Previously

- Network Software
- Network Layers
- Messages
- Design Issues
- Service Primitives

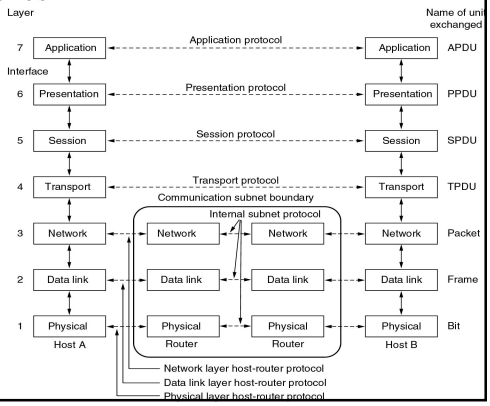
OSI
TCP/IP
Critiques

Reference Models

- OSI: Open Systems Interconnection
- TCP/IP: Transmission Control Protocol/Internet Protocol
- Critiques

OSI Reference Model

- ISO: International Standards Organisation + International Telecommunication Union-Telecommunications Standards Sector (ITU-T)
- Standard Model to which network architectures can be compared.
- The OSI model distinguishes
  - Services
  - Interfaces
  - Protocols
- Has 7 layers
- Lowest 3 are within a communication subnet only.



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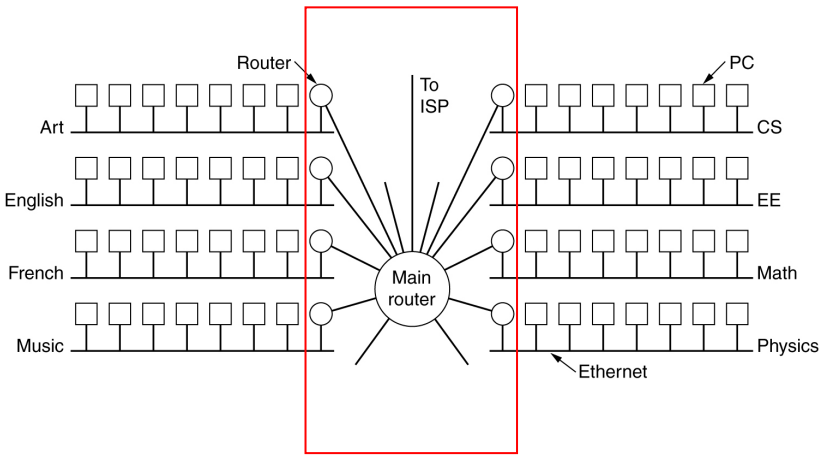
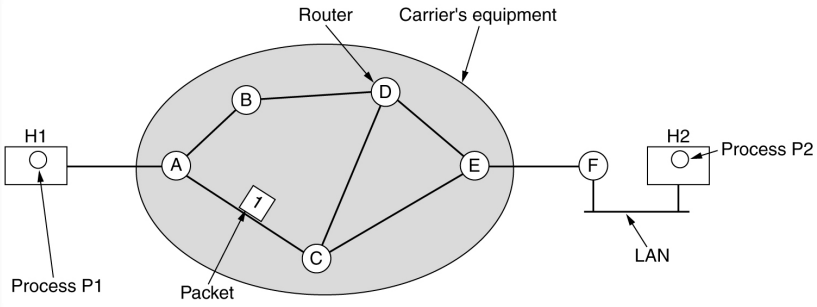
Subnet



Subnet - 2



OSI Layers (1)

- Physical Layer
  - Concerned with wiring and electrical standards, e.g. RS-232,
  - Provides an unreliable bit transmission/reception to the data link layer
- Data Link Layer
  - Concerned with using the physical layer to transmit chunks (frames) of information from node A to node B,
  - Handles sharing of the medium as well as providing flow control and error handling,
  - Provides a frame transmission/reception service to the network layer.
- Network
  - Determines how packets are routed from source to destination across a network or across different networks,
  - Provides a packet transmission facility to the transport layer.

