

# Lecture 9

## DHCP and Networking Summary

ELEC 3506/9506  
Communication Networks

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# IP addresses: how to get one?

That's actually **two** questions:

1. Q: How does a *host* get IP address within its network (host part of address)?
2. Q: How does a *network* get IP address for itself (network part of address)

How does *host* get IP address?

- hard-coded by sysadmin in config file (e.g., /etc/rc.config in UNIX)
- **DHCP**: Dynamic Host Configuration Protocol: dynamically get address from as server
  - “plug-and-play”

# DHCP: Dynamic Host Configuration Protocol

**goal:** host *dynamically* obtains IP address from network server when it “joins” network

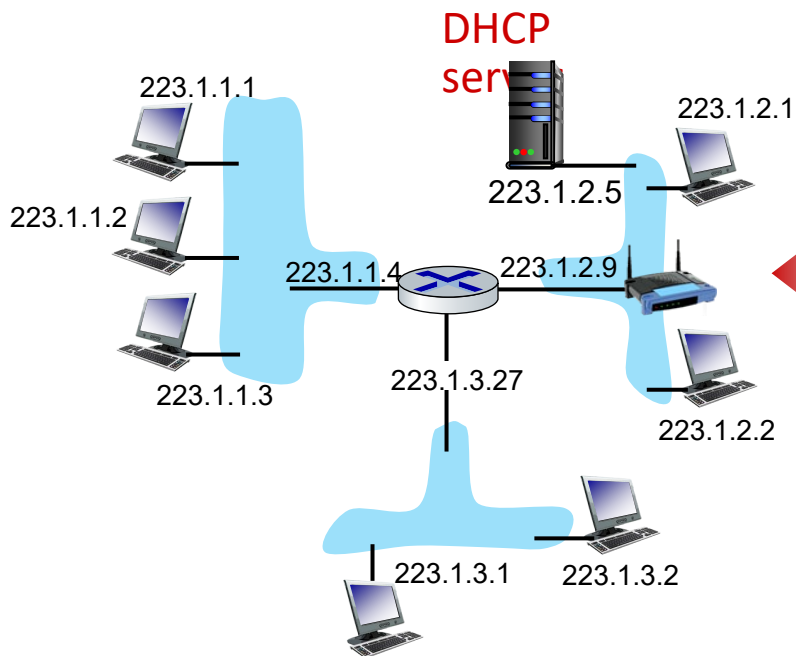
- can renew its lease on address in use
- allows reuse of addresses (only hold address while connected/on)
- support for mobile users who join/leave network

## DHCP overview:

- host broadcasts **DHCP discover** msg [optional]
- DHCP server responds with **DHCP offer** msg [optional]
- host requests IP address: **DHCP request** msg
- DHCP server sends address: **DHCP ack** msg

