Introduction to Networks

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1 Administrivia

Announcements

Assignment

Read 7.2.

From Last Time

Outline

1. Communication protocols: circuits, connection-oriented, connectionless.
2. Layered network models: OSI, TCP/IP.

Coming Up

Project days.

2 Communication Protocols

A set of rules followed by two processes (systems, people) which are communicating. The protocol governs how the communication is carried out.

Examples:

- A classroom
- The dinner table
- A diplomatic meeting

Circuit:

The pathway of communication between two computers. It may be a single wire, or a set of wires connected via switches (routers, gateways, bridges, etc.). The circuit may be dedicated or virtual.

Connection-Oriented protocols (TCP)

- Circuit set-up overhead
- Telephone service

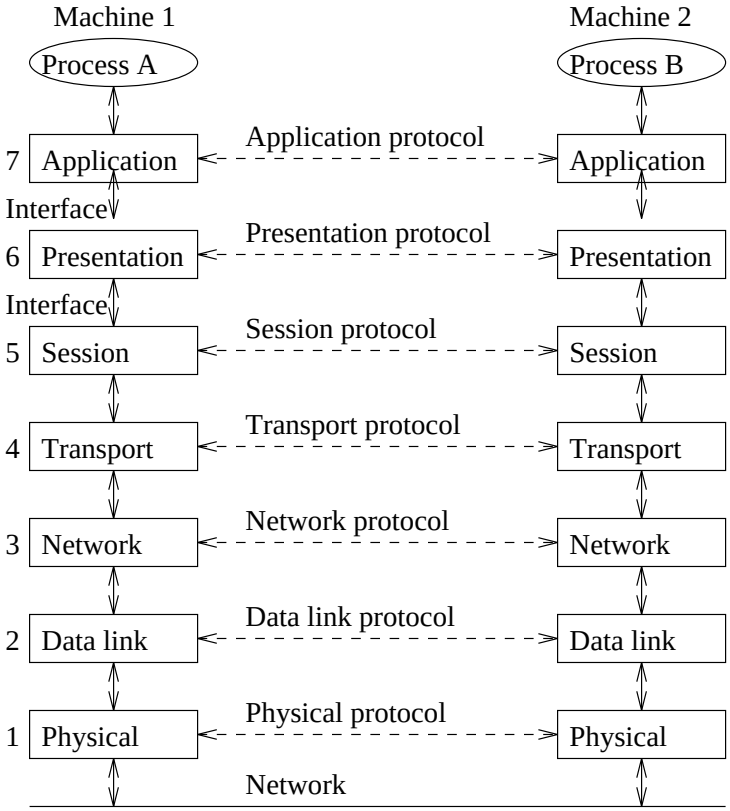
Connectionless protocols (IP, UDP)

- US mail service
- Packet, message (store and forward) switching

2.1 The OSI Model

(Open Systems Interconnection Reference Model)

Seven layered abstract model of a protocol *stack*:



Advantages: modularity

Disadvantages: call overhead; size increases due to added headers, trailers

2.1.1 Physical Layer

- Switching levels, transmission rate
- Duplex
- Type of connector, cable

Ethernet:

- 10BaseT (UTP, 10Base2 (thinnet), 10Base5 (thicknet), 10BaseF (fiber)

- 10, 100, 1000 Mbps

ATM:

- Fiber, SONET, Cat 5 UTP
- 45, 100, 155, 622Mbps; 2.5Gbps

Wireless:

- 802.11x
- SSID, WEP, WPA, and MAC address filtering

2.1.2 Data Link Layer

- Partition the bit (packet) stream into *frames*
- Append checksums for error detection
- "Guarantees" that a frame makes "one hop", not that it's seen at the higher layers

2.1.3 Network Layer

- Routing multi-hop messages
- Connection-Oriented: X.25
- Connectionless: IP

2.1.4 Transport Layer

- End-To-End (possibly multiple-hops) reliability
- Partition the message stream into packets

- Message reassembly if built on a connectionless network layer protocol
- Connection-Oriented: TCP
- Connectionless: UDP

2.1.5 Session Layer

- Additional reliability features
- Often, not implemented (because it's thought of as the user process)

