurring after 15 tries, the nodes will time out.

Common Ethernet Cables

Ethernet Type	Bandwidth	Cable Type	Maximum Distance
10Base-T	10Mbps	Cat 3/Cat 5 UTP	100m
100Base-TX	100Mbps	Cat 5 UTP	100m
100Base-TX	200Mbps	Cat 5 UTP	100m
100Base-FX	100Mbps	Multi-mode fiber	400m
100Base-FX	200Mbps	Multi-mode fiber	2Km
1000Base-T	1Gbps	Cat 5e UTP	100m
1000Base-TX	1Gbps	Cat 6 UTP	100m
1000Base-SX	1Gbps	Multi-mode fiber	550m
1000Base-LX	1Gbps	Single-mode fiber	2Km
10GBase-T	10Gbps	Cat 6a/Cat 7 UTP	100m
10GBase-LX	10Gbps	Multi-mode fiber	100m
10GBase-LX	10Gbp	Single-mode fiber	10Km

Ethernet Cabling

- There are generally three types of cables, Straight-through cable, Crossover cable and Rolled cable.
- Straight-through cables are used to connect dissimilar devices together, maybe a host to switch or hub and a router to switch or hub.
- Crossover cables are used to connect similar devices together, maybe a switch to a switch or a hub to another hub, host to a host.
- Rollover cables are used to connect a host to a router's console COM port for router configuration.

Data Encapsulation

- When a host transmits data across a network to another device, that data goes through encapsulation.
- It is wrapped with protocol information at each layer of the OSI model.
- Each layer communicates only with its peer layer on the receiving device.
- Each layer uses a PDU which holds the control information attached to the data at each layer of the model.
- PDUs are generally attached to the header in front of the data field but can also be attached in the end.

End of Lecture 18