CS118 Discussion 1B

Quiz 3, Wireless, Mobile IP

Week 9

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Some Problems from Quiz 3

About DHCP’s 4 Pieces

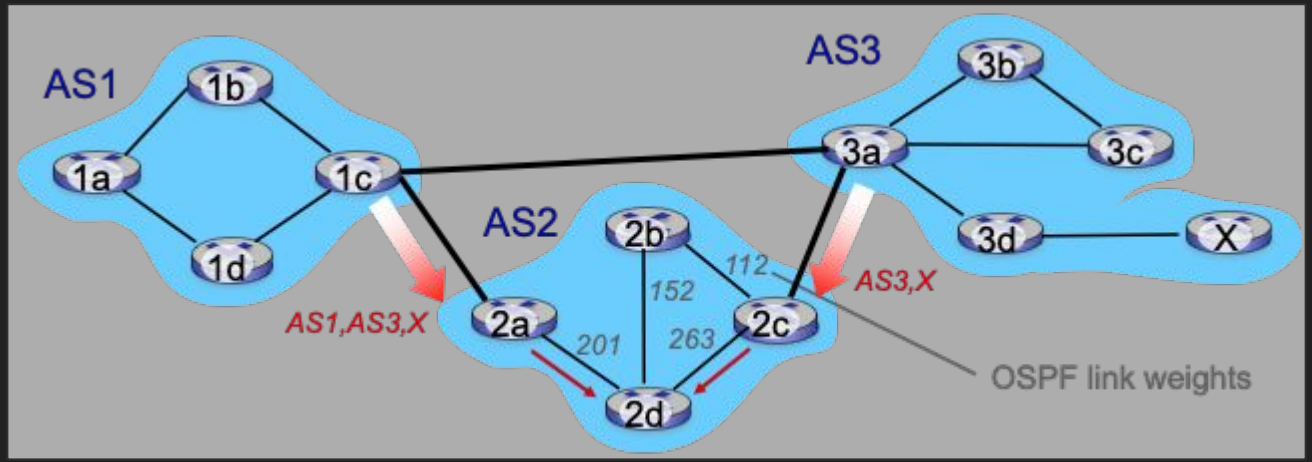
- DHCP provides four pieces of network configuration information for a host
  - IP address
  - Network mask
  - DNS’s IP
  - Gateway/Default router’s IP
- When changing from 223.1.2.0/24 and 223.1.3.0/24, how many pieces must be changed?
  - 2 pieces
  - One is your IP address, where the prefix is changed from 223.1.2.X to 223.1.3.X
  - Second is your Gateway router’s IP address, same

About DHCP’s 4 Pieces (cont’d)

- What about removing 223.1.2.0/24 and 223.1.3.0/24? How many pieces must be change when moves from one subnet to another subnet?
  - Can be 0
  - Think of your home network (where NAT is used all the time), it is possible your IP address/Gateway address is the same before and after the move
    - E.g., host IP from 192.168.0.2 to 192.168.0.2
    - E.g., gateway IP from 192.168.0.1 to 192.168.0.1

About Hot Potato

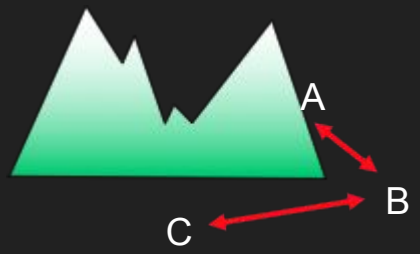
- When Hot potato is prioritized, the router will not consider shortest AS-PATH
- The only criteria is to select a border router in the SAME AS with the least cost path
  - The least cost path is learned from intra-AS routing, e.g., RIP, OSPF
  - The border router knowledge is learned from iBGP routing



802.11

Wireless network

- Two main modes: Infrastructure v.s. Ad-hoc
- Handle issues from the wireless network
  - Multiple Access (because of wireless is broadcast access, similar as a Ethernet LAN)
  - **Hidden terminal**: B can hear A and C but A and C is unaware of each other
  - **Signal attenuation**: Similar to hidden terminal. B's signal strength becomes unrecognizable when it reaches C.
  - Solution by 802.11: CSMA/CA