ARP  $\neq$  DHCP

# DHCP client-server scenario

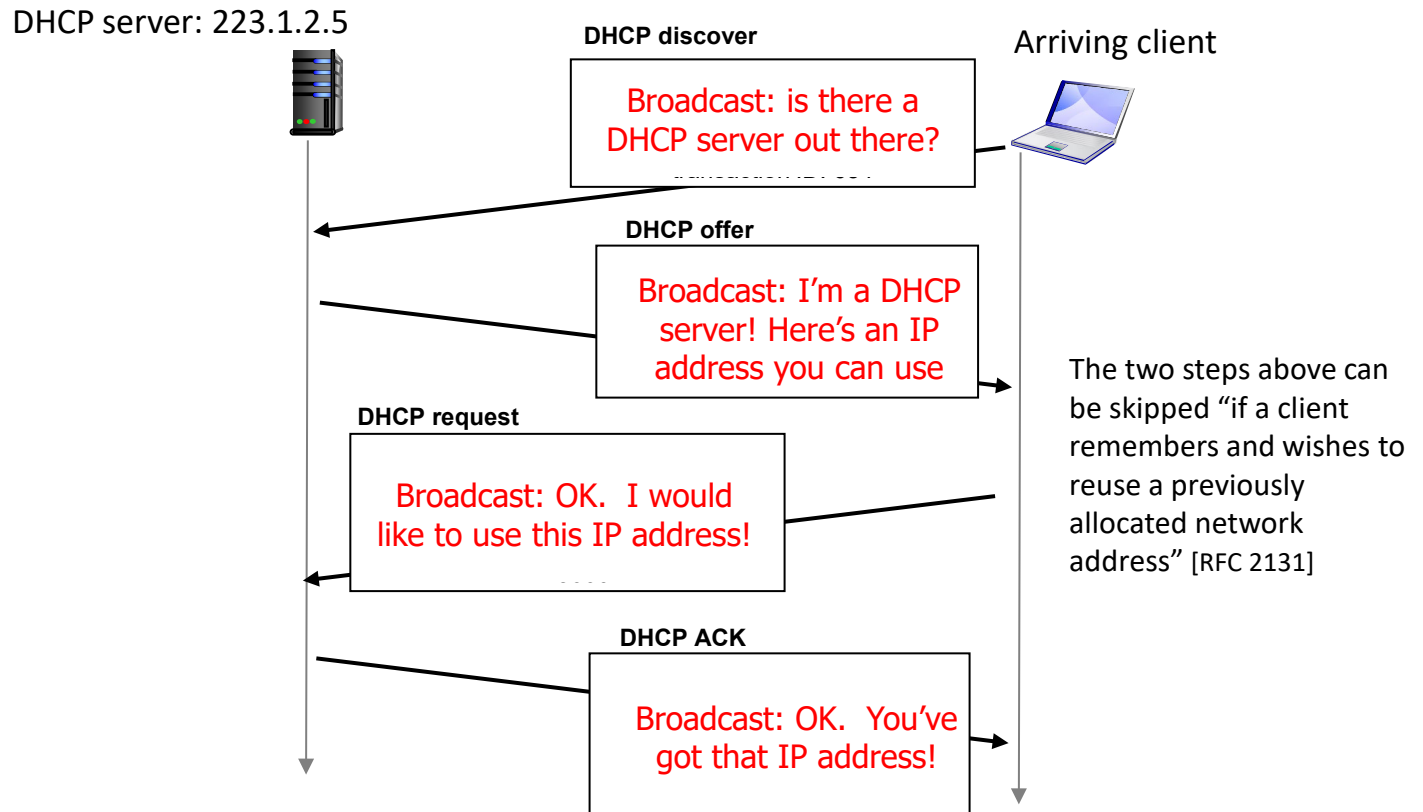


Typically, DHCP server will be co-located in router, serving all subnets to which router is attached



arriving **DHCP client** needs address in this network

# DHCP client-server scenario

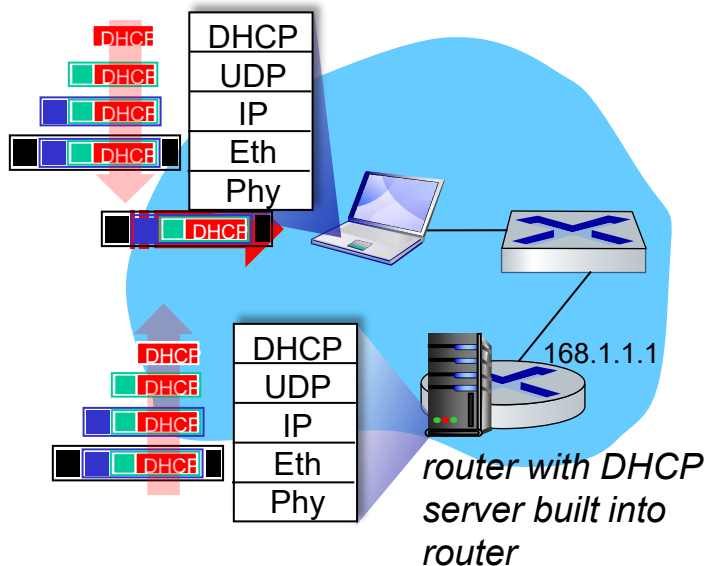


# DHCP: more than IP addresses

DHCP can return more than just an allocated IP address on the subnet:

