CSE3151

# COMPUTER NETWORKS

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## Network Software

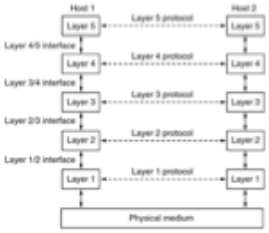
- The first computer networks were designed with the **hardware as the main concern** and the software as an afterthought.
- This strategy **no longer** works.
- To reduce their design complexity, most networks are organized as a stack of **layers or levels**, each one built upon the one below it.



## Network Software

- A protocol is an agreement between the communicating parties on how communication is to proceed.

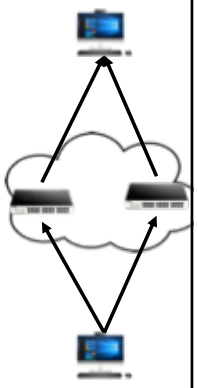
- **Peer** – both host
- A set of layers and protocols is called a **network architecture**.
- A list of the protocols used by a certain system, one protocol per layer, is called a **protocol stack**.






## Design Issues for the Layers

- **Reliability**
  - uses codes for error detection.
  - error correction
  - They are used at low layers,
- **Routing**
  - Finding a working path through a network
  - addressing or naming,
  - internetworking.





## Design Issues for the Layers

- **Resource allocation.**
  - Who will get priority
  - flow control.
  - Quality of service
- **Confidentiality**
  - authentication
  - Integrity



## Reference Models

- Two Popular Reference models
  - **OSI (Open Systems Interconnection)**
    - protocols associated with the OSI model are not used any more, the model itself is actually quite general and still valid, and the features discussed at each layer are still very important
  - **TCP/IP**

# OSI Reference Model

**A**LL **P**EOPLE **S**EEM **T**O **N**EED **D**ATA **P**ROCESSING



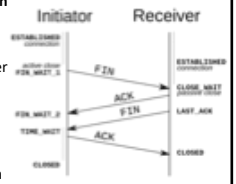
# THE PHYSICAL LAYER

- The physical layer is concerned with transmitting raw bits over a communication channel.
- The design issues have to do with making sure that
  - when one side **sends a 1 bit** it is received by the other side as a 1 bit, not as a 0 bit.
  - **what electrical signals** should be used to represent a 1 and a 0,
  - how many **nanoseconds** a bit lasts,
  - whether transmission may proceed **simultaneously** in **both directions**,
  - how the **initial connection** is established,
  - how it is torn down when **both sides** are **finished**,
  - how many **pins** the network connector has, and
  - what each **pin** is used for.



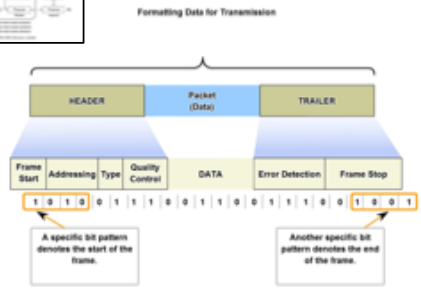
# THE DATA LINK LAYER

- The main task of the data link layer is to transform a raw transmission facility into a line that appears free of **undetected transmission errors**.
- It accomplishes this task by having the sender break up the input data into **data frames** (typically a few hundred or a few thousand bytes) and transmit the frames sequentially.
- The receiver confirms correct receipt of each frame by sending back an **acknowledgement frame.**





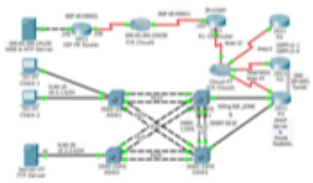

# THE DATA LINK LAYER






# THE NETWORK LAYER

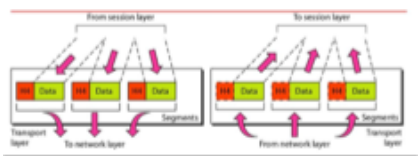
- A key design issue is determining how packets are routed from source to destination.
- More generally, the quality of service provided (delay, transit time, jitter, etc.) is also a network layer issue





# THE TRANSPORT LAYER

- The basic function of the transport layer is to:
  - accept data from above it,
  - split it up into smaller units if need be,
  - pass these to the network layer, and
  - ensure that the pieces all arrive correctly at the other end.



