CSE and EE 461
Lecture 4

Summer Quarter 1998

Services, Protocols, Interfaces

- Layer n services are those functions provided to communicate with a peer layer n agent.
- Interface between layers n-1 and n defines what primitive operations and services layer n-1 provides to layer n.
- Layer n protocol implements the layer n services.

Services

- Connection Oriented Service - Modeled after the telephone system

  A connection is established then used in a dialog. Ordered data stream.

  - reliable - file transfer or remote login
  - unreliable - digitized voice or video
- Connectionless Service - Modeled after the postal system

  No connection is established. Each data unit is on its own. Unordered data arrival.

  - with acknowledgments
  - reply expected - database query
  - unreliable
- Layering can accomplish:

  - providing a reliable service on top of an unreliable service
  - providing a connection oriented service on top of a connectionless one

Open Systems Interconnection

- The OSI standard was developed by ISO, the International Standards Organization around 1980. It consists of 7 layers:

  1. *Physical Layer* - transmission of a raw sequence of bits
  2. *Data Link Layer* - transmission of frames of data correctly on a "wire", concerned with data loss, data corruption, and flow control. Popular protocol is PPP = Point-to-Point Protocol.
  3. *Network Layer* - transmission of packets over many hops, concerned with routing and congestion. Classic protocol is IP = Internet Protocol
  4. *Transport Layer* - end-to-end layer, the network should be transparent at this layer, concerned with potential data loss and out of order packets. TCP = Transmission Control Protocol
  5. *Session Layer* - establishes of sessions between "users". An example of a session is an RPC = remote procedure call
  6. *Presentation Layer* - Concerned with the form of the data being transmitted. Encryption, compression, representation of the data, preparation of the data
  7. *Application Layer* - The particular application, netscape, lynx, FTP, telnet.

TCP/IP

- TCP = Transport Control Protocol

  - Transport layer
  - Provides a reliable connection oriented service (virtual circuit)

- IP = Internet Protocol

  - Network layer
  - Provides an unreliable connectionless service (datagram service)

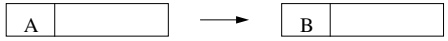
Protocol Standards

- OSI model - Open Systems Interconnection - from ISO, International Standard Organization
- TCP/IP - the internet standard
- X.25 and others - ITU (International Telecommunications Union) formally the CCITT
- IEEE 802.3 - Ethernet

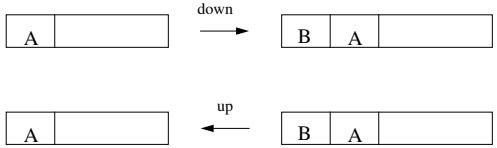
Addresses

- Different layers use different addresses. One role of a layer is to translate one address to another to enable the layer to operate.

  - within a layer such as the network layer it can replace one address with another in a packet



  - a layer can append or remove an address to move packet down or up a layer



Examples of Addresses

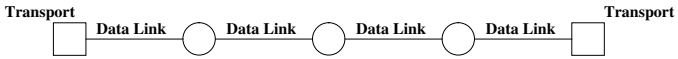
- ladner@cs.washington.edu - Internet address used at the application layer in the domain naming system. Logical name.
- june.cs.washington.edu - Internet address used at the application layer. Less logical name.
- 128.95.1.4 - IP address which is the name of June
- 8:0:26:1C:83:58 - ethernet address of June

  Address tables, which may be on "name servers", are used to translate from one address to another. A new address may be needed to pass to a lower layer or to transfer to a different network.

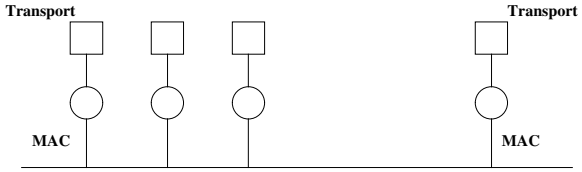
  Routing tables use the ultimate destination address to calculate the immediate next address to send a packet.

  Circuit tables use the current circuit number to calculate the circuit number of the next hop in a circuit.

Data Link vs. Medium Access Control



Point to Point Network



Broadcast Network

Repeater, Bridge, Router, Gateway

- **Repeater** - Passes a signal or sequence of bit from one subnet to another of the same type

  Physical Layer, buffer a bit
- **Bridge** - passes a data link or MAC packet from one subnet to another of perhaps a different type. Some venders call these switches.

  Data Link or MAC Layer, buffer a frame
- **Router** - Passes a network packet from one subnet to another. Packets are IP type packets. Packets may move from up or down in a hierarchical network.

  Network Layer, buffer a packet
- **Gateway** - Passes transport packet from one network to another. Network may be completely different like Bitnet and Arpanet. Sometimes called a multiprotocol router. Often used in "firewalls."

  Transport Layer, buffer a message