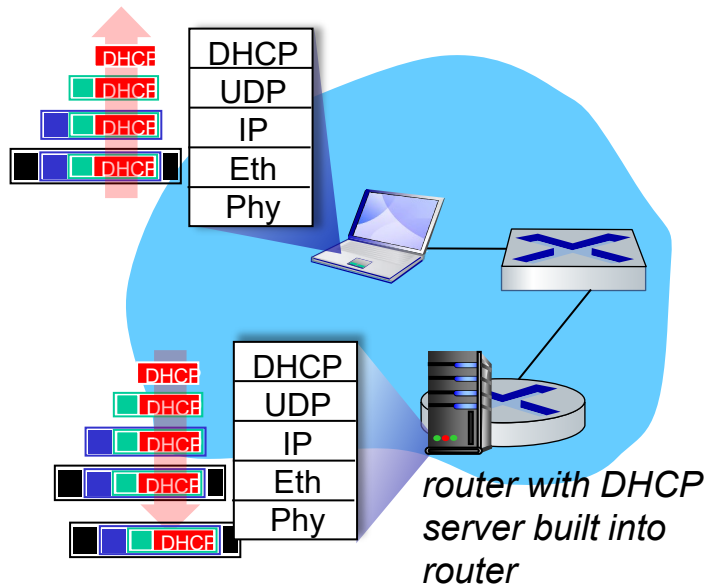
- address of first-hop router for the client (**Gateway Router** for client)
- name and IP address of DNS server
- network mask (indicating network versus host portion of address)

# DHCP: example



- Connecting laptop will use DHCP to get IP address, address of first-hop router, address of DNS server.
- DHCP REQUEST message encapsulated in UDP, encapsulated in IP, encapsulated in Ethernet
- Ethernet frame broadcast (dest: FFFFFFFFFFFFFFFF) on LAN, received at router running DHCP server
- Ethernet demux'ed to IP demux'ed, UDP demux'ed to DHCP

# DHCP: example



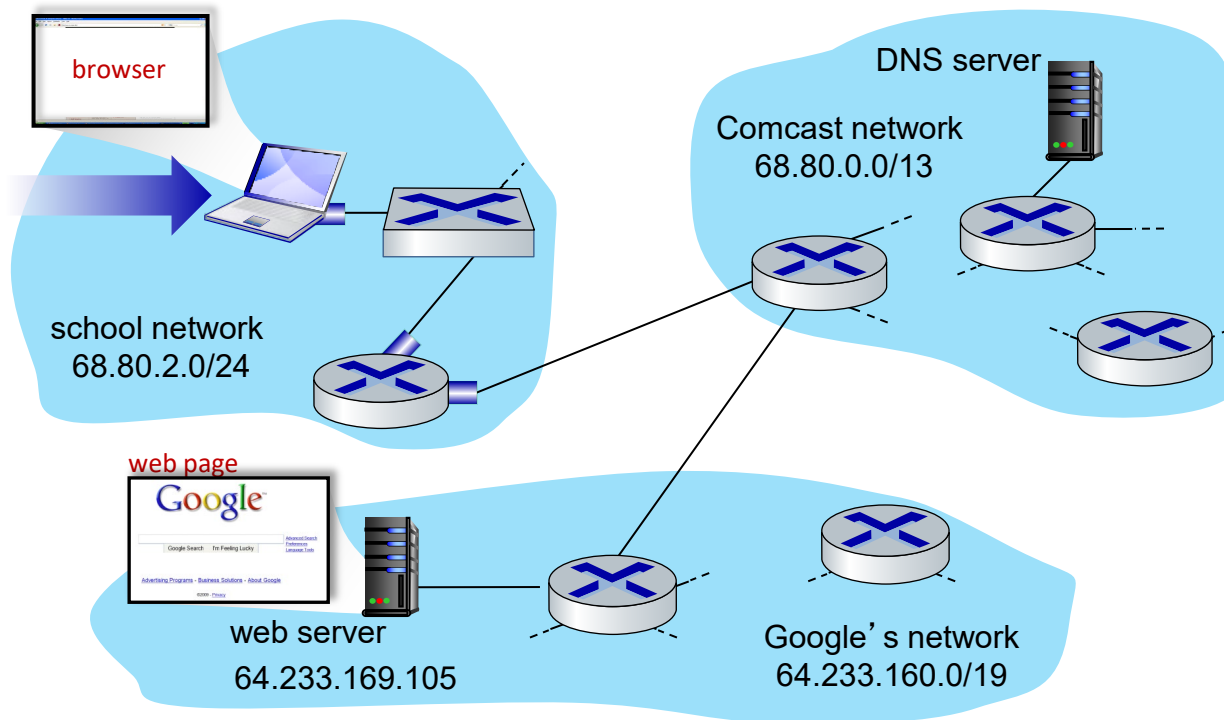
- DHCP server formulates DHCP ACK containing client's IP address, IP address of first-hop router for client, name & IP address of DNS server
- encapsulated DHCP server reply forwarded to client, demuxing up to DHCP at client
- client now knows its IP address, name and IP address of DNS server, IP address of its first-hop router