## THE SESSION LAYER

- The session layer allows users on different machines to establish sessions between them.
- Sessions offer various services:
  - including dialog control (keeping track of whose turn it is to transmit),
  - token management (preventing two parties from attempting the same critical operation simultaneously), and
  - synchronization



## THE PRESENTATION LAYER

- Unlike the lower layers, which are mostly concerned with moving bits around, the presentation layer is concerned with the **syntax and semantics of the information transmitted.**
- In order to make it possible for computers with different internal data representations to communicate, the data structures to be exchanged can be defined in an abstract way, along with a standard encoding to be used ''on the wire.''
- The presentation layer manages these abstract data structures and allows higher-level data structures (e.g., banking records) to be defined and exchanged

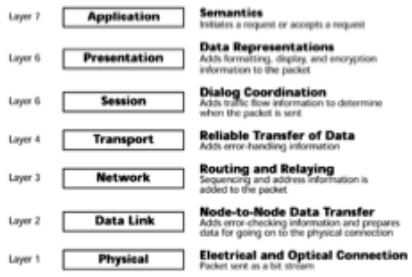


## THE APPLICATION LAYER

- The application layer contains a variety of protocols that are commonly needed by users.
- One widely used application protocol is HTTP (HyperText Transfer Protocol), which is the basis for the World Wide Web.
- When a browser wants a Web page, it sends the name of the page it wants to the server hosting the page using HTTP.
- The server then sends the page back. Other application protocols are used for file transfer, electronic mail, and network new



## OSI Reference Model






## TCP/IP Reference Model

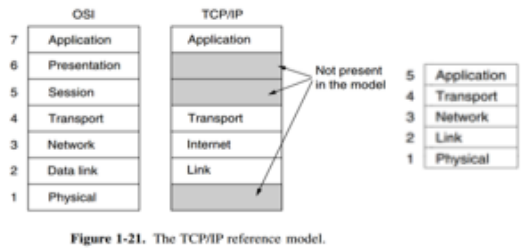
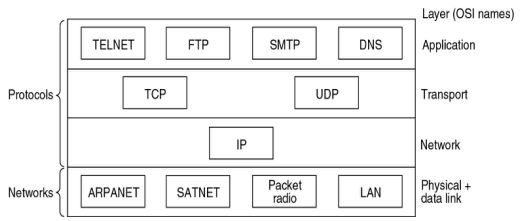



**Figure 1-21.** The TCP/IP reference model.






Protocols and networks in the TCP/IP model initially.

- DSL- Digital Subscriber Line
- DSLAM - Digital Subscriber Line Access Multiplexer
- Module- modulator demodulator

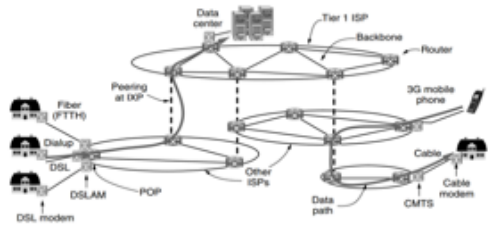



**Figure 1-29.** Overview of the Internet architecture.

- CMTS - Cable Modem Termination System
- FTTH - Fiber to the Home
- POP -Point of Presence

- ISP networks may be regional, national, or international in scope
- ISPs connect their networks to exchange traffic at IXPs (Internet eXchange Points)
- Basically, an IXP is a room full of routers, at least one per ISP.

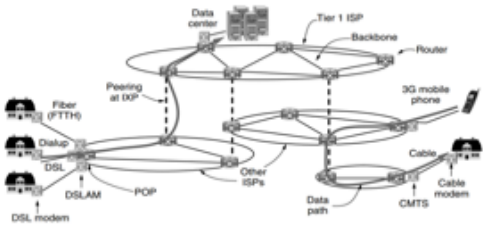



**Figure 1-29.** Overview of the Internet architecture.

- A LAN in the room connects all the routers, so packets can be forwarded from any ISP backbone to any other ISP backbone

## Basic Internet Structure



## Basic Internet Structure