Infrastructure mode v.s. Ad hoc mode

- **Infrastructure mode**
  - Have the connection to the infrastructure (e.g., stationary facilities, Internet), usually via the base station
  - E.g., WiFi network, vehicle to RSU (road side unit) communication, 3G/4G/5G
- **Ad hoc mode**
  - Purely formed by end hosts
  - E.g., Apple’s AirDrop, vehicle to vehicle communication

CSMA/CA

- 802.11 sender: channel sensing
  - If sense channel idle for DIFS period then transmit entire frame
  - Else if sense channel busy then
    - start random backoff timer
    - timer counts down while channel idle
    - transmit when timer expires
    - if no ACK, increase random backoff interval, repeat
- 802.11 receiver
  - if frame received OK then return ACK after SIFS
- For long data frame, the sender can reserve the link
  - by sending a request-to-send and the Access Point can approve the request by sending back a clear-to-send.

Collection of Terminologies in Wireless

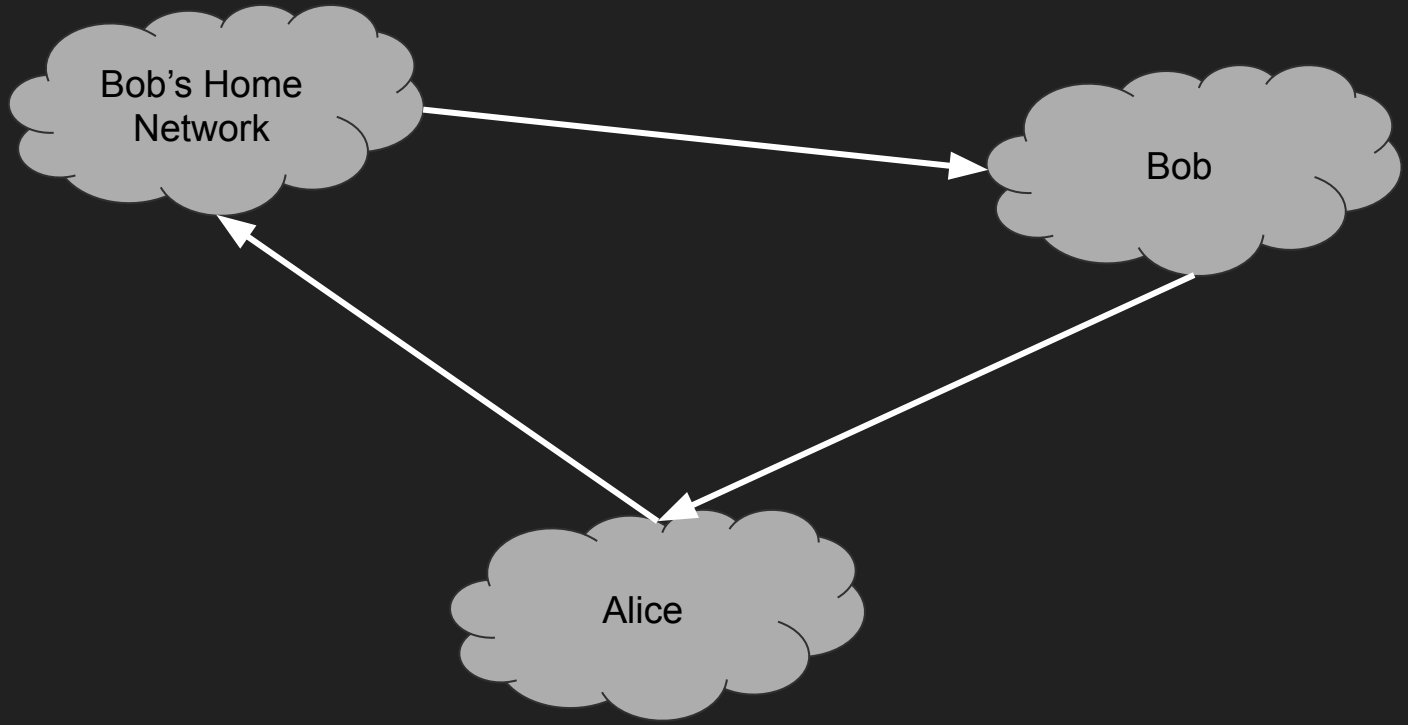
- **SNR**:
  - signal to noise ratio, the higher the better.
- **BER**:
  - bit error ratio, the lower the better
- **dB**:
  - decibel, a unit to indicate how strong is the signal
- **AP**:
  - the based station in 802.11 wireless family, e.g., your home WiFi router
- **BSS**:
  - Basic service set. A cell that contains the wireless end hosts + AP or ad hoc hosts, e.g., your home WiFi network as a whole, your phone A and phone B using the AirDrop.
- **RTS/CTS**:
  - request-to-send / clear-to-send used in CSMA/CA.

