CECS 327 Intro to Networking and Distributed Computing

Seminar Notes

Goal of Networking:

- Enable communication between network applications on different end points

    Endpoint = computers, cell phones, …

    Application = web, peer to peer, streaming video

    Communication = transfer bits

- Network must understand application needs/demands

    - What data rate?

    - Traffic patter? (bursty or constant bit rate)

    - Traffic target? (multipoint or single destination)

    - Application sensitivity? (to delay, "jitter", loss)

    - Difficulty

- How does application "use" networking?

    - client-server: web….

    - peer to peer: Skype….

Defining a "Network"

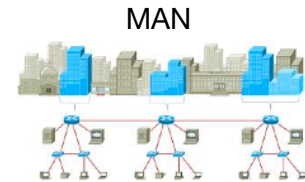- Network = nodes + links

- Different networks:

    - The Internet

    - UWT network

    - Telephone network

    - Home Wireless Networks

    - Others - sensor nets, cellular networks

LAN

- WAN (Wide Area Network)

  • All network talking to each other

- MAN (Metropolitian Area Network)

  • Like LAN but a bigger network

    IE: LAN = home & WAN = School

MAN

"The Internet"

• Internet vs internet

• The interconnected set of networks of the Internet Service Providers (ISPs) and end-networks, providing data communications services

  - IE: www.csulb.edu —> .edu will provide ISPs which server to look for

  - About 17k different ISP networks make up the internet

  - ISP contact each other to find if that webaddr is cached

    - if not then it goes to DNS

Requirements

• Application Programmer

Types of Computer Networks

Connectivity

  Terminologies

    - Scale

    - Link

    - Nodes

    - Point-to-Point (type of connection where 2 nodes talk to each other)

    - Multiple Access (nodes have access to shared resources)

    - Switched Network

        1. Circuit Switched

            - Circuit needs to be open until call ends

            - Second call can't be made until circuit is free

- while you are talking, package is send

- Even if you are not talking, you send empty pack.

2. Packet Switched

- Doesn't care about one on one circuit, as circuit is shared

- If package needs to be send, then it is send on same circuit

- Thus no one is waiting on circuit to open

- Big Different: send pieces of packages, not one whole

- Packet, Message

- Store-and-Forward

- Cloud

- Hosts

- Switches

- Internetwork

- Router/Gateway

- Host-to-host connectivity

- Address

- Routing

- Unicast/Broadcast/Multicast

September 03, 2018

Labor Day

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Missed

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September 10, 2018

What is Layering?

- • A way to deal with complexity

    - Add multiple levels of abstraction

- IE: Organization of Air Travel

* Ticket (Purchase)	* Ticket (Complain)
* Baggage (Check)	* Baggage (Claim)
* Gates (Load)	* Gates (Unload)
* Runway Takeoff	* Runway Landing
* Airplane Routing	* Airplane Routing

            Airplane Routing

    - Series of Steps

- Layers: each layer implement a service

- IE: Network Layering

Aplication Programs	
Request/Replay Channel	Message Stream Channel
Host-to-Host Connectivity	
Hardware	

Features of Layering

- • Sub-Divided the problem

    - Each layer relies on services from layer below

    - Each layer exports services to layer above

- Advantages of layering?

    - Simplifies design and implementation

    - Easy to modify/evolve

Protocol

- Standardized method for transmitting data and/or establishing communications between different devices

- protocols are the key to interoperability

    - Networks are very heterogeneous

| Hardware/Link	Ethernet: 3com, Dlink
Network	Routers: Cisco, Juniper etc.
Application	APP: Email, IM, IE, etc.

