CSE 461 Midterm Review

Autumn 2019

Section Overview

- Physical Layer
- Link Layer
- IP Layer

Physical Layer

Modulation Methods:

Amplitude, Frequency, Phase

Latency:

- **Transmission Delay**
  - Δt between the 1st bit on the wire and the last bit on the wire
- **Propagation Delay**
  - Time for bits to travel from one end to the other
- **Bandwidth-Delay Product**

Shannon Capacity

The maximum rate of information that can be transmitted over a channel of a specified bandwidth in the presence of noise without loss:

$$C = B * \log_2(1 + S/N)$$

C: Transmission rate

B: Bandwidth

S: Signal

N: Noise

⇒ **Increasing Bandwidth is MUCH more effective than increasing Signal or decreasing Noise.**

Link Layer

Framing:

Byte Counting, Byte Stuffing, Bit Stuffing

Error Detection/Correction:

- **Hamming Distance**
  - The minimum number of bits to change from valid codeword to another
- **Parity Bit**
  - XOR corresponding bits
- **Retransmissions:**
  - Automatic Repeat reQuest (ARQ)
  - Stop-and-Wait & Sliding window

Multiple Access Problem

- **ALOHA:** Node just sends when it has traffic; if collision happens, wait for a random amount of time and try again. ➪ Huge amount of loss under high load
- **CSMA (Carrier Sense Multiple Access):** Listen before send. ➪ Collision is still possible because of delay
- **CSMA/CD (Carrier Sense Multiple Access with Collision Detection):** CSMA + Aborting JAM for the rest of the frame time ➪ Minimum frame length of 2D seconds
- **CSMA "Persistence":** CSMA + P(send) = 1 / N ➪ Reduce the chance of collision
- **Binary Exponential Backoff (BEB):** Doubles interval for each successive collision ➪ Very efficient in practice

Hidden vs. Exposed Terminal Problem

- **Hidden Node Problem:** Node A and node C both want to send to node B. Since A and C are out of each other's range, they can't "see" each other. Collision could happen if A and C are transmit to B simultaneously.
- **Exposed Terminal Problem:** Node B wants to send to node A, node C wants to send to node D. B and C are near each other while A and D are far apart. B and C are afraid of interfering each other's transmission and would both "shut up."
- **Solution?** RTS-CTS Mechanism!

Switching

- **Backward Learning:** Learn the sender's port by looking at the packets
- **Spanning Tree Solution:**
    - Elect the root node of the tree (Usually the switch with the lowest address)
    - Grow tree based on the shortest distance from the root
    - Ports not on the spanning tree are turned off

IP Layer

Datagram Model:

- Connectionless service
- Packets contain destination address
- Packets may use different paths
- Each router has a forwarding table keyed by ip address.

Virtual Circuit Model:

- Connection-oriented service
- Packets contain labels to identify the circuit
- Packets use the same path
- Each router has a forwarding table keyed by circuit

Breakdown of IP

- **Bootstrapping (DHCP)**
- **Finding Link nodes (ARP)**
- **Really big packets (Fragmentation)**
- **Errors in the network (ICMP)**
- **Running out of addresses (IPv6, NAT)**

DHCP

- **Purpose:** Automatically configure addresses
- **Steps of DHCP :**
    - The node broadcasts a DISCOVER message on the local network (255.255.255.255)
    - DHCP server responds with an OFFER message
    - The node sends a REQUEST message to the server, asking for an ip address
    - The server responds with an ACK message, assigning an ip address

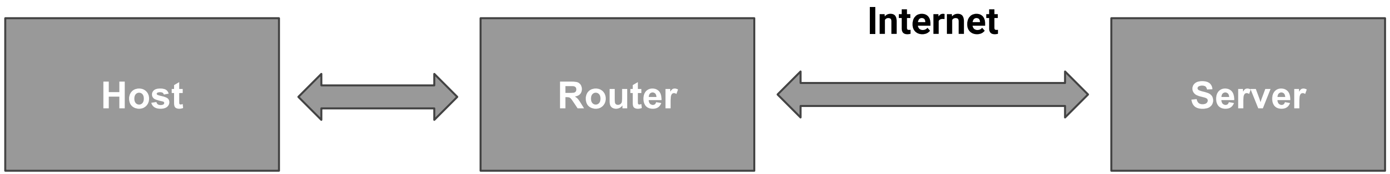
NAT (Network Address Translation)

- **Purpose:** Provide a solution to the exhaustion of ipv4 addresses

Private Address:
192.168.1.2

Router Address:
12.11.8.1

Server Address:
18.21.9.22



NAT Forwarding Table

Private Address	Public Address
192.168.1.2:12345	12.11.8.1:22222

G00D luck :)