Mobile IP

Mobile IP

- What problem to solve?
  - Alice wants to visit Bob but does not know Bob’s current IP address because Bob moves all the time
    - When Bob moves to a new network, he obtains a new address
- Solution directions:
  - Handled purely by applications:
    - Bob can tells Alice about his new IP address from time to time
  - Mobile IP solution
    - Bob set a stationary network as his home network with a permanent IP address to forward Alice’s traffic to Bob’s current IP address

Mobile IP: Indirect Routing

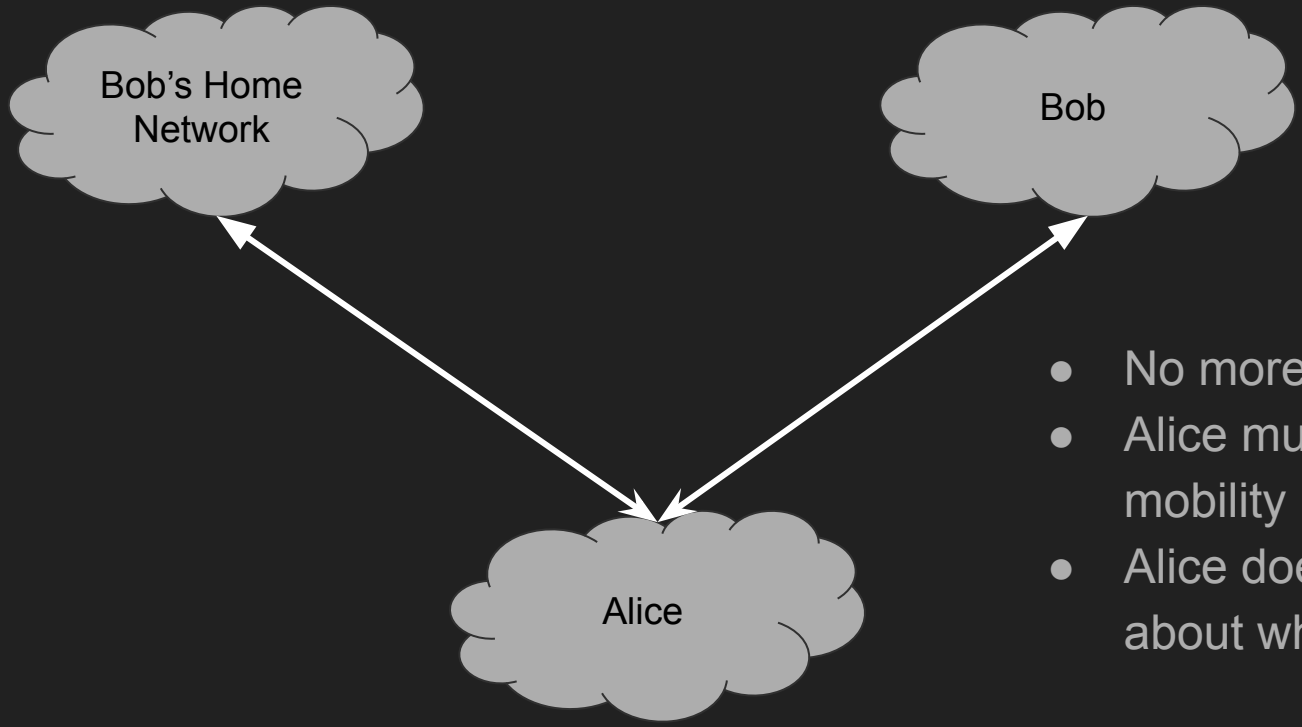


A summary of Mobile IP solution: Indirect Routing

- Alice sends data to the Bob's home agent
  - Source = Alice; destination = Bob's permanent IP
- Bob's home agent tunnels data to Bob
  - Outer IP header: Source = Bob's permanent IP; destination = Bob
  - Inner IP header: Source = Alice; destination = Bob's permanent IP
- Bob tunnels data to Alice
  - Outer header: Source = Bob; destination = Alice
  - Inner header: Source = Bob's permanent IP; destination = Alice