- Must speak the same language

- All hardware/software must communicate with each other with same specification

    - even if they are from different vendor

Protocol Layering

- Protocols exist at many levels

    - Application level protocols

    - Protocols at the hardware level

- Each protocol provides different service to higher layers and relied on services from lower layers

- Protocols build upon each other

    - adds value, improves functionality overall

        - IE: a reliable protocol running on top of IP

    - Reuse, Avoid Re-writing

   - IE: OS provides TCP, so application don't have to rewrite

Protocols Interfaces

• Each protocol offers interfaces to communicate with each other

- Service Interface:

• Defines operations on this protocol

- Peer-to-Peer Interface:

• Defines messages exchanged with peer

Figure 1.11   Example of a protocol graph.
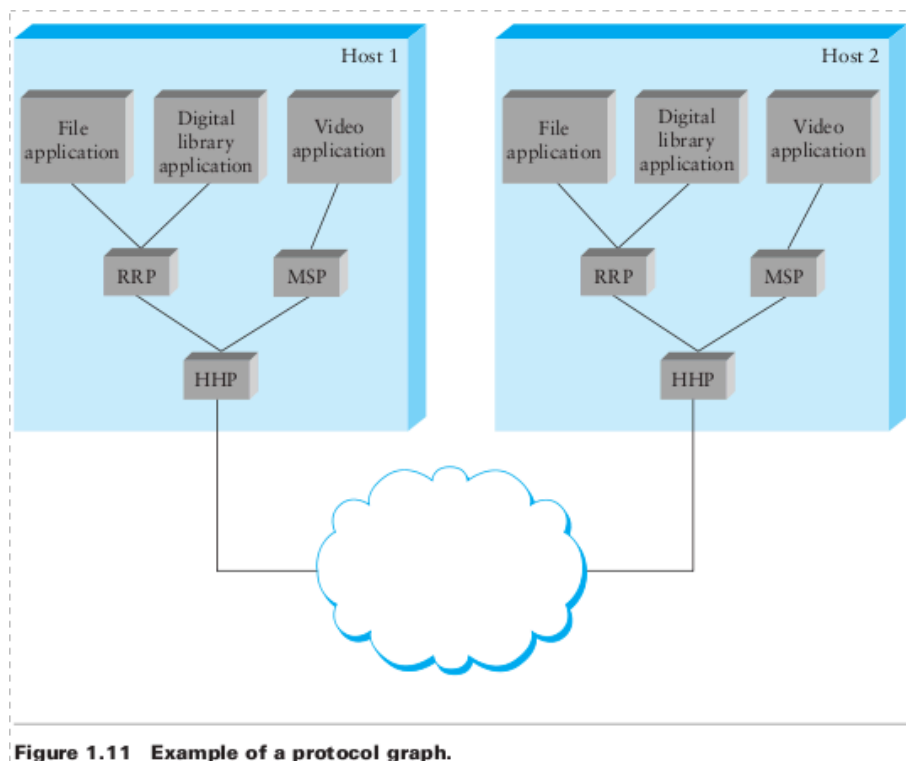
Encapsulation

• High-Level messages are encapsulated inside of Low-Level messages

Encapsulation

High-level messages are encapsulated
inside of low-level messages

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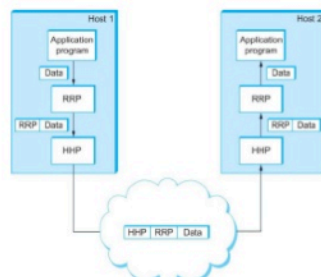
OSI (Open Systems Interconnection) Architecture: 7-layers

Description of Layers (1)

- Physical Layer

    • Handles the transmission of raw bits over communication link

- Data Link Layer

    • Collects bits of data into larger "Frame"

    • Network adaptor implement the protocol in this layer

    • Frames are actually delivered to hosts

- Network Layer

    • Handles routing among nodes within a pack-switched network

    • "Packet" are exchanged here

    Frame vs Packet:

        - Frames are used in switch and hub while packet is used in router

        - Switches and Hubs use MAC address to send Frame

        - Routers use IP address to send Packet

Description of Layers (2)

- Transport Layer

    • Implements a process-to-process channel

    • Unit of data exchanges in this layer is called a "Message"

- Session Layer

    • Mechanism of Opening, Closing, and Managing communication between hosts

- Presentation Layer

    • Concerned about the format of data exchanged between peers

- Application Layer

• Ensure applications communication with other apps.

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More about OSI Model

      Why 7 Layers?

