EECS 563 Fall 2014

Review Test 1

Drivers

- CPU ↑
- Link Rates ↑
- # Users ↑
- Economic
- Policy

Value of Net ↑
Issues in Networking

- Sharing
- Protocols
- Distributed Network Elements (NE)
  - Imperfect Knowledge
  - “Real time”
- Cooperation among competing entities (network of networks)

Components

- Transmission
  - TDM, TDMA, TDD
  - FDM, FDMA, FDD
  - Statistical multiplexing
- Switching
- Signaling
  - SS7
  - SIP
- Structure
  - Tier i
  - ISP
  - NAP
Network Evolution, Standards, and Layered Architectures

- Standards
  - IETF
  - IEEE
  - ITU
  - The good and bad of standards

- Layers provide a way to
  - Describe networks
  - Organize functionality
  - Enable flexibility

- Layered Architecture (OSI)
  - PHY, DLC, Network, Transport, Session, Presentation, Application

- Internet Architecture
  - PHY, Access Network, Internetwork, Transport, Application
Network Evolution, Standards, and Layered Architectures

- Role of packet headers
  - Add headers as data goes from upper-to-lower layers
  - Consume headers as data goes from lower-to-upper layers
- Role of encapsulation
- Common Protocol Functions

Network Switching Technologies, Impairments, and Metrics

- Circuit Switching
- Packet Switching
  - Statistical multiplexing
- Virtual circuit packet switching
- Datagram
- Connection oriented

Trade-offs and attributes
Network Switching Technologies, Impairments, and Metrics

- Impairments
  - Delay
    - # bits in RTT
    - # packets in RTT
    - LAN, MAN, WAN
  - Errors
    - Random
    - Bursty
    - Time between errors

Network Switching Technologies, Impairments, and Metrics

- Metrics
  - Response Time
  - Throughput
  - \( S_{\text{min}} \)
  - \( S_{\text{Max}} \)
  - Utilization
  - Channel Efficiency
  - Loss/blocking
  - Reliability
  - Fairness

- Network Performance Guarantees
  - QoS
  - CoS
Internet Protocols

- IPv4 - packet header
  - Source/Destination Address-32 bits
  - TTL
  - ToS
  - Header check
  - Fragmentation/reassembly

Internet Protocols

- Addressing IPv4
  - Net_Id, Host_Id
  - a.b.c.d format
  - /X
    - Subnetwork mask
    - Address range/network
    - # hosts/network
  - Subnetworks
Internet Protocols

- Header check sum Not equal 0 → drop packet
- TTL=1 and when decrement TTL= 0 then → drop packet & send ICMP packet to source
- Forwarding → Router actions upon arriving packet

<table>
<thead>
<tr>
<th>Dest Network</th>
<th>Next Hop</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.1.1.0/24</td>
<td>Router 7</td>
<td>Fiber1</td>
</tr>
<tr>
<td>237.5.0.0/16</td>
<td>Router 9</td>
<td>Eth3</td>
</tr>
<tr>
<td>Default</td>
<td>Router 8</td>
<td>Fiber2</td>
</tr>
</tbody>
</table>

Internet Protocols

- ICMP
- DHCP
- DNS
- ARP
- Tunneling
Internet Protocols

- Routing → gather information and build the forwarding tables
  - Issues
    - How to learn the network topology?
    - How to share information?
    - How to define “distance”?
    - What shortest path algorithm to use?
    - How to respond to failures?
    - How to respond to congestion?

- Exhaustive Search

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Internet Protocols

- Routing hierarchy
  - AS & between AS’s
    - Within one AS uses IGP, example OSPF
    - Between AS’s uses EGP, example BGP
  - ASN (32 bits)
  - EGP’s need to consider cooperation among competing entities, BGP policies are based on business relationships

- Source Routing
Internet Protocols

- IPv6
  - Addresses → 128 bits
  - Header
    - TTL becomes a Hop Limit
    - No header checksum
    - No Fragmentation
    - Flow label
  - Transition
    - Dual stacks
    - Tunneling

At the conclusion of this class the students are expected to:

- Understand the basics of multiplexing
- Understand the layered structure of protocols
- Understand the importance of standards and who sets them
- Understand the basics of network protocols, including:
  - Datagram/virtual circuit switching
  - Statistical Multiplexing
  - Forwarding
  - IP & supporting protocols
  - Routing
- Be fluent in the language of communication networks, i.e., understand the meaning of networking terms and abbreviations
- Use network analysis tools, e.g., traceroute and ping