- Supports mobile movement transparently
  - No change to transport protocols, transparent to Alice
  - Cost: **triangle routing**

Mobile IP: Direct Routing



- No more triangle routing
- Alice must handle the mobility logic as well
- Alice does not know about when Bob moves

Collection of Terminologies in Mobile IP

- Home network:
  - Stationary network that the host belongs to
- Home agent:
  - Entity that will perform mobility functions when the host is out of the home
- Permanent address:
  - The IP address assigned to the host in the home network
- Correspondent:
  - The host who wants to contact the host
- Visited network:
  - The network (not home network) that the host resides now
- Care-of-address:
  - The IP address obtained in the visited network (current IP address)
- Foreign agent:
  - Entity that will perform mobility functions in the visited network

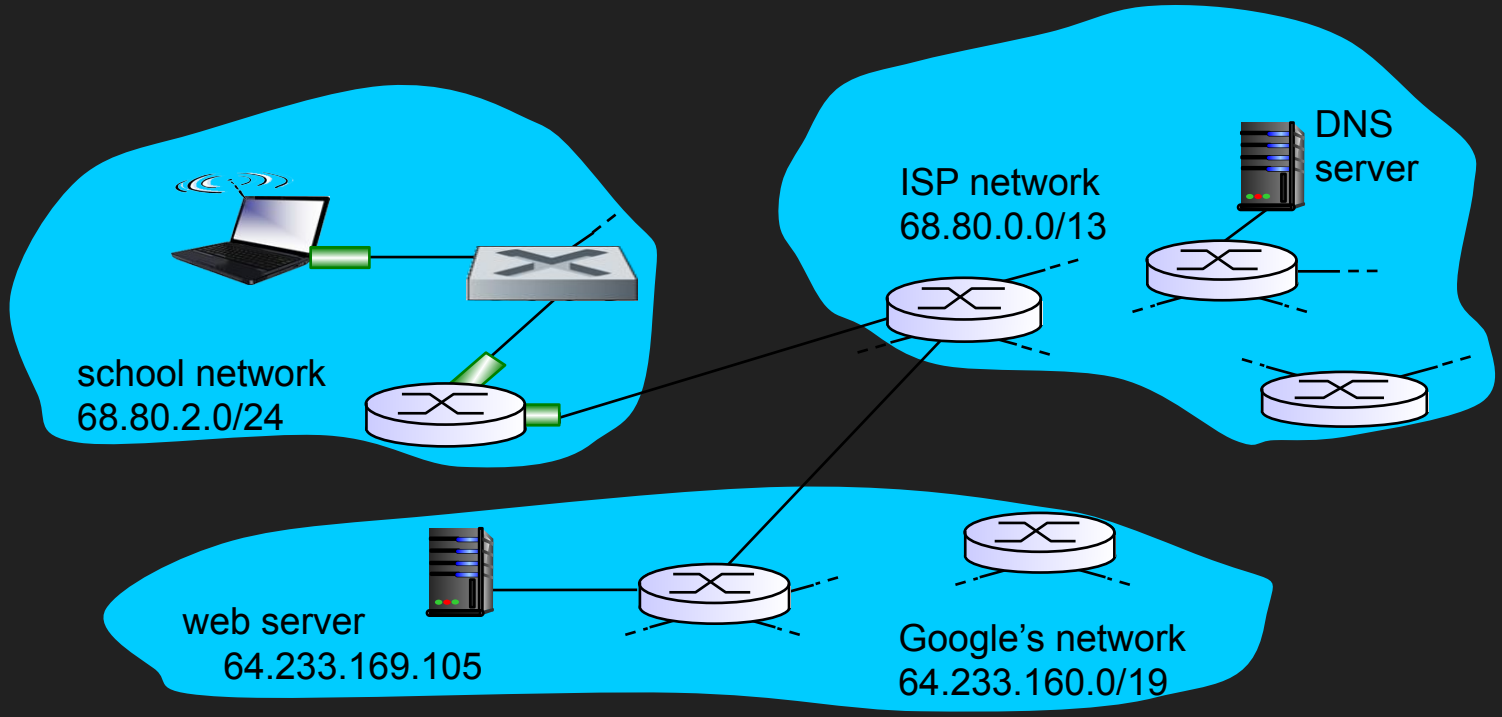
Cellular Network

Cellular Network

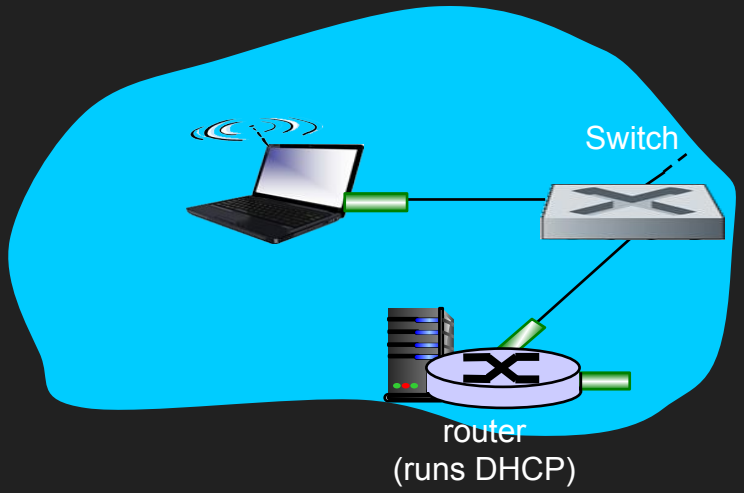
- Wouldn’t talk more here because the material in the lecture slides are solid enough
- Some high level ideas in this discussion
  - More complicated because more functionalities are needed, e.g., voice, data, charging, mobility, collaboration of multiple providers
  - 3G is based on the cellular voice network and thus less efficient and more complicated than later standards
  - After 3G, the structure is clearer and voice and data are unified in the cellular architecture