# Synthesis: a day in the life of a web request

- our journey down the protocol stack is now complete!
  - application, transport, network, link
- putting-it-all-together: synthesis!
  - *goal*: identify, review, understand protocols (at all layers) involved in seemingly simple scenario: requesting www page
  - *scenario*: student attaches laptop to campus network, requests/receives [www.google.com](http://www.google.com)

# A day in the life: scenario

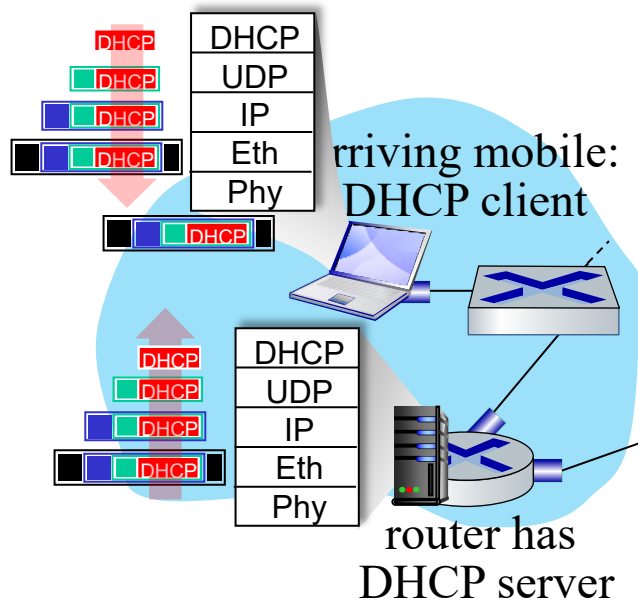


## scenario:

- arriving mobile client attaches to network ...
- requests web page:  
`www.google.com`

