Introduction to the Internet and Data Networking

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Introductions.

Go around the room – each person 1-2 minutes on:

1. Who they are?
2. Why they are here?
3. What do they wish to accomplish?

Goals of the Course

- **Week 1:** Gain a basic understanding of how the Internet was formed.
- **Week 2:** Understand the following networking concepts: LAN/WAN, Seven Layer OSI Model, TCP/IP.
- **Week 3:** Gather an overview of the various core technologies of Data Networking
- **Week 4:** Understand what companies, agencies, and organizations are helping to build the Internet today.
- **Week 5:** Have an ability to discuss the pros/cons of the Internet and why it will change the way we work, live, play, and learn.

Week 6 is open …

Possibilities:

HANDS-ON EXPERIENCE

CCNA Prep

Quiz Show Game with Teams

Final Exam

Last Week – Review & Questions

Review:

- Development of the "Internet" – DARPA created **ARPANET -> NSFNET -> "Internet"** (DoD funded Research, Gov't Agency & Academia, Commericial, Future ?)
- Internet ~100M Hosts, doubles (~1.5x) yearly growth rate, Closely tied to TCP/IP

Questions:

1) UNIX? Why is it so special?
2) Intranet & Extranet
3) IP Telephony (Voice-Over)
4) Circuit Speeds

Questions:

1) UNIX is the OS de facto of the internet. BSD (Berkley Systems Development) implemented the TCP/IP communications suite and fully integrated communication services within the OS. Since the 1970s, the majority of the host on the Internet are UNIX based – but this could be changing with MS, wireless apps, etc.
2) Intranet – LAN services traditionally found on the Internet but not accessible by anyone outside. Extranet is an extension of services found within a network to users/hosts who reside outside the LAN on a separate network. VPN and Tunneling software is beginning to enable this technology.
3) IP Telephony – Voice-over-FR, Voice-over-ATM, Voice-over-IP, etc. Telephony migration onto a single data network.
4) Circuit speeds – T1 = 1.54Mbps, T3=54Mbps, OC-3 = ?

Basic Network Topology

- Star Configuration – single hub or switch, single point of failure
- Loop Configuration – commonly used in Token Ring and FDDI
- Meshed (Fully-Meshed) Configuration – modified loop with interconnects among all nodes. Very redundant, often complex.
- Tree (Multi-Tier) Configuration – hierarchical approach, very common in IP networks.

Examples:

Star = hub or switch

Loop = Token Ring & FDDI (IBM)

Meshed = necessary in networks that require high availability. More meshed -> more redundant & less flexible

Tree = most common approach in IP networks. Three components in network design: CORE, DISTRIBUTION, ACCESS -> younger designs: CORE & ACCESS

Circuit Switching vs. Packet Switching

1. Bandwidth guaranteed 2. Once circuit is established, full capacity of circuit is available for single communication 3. Traffic tends to be more predictable 4. Circuit costs are independent of the amount of data transmitted	1. Bandwidth dynamically allocated on as-needed basis 2. Multi-conversations can occur concurrently over single physical link 3. Traffic is very bursty, more susceptible to delay from congestion 4. More cost-effective and better overall performance

Examples:

Circuit Switching = Telephony SS7 Networks, PVC (Permanent Virtual Circuit), SVC (Switched Virtual Circuit)

Packet Switching = Any CSMA/CD (Carrier Sense Media Access/Collision Domain) network: Ethernet/802.3, Token Ring, FDDI.

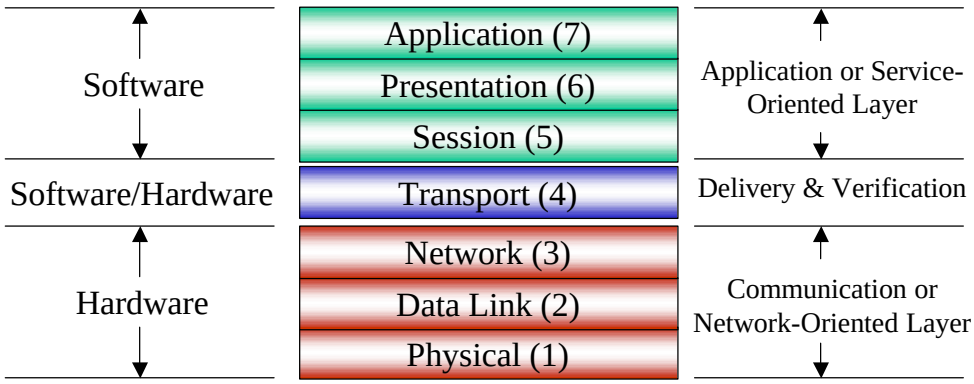
Cell Switching = ATM is a special packet switching where the packet is a fixed size 52 bytes to be called a “Cell”