A day in the life of the Internet

A day in the life: You want to visit Google.com

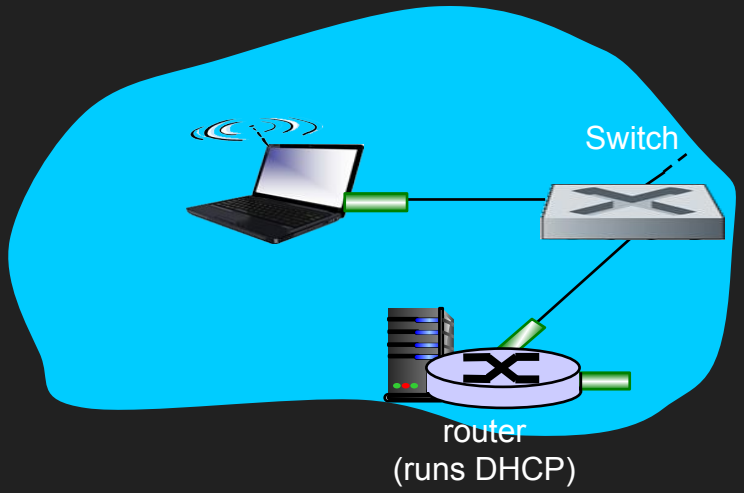


1. Connecting to the Internet with DHCP



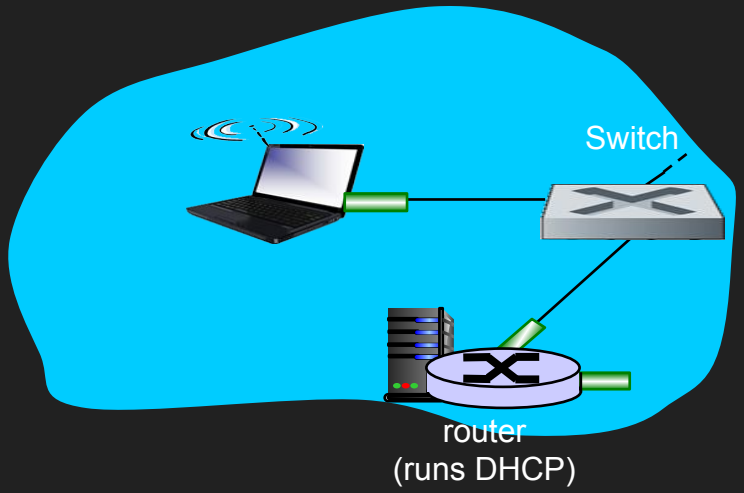
- DHCP request encapsulated in UDP, in IP, in Ethernet
- Broadcast on LAN and received by the DHCP server
  - Switch can learn host's MAC address
- Returned packet demultiplexed to IP, to UDP, to DHCP
- Finally, DHCP server formulates DHCP ACK containing 4 pieces and send back to the host

2. ARP to learn router's interface



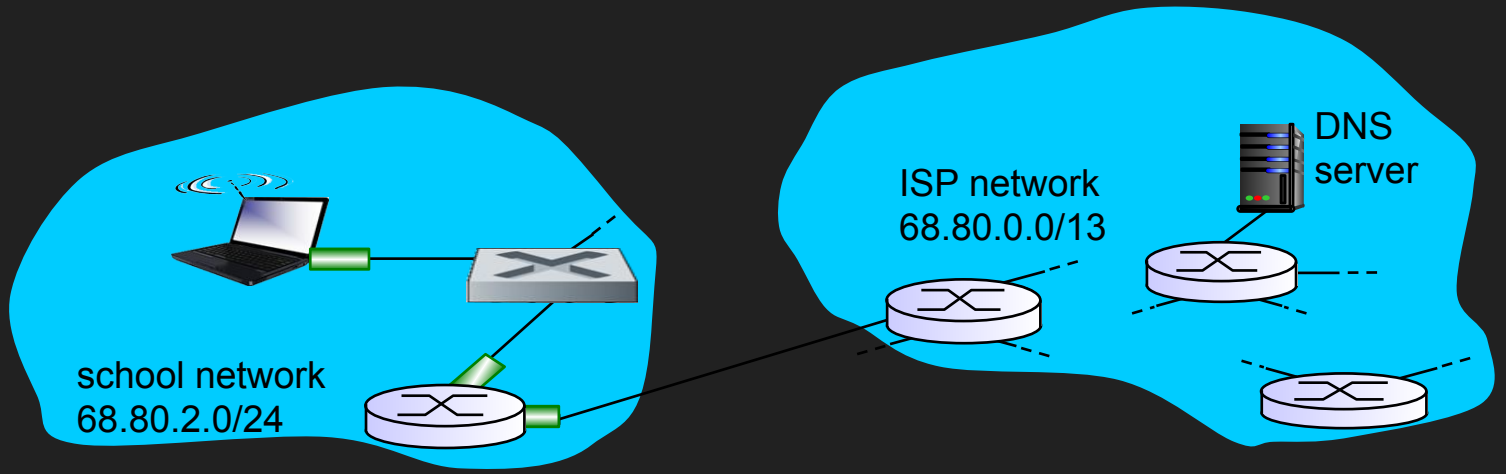
- To know Google.com's IP, you need to send out an DNS query
- Since DNS is not in the local network, you need to send your query out
- To send your query out, you need gateway router's IP (you knew it from DHCP already)
- To send your query to the gateway router's IP, you need gateway router's MAC address
- ARP