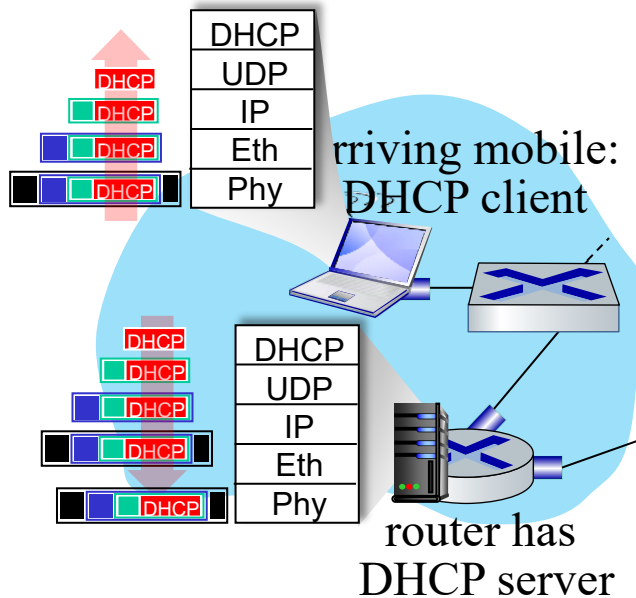
*Sounds simple!* 

# A day in the life: connecting to the Internet



- connecting laptop needs to get its own IP address, addr of first-hop router, addr of DNS server: use **DHCP**
  - DHCP request **encapsulated** in **UDP**, encapsulated in **IP**, encapsulated in **802.3 Ethernet**
    - Ethernet frame **broadcast** (dest: FFFFFFFFFFFFFFFF) on LAN, received at router running **DHCP** server
- Ethernet **demuxed** to IP demuxed, UDP demuxed to DHCP

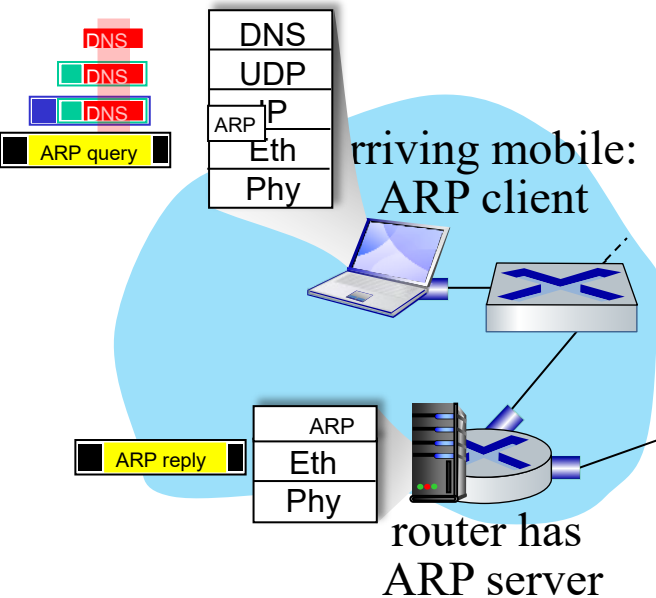
# A day in the life: connecting to the Internet



- DHCP server formulates **DHCP ACK** containing client's IP address, IP address of first-hop router for client, name & IP address of DNS server
  - encapsulation at DHCP server, frame forwarded (**switch learning**) through LAN, demultiplexing at client
- DHCP client receives DHCP ACK reply

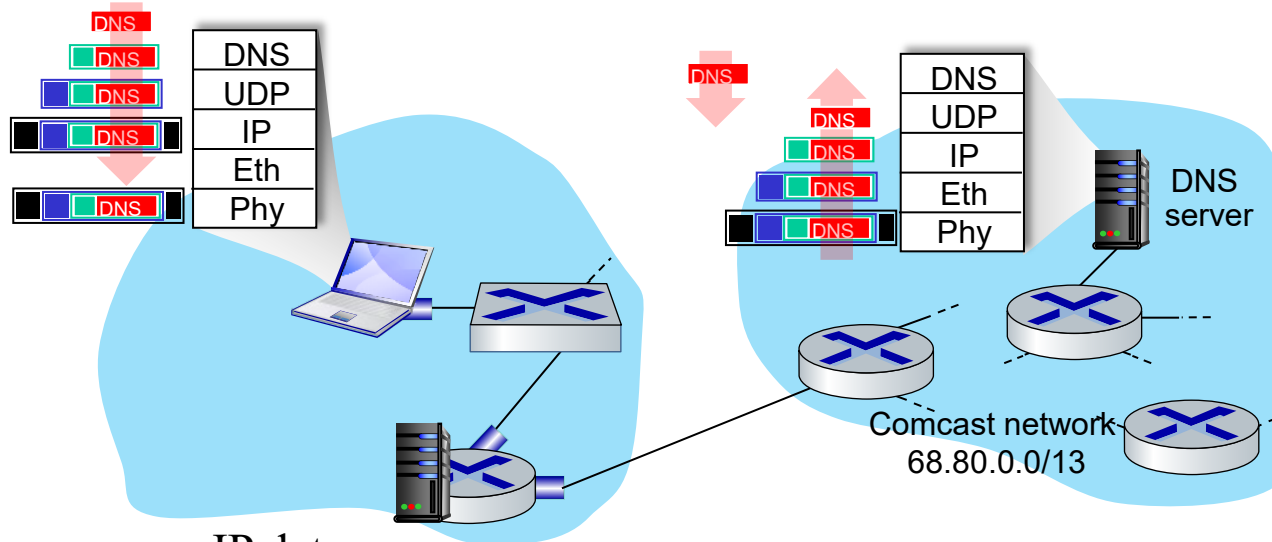
*Client now has IP address, knows name & addr of DNS server, IP address of its first-hop router*

