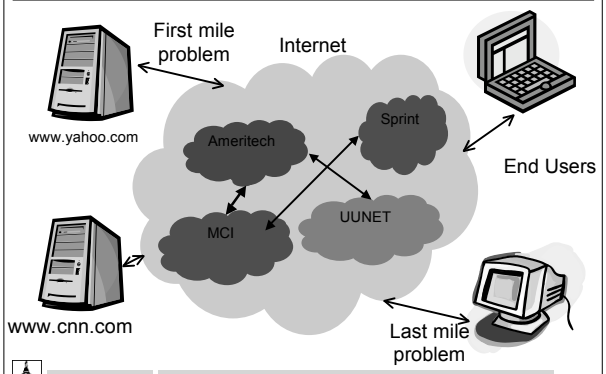
Review



Lecture 2

- Network Applications
  - Naming
  - Applications
    - Central Server based
      - Easy to administer, not scaleable, fault tolerant
      - Web servers
    - Hierarchical Services
      - Domain Name System – DNS
    - Peer-to-Peer Systems
      - No “server”, can scale, location problem harder
      - Napster, gnutella

Lecture 3/4

- End-to-end argument
  - KISS principle (Keep It Simple, Stupid)
- Chapter 2: Direct Link Networks
  - Connecting hosts directly (ethernet, wireless etc.)
  - Encoding (how are we talking - language)
    - NRZ, NRZI, Manchester, 4B/5B
  - Framing (how do we know the end)
    - Sentinel (special boundary), count based, clock based
  - Error Detection
    - CRC
  - Reliable transmission (using ACK, Automatic Repeat Request - ARQ)
    - Sliding Window Algorithm (multiple outstanding frames)
      - Initial sequence number

Lecture 5

- Shared Access Networks
  - Bus (Ethernet)
    - CSMA/CD
      - carrier sense: Can sense the channel for collisions
      - multiple access: More than one node can access the channel
      - collision detection: Sender can detect its own collisions
        - » P-persistent and retry
  - Token ring (FDDI)
    - must capture token before transmitting
    - release token after done transmitting
    - Bounds for delay to send frames
  - Wireless (802.11)
    - Mobility issues because of the wireless channels
    - Bluetooth, irda, IEEE 802.11 wireless

Lecture 6

- Switching and forwarding
  - Store-and-Forward Switches
    - Source routing
    - Virtual circuit switching
  - Bridges and Extended LANs
    - Learning bridges
    - Spanning bridge algorithm
      - Choose routes such that there are no loops
      - Does not take congestion into account
  - Cell Switching
    - ATM networks
  - Segmentation and Reassembly

Lecture 7

- Router construction
  - Workstation based
  - Switching hardware
    - Crossbar
    - Knockout switch
    - Self routing switches
- Internetworking
  - Best Effort Service Model
    - Connectionless (datagram-based)
    - Best-effort delivery (unreliable service)
      packets are lost, delayed, duplicates delivered, delivered out of order
- Datagram format
- Global Addressing Scheme

Lecture 8

- Fragmentation and reassembly
  - Different networks have different MTU
- Global addresses
  - Class A, B, C, CIDR
- Datagram forwarding
  - every datagram contains destination's address
  - if directly connected to destination network, then forward to host
  - if not directly connected to destination network, then forward to some router (default router?)

Lecture 8

- Routing
  - Distance Vector (RIP)
    - Exchange information with connected routers
    - Loops can be a problem
      - Count to infinity problem
        - » Define infinity as 16
        - » Split horizon
        - » Split horizon with poisoning
- Link state (OSPF)
  - Exchange state with *all* routers
  - Individual nodes run shortest path algorithm
  - Need reliable flooding of routing state

Lecture 9

- Internet
  - Subnetting
    - Create organization for local networks
    - Nodes use default routers to forward traffic
  - BGP4 routing for the backbone (complex protocol)
    - stub AS: has a single connection to one other AS
      - carries local traffic only
    - multihomed AS: has connections to more than one AS
      - refuses to carry transit traffic
    - transit AS: has connections to more than one AS
      - carries both transit and local traffic
- Multicast routing
- Peering and transits

Lecture 10

- Reliable transmission (TCP)
  - Connection Establishment/Termination (SYN/FIN)
  - Sequence number selection
    - To guard against packets from earlier connections
  - Connection tear-down (RESET)
  - Round-trip estimation
    - Retransmission ambiguity
  - Window flow control
    - Flow control: keep sender from overrunning receiver
    - Congestion control: keep sender from overrunning network
  - Sliding Window Revisited
  - Adaptive Timeout