Finals Review – Part A

EECS 122

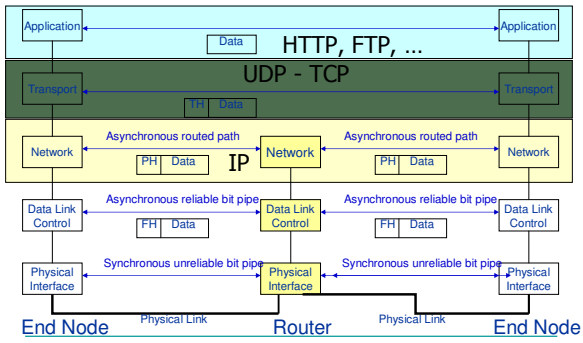
Spring 2004

University of California
Berkeley

Network Architecture and Modeling

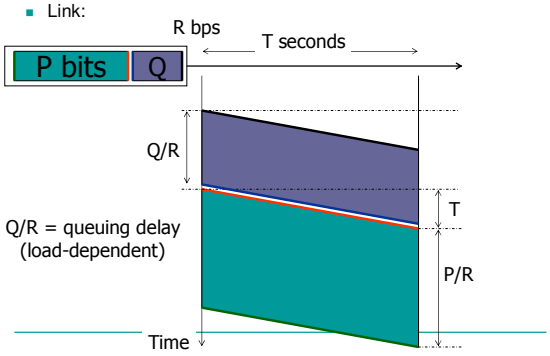
- What are the basic differences between Circuit and Packet Switching?
- Understand Packet Switch network hierarchy: LAN, MAN, WAN
- What is the motivation behind layering? What are the different layers and the corresponding key protocols?
- What are the main performance metrics? Howa re they defined and what are the relationships among them?

Layers & Protocols

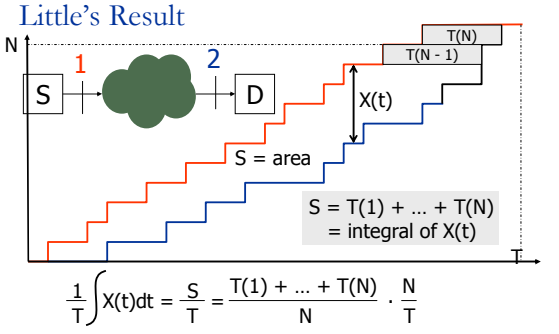


Timing: Queuing

- Link:



Throughput – Delay Relationship: Little's Result



$$\frac{1}{T}\int X(t)dt = \frac{S}{T} = \frac{T(1) + \ldots + T(N)}{N} \cdot \frac{N}{T}$$

→ Average occupancy = (average delay)x(average arrival rate)

Physical and Link Layers

- What does Shannon's theorem for the channel capacity state?
- How do the basic data encoding schemes (NRZ, NRZI, 4B/5B, etc.) work?
- How do the basic error detection schemes (parity, CRC, etc.) work?

Physical and Link Layers (Cont'd)

- What's the motivation behind shared media protocols?
- Ethernet:
  - Why is Ethernet an improvement over Aloha?
  - How does Ethernet MAC work? What's the relationship between the maximum propagation time and the minimum frame size?
  - How do hubs, bridges, and switches operate? What are the key differences among them?
  - Why is the Spanning Tree algorithm required? How does it work?

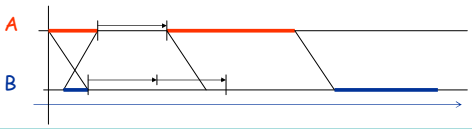
Physical and Link Layers (Cont'd)

- 802.11 (Wi-Fi)
  - What are the basic physical layer protocols used by 802.11?
  - How doe the 802.11 MAC work?
  - What's the efficiency of 802.11 MAC?
  - What are the differences between Ethernet and 802.11 MAC protocols? Why are they necessary?
  - Understand the key 802.11 MAC ideas: RTS/CTS, NAV, different IFS, etc.

Random Multiple Access

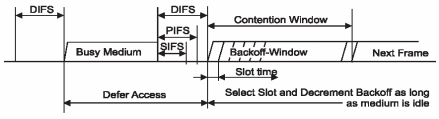
Ethernet: CSMA/CD

- Wait until channel is idle; try; if collide, stop, wait, repeat
- Idea: CS should improve efficiency if fast enough
- Wait random multiple of 512 bit times (exponential back off)
- Analysis: Efficiency ≈ 1/(1 + 5a), a = PROP/TRANS



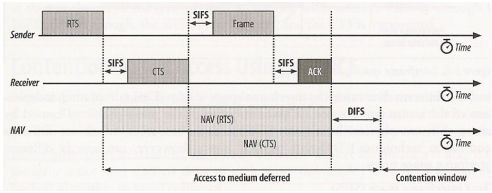
802.11 MAC (CSMA/CA)