OSI Layers (2)

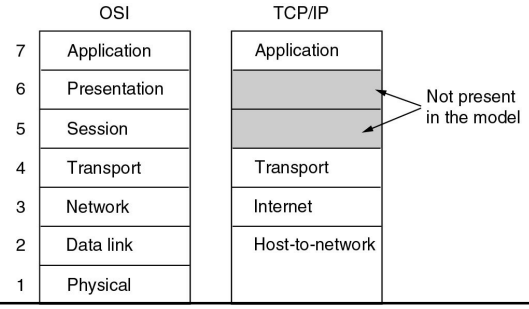
- Transport Layers
  - Independence
  - Provides segmentation and re-assembly of data,
  - Also provides error correction and flow control,
  - Provides a network independent message transmission facility.
- Session Layers
  - Allows users on different machines to establish sessions between them,
  - Includes dialog control, synchronisation and exception handling.

OSI Layers (3)

- Presentation Layer
  - Provides functions to do with representation of data and security, e.g., conversion between ASCII and EBCDIC.
- Application
  - Functionality defined by the application,
  - Uses the services provided by the next layer down.

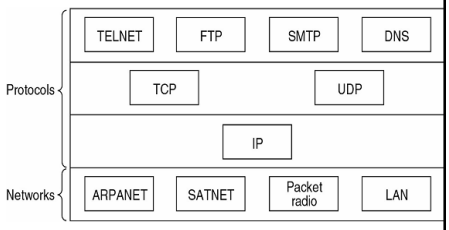
TCP/IP Reference Model

- One of the most common set of protocols,
- It is used for the internet and came from its predecessor – Arpanet.
- Designed to deal with possible loss of hardware (e.g. if it got blown up),
- Designed with a very flexible architecture as applications with divergent requirements were expected.



TCP/IP Layers

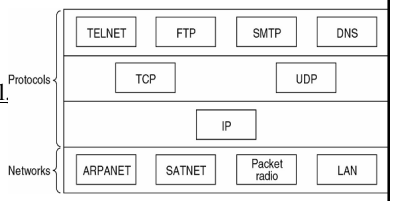
- Host-to-Network Layer
  - Not specified within the TCP/IP Reference Model. Protocols used vary from network to network, (e.g. could be LAN, packet radio, etc.)
- Internet Layer
  - Defines a packet format and protocol in order to provide a connectionless packet-switching service.
    - IP: Internet Protocol



TCP/IP Layers

- Transport Layer
  - Allows peers to have a connection using either:
  - Transmission Control Protocol (TCP):
  a reliable connection oriented protocol,
  - User Datagram Protocol (UDP):
  an unreliable connectionless protocol,

- Application Layer
  - **Telnet**:Virtual Terminal,
  - **FTP**:File Transmission,
  - **SMTP**:Simple Mail Transfer Protocol.
  - **DNS**:Domain Name System



OSI vs. TCP/IP

- Similarities
  - Are both end-to-end network independent protocols,
  - Have similar layers,
  - Support connectionless protocols.
- Differences
  - Number of layers though is different – Physical and Data Link subsumed in the Host-to-Network Layer and the Session and Presentation are subsumed into the Application Layer,
  - Connection oriented protocol only supported by the Network Layer in OSI, while TCP/IP supports it at the Transport Layer,
  - Concepts of services, interfaces and protocols only defined explicitly at the OSI Reference Model.

Critique of OSI Model

- *Bad timing*
  - No organization willing to develop a new protocol stack unless they were forced to by competition or government,
  - TCP/IP already there,
- *Bad technology*
  - Uneven layers: Session and Presentation layers are virtually empty, whereas Data Link and Network are jam packed,
  - Hard to implement: The standard is very long,
  - Inefficient: Addressing, flow control, error control reappear over multiple layers.
- *Bad implementations*: Initial implementations of OSI were poor, which left it with a bad image,
- *Bad politics*: TCP/IP was seen as being part of UNIX, whereas OSI was seen as being a creation of European telcos, ministries, the EC and later the U.S. government,
- 5 layers of the model are popular for discussing networks. However its protocols are not.

The missing 3 layers of OSI

10	**Religion**
9	**Politics**
8	**Money**
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

Critique of TCP/IP Model

- Concepts (Service, Interface, Protocol) not distinguished,
- Not a general model: It is virtually impossible to describe any protocol stack other than TCP/IP,
- Host-to-network "layer" not really a layer. Instead it is really defined as an interface,
- Some of the protocols (Application layer mostly) developed in a very ad-hoc way, although TCP & IP are well thought out.