Types of Services
Connection-Oriented vs. Connectionless

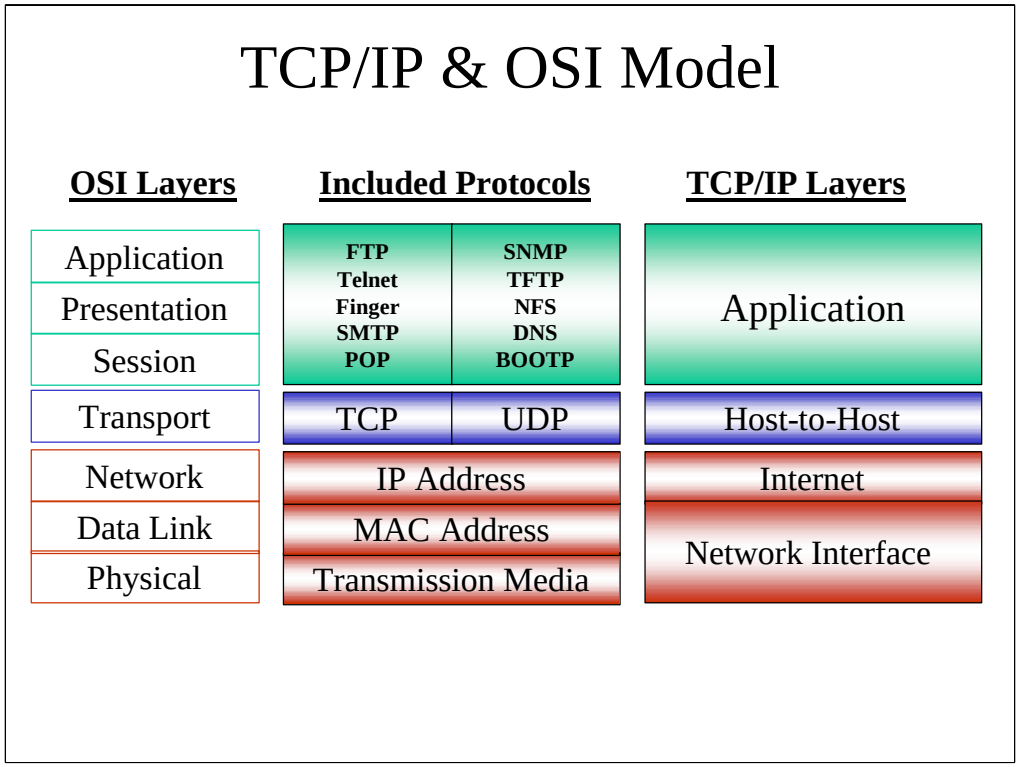
- Connection-Oriented Service: Prior to the transmission of data a physical (and virtual) link is established between the sending and receiving nodes. The link remains in effect for the duration of the session. Data is transmitted in proper sequence. This lends itself to more **reliability**.

- Connectionless Service: no link is established prior to communication, rather the data is partitioned into packets and routed through the network. Each packet independent and capable of arriving in any order. This lends itself to more **efficient** usage of the link.

ISO Seven Layer - OSI Model



"A Packet Should Travel Nicely Down Pipes"



Just explain this slide …

Toward the end of discussion:

Talk about how two computers talk to one another.

Start with example like Client/Server example with Browser & HTTPD.

Browser makes a request:

1) www.yahoo.com

2) DNS lookup

3) IP address is provided

4) HTTP GET on URL (default: index.html)

5) HTTPD listening on PORT: 80 on IP of www.yahoo.com

6) Takes request and transmit back the binary information of index.html to the Web browser.

Binary communications (bits) 101011010

Bits -> Bytes

8 bits to make up a byte

Example #1 – Snail Mail

Interactive Role Play – FUN!

I apologize in advance, we will be taking some liberties on how the US Postal Service works.

I. John Doe write a letter (raw data) to Suzy Q.

II. John Doe gets his address book (TCP/IP suite).

III. He packages his letter in an envelope (TCP/IP:Application Layers – OSI:Upper Layers 7,6,5 of OSI)

IV. He begins to address the envelope with

a) Name (Port Address – TCP/IP:Protocol OSI:Layer 4 Transport)

b) City, State (IP Address – OSI: Layer 3 Network)

c) Street & ZIP (Hardware/MAC Address – OSI: Layer 2)

V. Drop the letter in the mailbox (Physical transmission – OSI: Layer1)

VI. Local Post Office (LAN Switch) receives the letter.

a) Check the ZIP & Street (MAC) to see if locally deliverable.

b) if so, then delivered

c) else, forwards the letter to the region (router) office

VII. The region office (router) examines the address particularly City & State (IP)

a) Routes/Delivers the letter to the proper city & state (via other cities/routers)

b) If arrives in the proper city & state, the region office sends it to the proper local office (sends the packet from the router -> switch by adding the ARPed MAC address)

VIII.

Example #2 – E-Mail

Interactive Role Play, Again – Also FUN!

I. johndoe@sanjose.ca write an email (raw data) to suzyq@ny.ny.

II. John Doe gets his address book "suzyq@ny.ny" (TCP/IP suite).

III. He sends his email with Microsoft Outlook via SMTP (TCP/IP:Application Layers – OSI:Upper Layers 7,6,5 of OSI)

IV. The SMTP email data contains:

a) Port Address – TCP/IP:Protocol OSI:Layer 4 Transport (like the Name on the letter)

b) IP Address – OSI: Layer 3 Network (like the City & State)

c) Hardware/MAC Address – OSI: Layer 2 (like Street & ZIP)

V. Physical transmission – OSI: Layer1 (like putting the letter in the mailbox)

VI. LAN Switch receives the datagram (Local PO gets the letter).

a) Lookup MAC Address on header in its ARP cache to see if locally deliverable. (like looking at the ZIP & Street)

b) if so, then switch on the ports and deliver

c) else, forwards the letter to the router (region office)

VII. Router examines the IP address (like City & State)

a) Routes/Delivers the packet across the network (hopping across the network)

b) If arrives at the proper router, the router sends it to the proper switch and adds another header with the MAC address (ARPed)

VIII. Letter has been delivered.

Summarize Key Points

- Network Topology – star, loop, meshed, tier
- Circuit vs. Packet Switching
- Connection-Oriented vs. Connectionless
- Seven Layer OSI Model
- TCP/IP & Examples
- Example to pull in all concepts discussed: Snail Mail vs. Email (understanding switching, routing, TCP/IP, and OSI)