3. ARP to learn router's interface (cont'd)



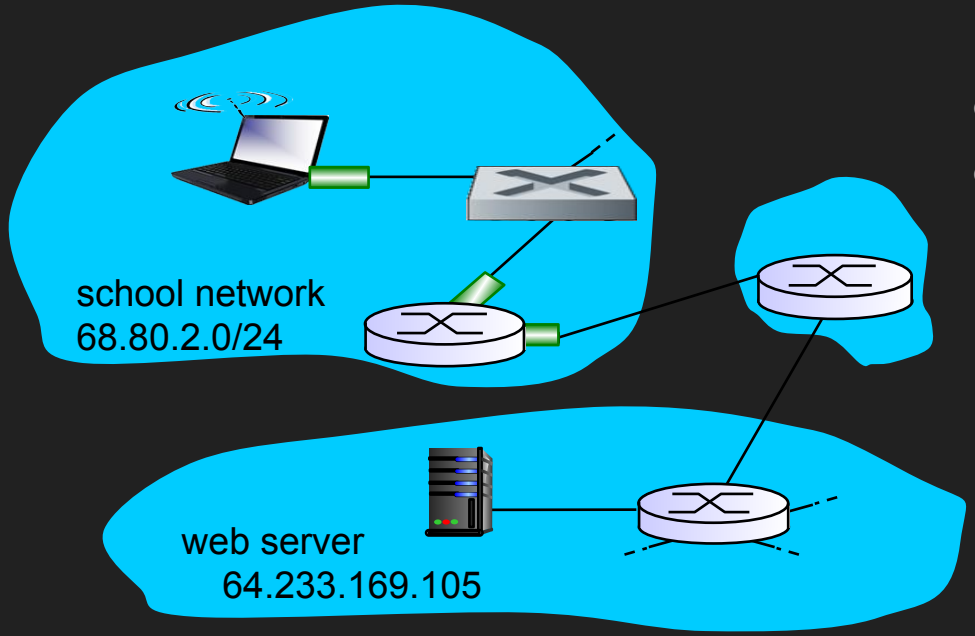
- You broadcast ARP query, which is received by the router
- Router receives the request, replies with the ARP reply containing router's MAC address for that interface

4. DNS



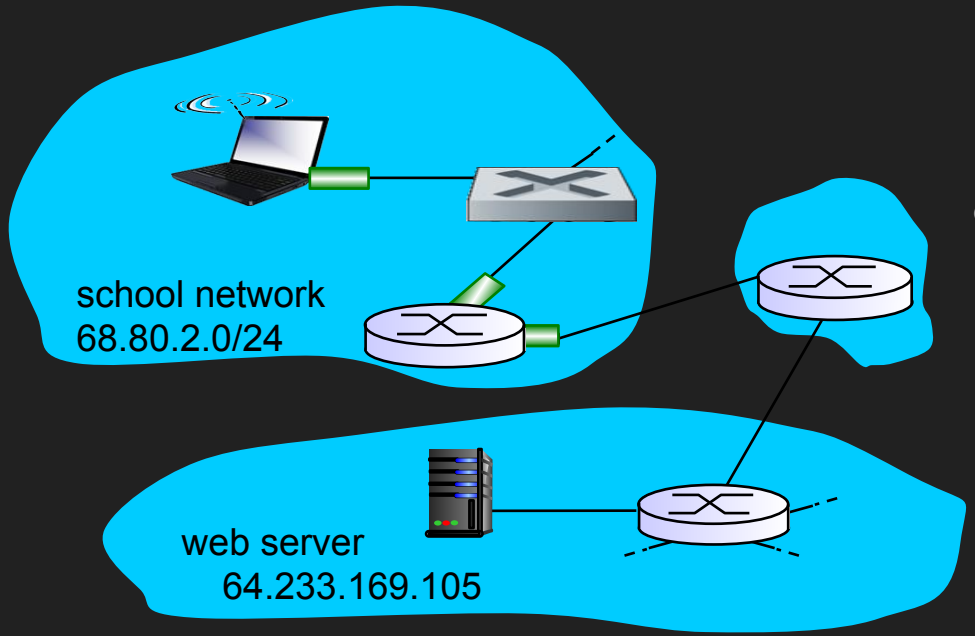
- DNS query will be encapsulated in UDP, IP, Ethernet and then sent to the router
- The router uses the forwarding table to forward the packet to the ISP network
  - Forwarding table created by intra-AS routing protocols (e.g., RIP, OSPF) and/or inter-AS routing protocol (e.g., BGP)
- The router re-encapsulates the packet using the link layer protocol in the next link (MAC addresses changing)

5. TCP



- You send TCP SYN packet to the web server
- Web server replies SYNACK
- You send ACK again to finish the TCP connection

6. HTTP



- You send HTTP GET request to the web server
  - Request will be encapsulated in TCP, in IP, in Ethernet
- Web server responds with HTTP reply