            • Many Fundamental issues can be addressed at multiple layers

                  - Flow Control

                  - Reliability

                  - Addressing

      Not Widespread Acceptance? Why?

TCP/IP Model

      Application protocols

      Two Transport protocols: provide logical channels to applications

OSI vs TCP/IP

      7 layers for OSI

      TCP/IP =

            - Application

            - TCP/UDP

            - IP

            - Network

Switch is faster because it doesn't slow anyone else down

Encapsulation:

      Know:

            Message vs segment vs datagrain vs frame

Multiplexing and Demultiplexing

• Packet header includes a demultiplexing field

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Performance:

    • Bandwidth

        - How many bits can be crammed over the network in one second?

        - What if throughput?

    • Latency or Delay

        - How long does it take a message to travel from one end of a network to the other?

    • The Delay-Bandwidth product is a measure of network capacity

Bandwidth:

    Def: Maximum number of bits per second that can be transmitted over a communication link

    • Width of the frequency band

Latency:

    • Sources of delay

    Router

        - Put data in queue if its capacity is full

        - Queue affect latency, bigger queue means slower internet

    Latency = Propagation + Transmit + Queue

        Propagation = distance/speed of light

            - Propagation Delay = delay over distance at current time

        Transmit = size/bandwidth

        Queue

            • Depends on congestion

Using "ping" command:

    3 Results:

        1. Reply back

        2. Request Time Out

        3. Destination Unreachable

TTL = Time To Live

    - If we don't have time to live, the packet could loop through many different router indefinitely

Traceroute:

    IE: going to google.com, how many hoops you need to take to get there

        - It is not always a straight shot

Throughput

Def: Actual rate (bits/time unit) at which bits transferred between sender/receiver

    • Instantaneous: rate at given point in time

    • Average: rate over longer period of time

Bandwidth vs Latency

Delay X Bandwidth

    • Network Capacity = Delay-Bandwidth product

    •How many bits the sender must transmit before the first bit arrives at the receiver if the sender keeps the pipe full

    • takes another one way latency to receive a response from the receiver

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September 19, 2018

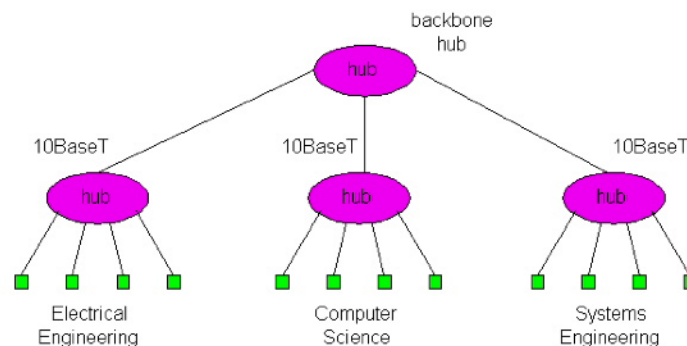## Interconnecting LANs

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Why not have one big LAN?

- Too much traffic

Collision Domain

• part of a network where packet collisions can occur

• when two devices set information at the same time

Hubs

• Physical Layer Devices

- Repeaters operating at bit level

• can be arranged in a hierarchy (or multi-tier design) with backbone hub at its top

Limitations

• single collision domain results in no increased

Switch

• Link Layer devices: operate on Ethernet frames, examining frame header and selectively forwarding frame based on its destination

• Switch isolates collision domains since it buffers frames

• When frame is to be forwarded on segment, switch uses CSMA/CD to access segment and transmit

- CSMA/CD = Carrier-Sense Multiple Access with Collision Detection

Advantages

- Due to CSMA/CD, lead to higher total max throughput

- does not limit the number of nodes nor geographical coverage

- can connect different type Ethernet since it is a store

Switch BackBone does exist as well.

Interconnection without Backbone

 • Not recommended

Switch Filter Packets:

 • Same-LAN - segment frames not forwarded onto other LAN Segments

Forwarding:

 • How does the switch know where to send frame?

Switch Filtering:

 • Switch learn which hosts can be reached through which interfaces

 - maintain filtering tables

Switch Learning

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