- If medium is idle for DIFS interval after a correctly received frame and backoff time has expired, transmission can begin immediately
- If previous frame contained errors, medium must be free for EIFS
- If medium is busy, access is deferred until medium is idle for DIFS and exponential backoff
- Backoff counter is decremented by one if a time slot is determined to be idle
- Unicast data must be acknowledged as part of an atomic exchange



802.11 Virtual Carrier Sensing

- Virtual Carrier Sensing using Network Allocation Vector (NAV)

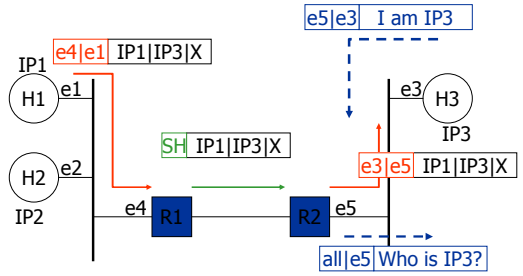


Network Layer: IP – Internet Protocol

- Understand the addressing scheme
- What's the motivation behind CIDR?
- How does ARP work?
- How do NAT and DHCP work?
- Understand the operation of the key routing protocols (RIP, OSPF, BGP)? What are the pros/cons of each algorithm?

Internetworking

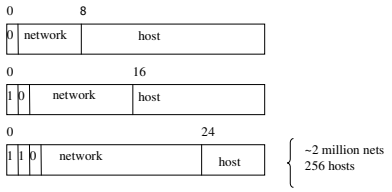
Indirect Delivery



Note: Fragmentation may be required at R1

Class-based Addressing

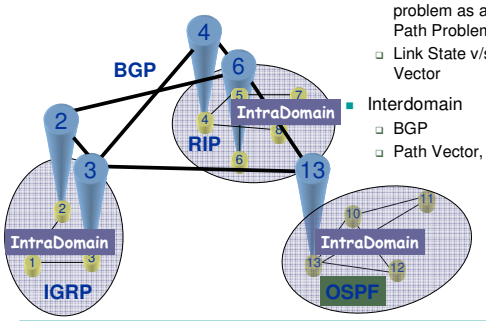
- Addressing reflects internet hierarchy
  - 32 bits divided into 2 parts:
  - Class A
  - Class B
  - Class C



Classless Internet Domain Routing (CIDR)

- Problem: Class B is facing address space exhaustion
- If multiple Class C addresses are given out, routing table size needed can be too large
- Solution: Assign consecutive Class C addresses and in essence allow network address length to be flexible
- Example: A corporation needs 16 Class C addresses
  - CIDR scheme could assign network addresses 192.4.16 to 192.4.31, i.e., in the range
    11000000 00000100 00010000 00000000
    11000000 00000100 00011111 00110001
- They share the first 20 bits of 192.4.16.0
  - Routing tables store the 20 bit prefix
    (Convention: 192.4.16.0/20 = prefix)

IP Routing



- Intradomain
  - Formulate the routing problem as a Shortest Path Problem
  - Link State v/s Distance Vector
- Interdomain
  - BGP
  - Path Vector, Policies

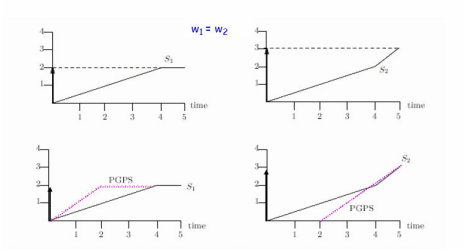
Route Computation

- Dijkstra: Link State
  - Use a flooding protocol to discover the entire topology
  - Find the shortest paths in order of increasing path length from node i.
- Bellman Ford: Distance Vector
  - $D(i,d) = \min_{j \in N(i)} \{c(i,j) + D(j,d)\}$
- BGP: Path Vector
  - Policy routing: Receive and advertise entire routes
  - AS identifiers describe the path to a CIDR prefix

Scheduling

- Why is a scheduling scheme like WFQ needed?
- Understand the properties of WFQ: Bandwidth sharing, Work-conservative scheduling, etc.
- What's the relationship between GPS and PGPS (same as WFQ)?
- Understand (at a high level) the algorithm for the WFQ practical implementation based on the GPS finish times

WFQ Example



- Solid line shows the evolution under GPS
- In this example, no packets under WFQ finish later than under GPS
- In general, maximum lateness under WFQ is L_{max}/C where L_{max} is the maximum packet size

RTP and VoIP

- Where do RTP and RTCP fit in the protocol layers?
- What are the services provided by RTP and the companion RTCP?
- What's the rationale behind VoIP being an attractive service over IP networks?
- Understand the basics of the alternative protocol suites for VoIP: H.323 and SIP