Welcome to

**CS 3516:**
Advanced Computer Networks

Prof. Yanhua Li

*Time: 9:00am – 9:50am M, T, R, and F*
*Location: Fuller 320*
*Fall 2016 A-term*

Final Review

- (1) CRC
- (2) DHCP
- (3) CSMA/CD (to be introduced on Monday 10/10)
- (4) LS and DV routing
- (5) IPv4 classful addressing
- (6) Inter-AS routing and BGP

- (1) 7 questions
- (2) 32 points
- (3) Q1-4: Small
- (4) Q5-7: bigger questions

TA office hour this afternoon 1-3pm

My office hour 10-10:45AM
DHCP client-server scenario

arriving DHCP client needs address in this network
DHCP client-server scenario

DHCP server: 223.1.2.5

DHCP discover

Broadcast: is there a DHCP server out there?

DHCP offer

Broadcast: I’m a DHCP server! Here’s an IP address you can use

DHCP request

Broadcast: OK. I’ll take that IP address!

DHCP ACK

Broadcast: OK. You’ve got that IP address!
CSMA/CD (collision detection)
1. NIC receives datagram from network layer, creates frame.

2. If NIC senses channel idle, starts frame transmission. If NIC senses channel busy, waits until channel idle, then transmits.

3. If NIC transmits entire frame without detecting another transmission, NIC is done with frame!

4. If NIC detects another transmission while transmitting, aborts and sends jam signal.

5. After aborting, NIC enters *binary (exponential) backoff*:
   - after *m*th collision, NIC chooses *K* at random from \{0, 1, 2, \ldots, 2^m - 1\}. NIC waits *K*·512 bit times, returns to Step 2.
   - longer backoff interval with more collisions
Interconnected ASes

- Forwarding table configured by both intra- and inter-AS routing algorithm
  - intra-AS sets entries for internal dests
  - inter-AS & intra-AS sets entries for external dests
Inter-AS tasks

- Suppose router in AS1 receives datagram destined outside of AS1:
  - Router should forward packet to gateway router, but which one?

**AS1 must:**
1. Learn which dests are reachable through AS2, which through AS3
2. Propagate this reachability info to all routers in AS1

*Job of inter-AS routing!*
BGP basics: distributing path information

- Using **eBGP** session between 3a and 1c, AS3 sends prefix reachability info to AS1.
  - 1c can then use **iBGP** to distribute new prefix info to all routers in AS1
  - 1b can then re-advertise new reachability info to AS2 over 1b-to-2a eBGP session

- When router learns of new prefix, it creates entry for prefix in its forwarding table.
Example: setting forwarding table in router 1d

- suppose AS1 learns (via inter-AS protocol) that subnet x reachable via AS3 (gateway 1c), but not via AS2
  - inter-AS protocol propagates reachability info to all internal routers
- router 1d determines from intra-AS routing info that its interface e is on the least cost path to 1c
  - installs forwarding table entry (x,e)
Example: choosing among multiple ASes

- now suppose AS1 learns from inter-AS protocol that subnet x is reachable from AS3 and from AS2.
- to configure forwarding table, router 1d must determine which gateway it should forward packets towards for dest x
  - this is also job of inter-AS routing protocol!
  - *hot potato routing: send* packet towards closest of two routers.

![Diagram of network topology with ASes and subnet x]
Path attributes and BGP routes

- advertised prefix includes BGP attributes
  - prefix + attributes = “route”

- two important attributes:
  - **AS-PATH**: contains ASs through which prefix advertisement has passed: e.g., AS 67, AS 17;
  - AS numbers are maintained by ICANN;
  - **NEXT-HOP**: indicates specific internal-AS router to next-hop AS. (may be multiple links from current AS to next-hop-AS)
Questions?