2.1.6 Presentation Layer

"Library"-type functionality

- Compression
- Encryption
- Character code conversion

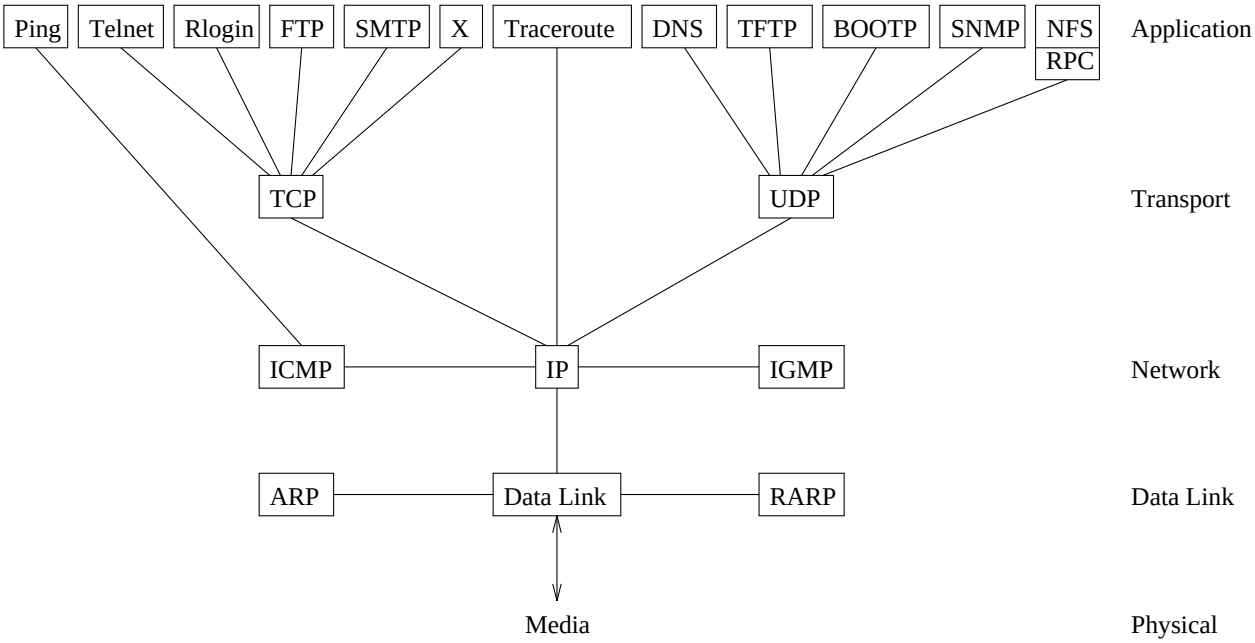
2.1.7 Application Layer

User- System-Level utilities:

- ftp
- telnet, rlogin
- SMTP
- NFS
- DNS

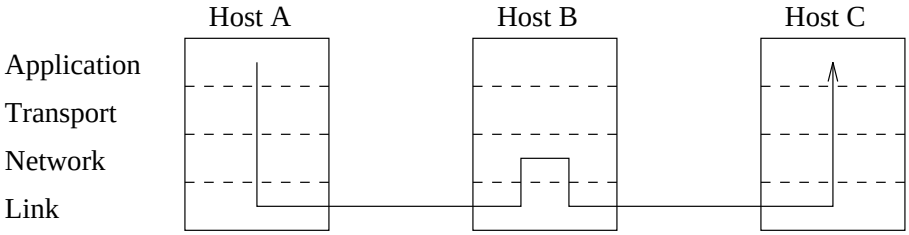
3 Introduction to TCP/IP

Some of the protocols:



- **Link layer** — NIC, device driver
- **Network layer** — Routing, "hop-by-hop" messages
- **Transport layer** — "end-to-end" messages

Message transmission example:



3.1 "Gluing" Networks Together

- Repeaters/Hubs — physical layer

- Bridges/Switches — data link layer (ethernet)
- Routers — network layer (protocol specific)
- Gateways — protocol conversion

3.2 IP Addresses

Form:

- 32-bit, dotted decimal
- different from ethernet address (ARP, RARP)
- Class A: 0, 7 bit netid, 24 bit hostid

  0.0.0.0 to 127.255.255.255
- Class B: 10, 14 bit netid, 16 bit hostid

  128.0.0.0 to 191.255.255.255
- Class C: 110, 21 bit netid, 8 bit hostid

  192.0.0.0 to 223.255.255.255
- Domain Name System

3.3 Encapsulation

1. Data
2. Application layer
3. TCP/UDP layer — TCP frame
4. IP layer — IP datagram

5. Ethernet layer — ethernet frame: 46–1500 bytes (MTU)

Demultiplexing

3.4 Process Communication

How do processes on separate machines communicate?

- Client/Server
- "Well-known" addresses
- Multiple telnet clients