# A day in the life... ARP (before DNS, before HTTP)



- before sending **HTTP** request, need IP address of `www.google.com`: **DNS**
- DNS query created, encapsulated in UDP, encapsulated in IP, encapsulated in Eth. To send frame to router, need MAC address of router interface: **ARP**
- **ARP query** broadcast, received by router, which replies with **ARP reply** giving MAC address of router interface
- client now knows MAC address of first hop router, so can now send frame containing DNS query

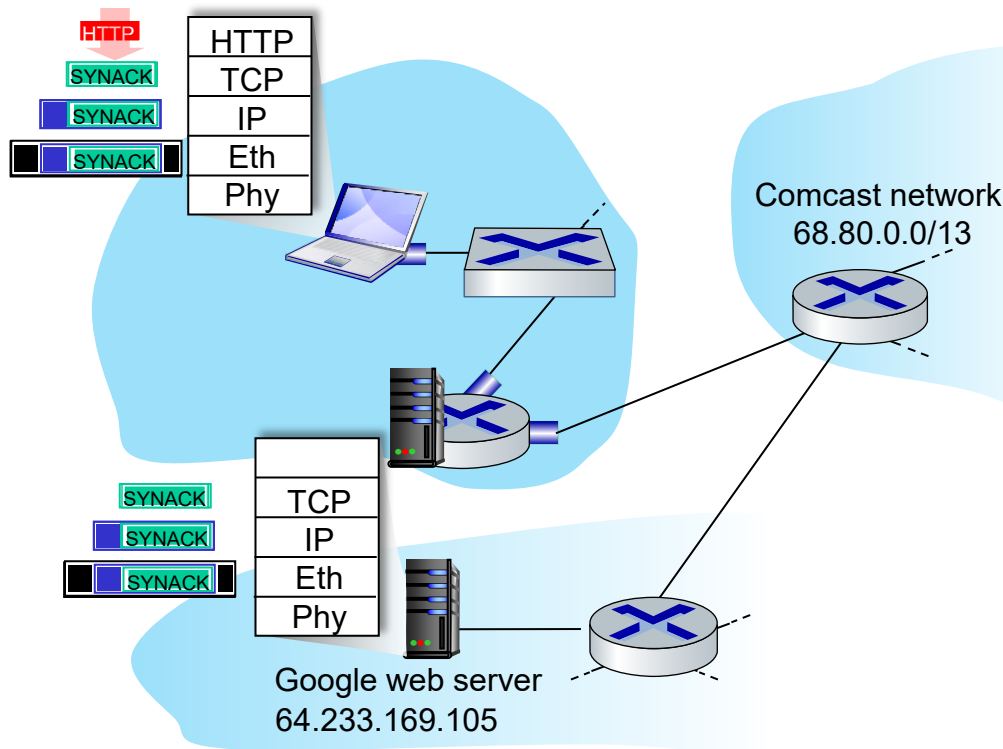
# A day in the life... using DNS



- demuxed to DNS
- DNS replies to client with IP address of [www.google.com](http://www.google.com)

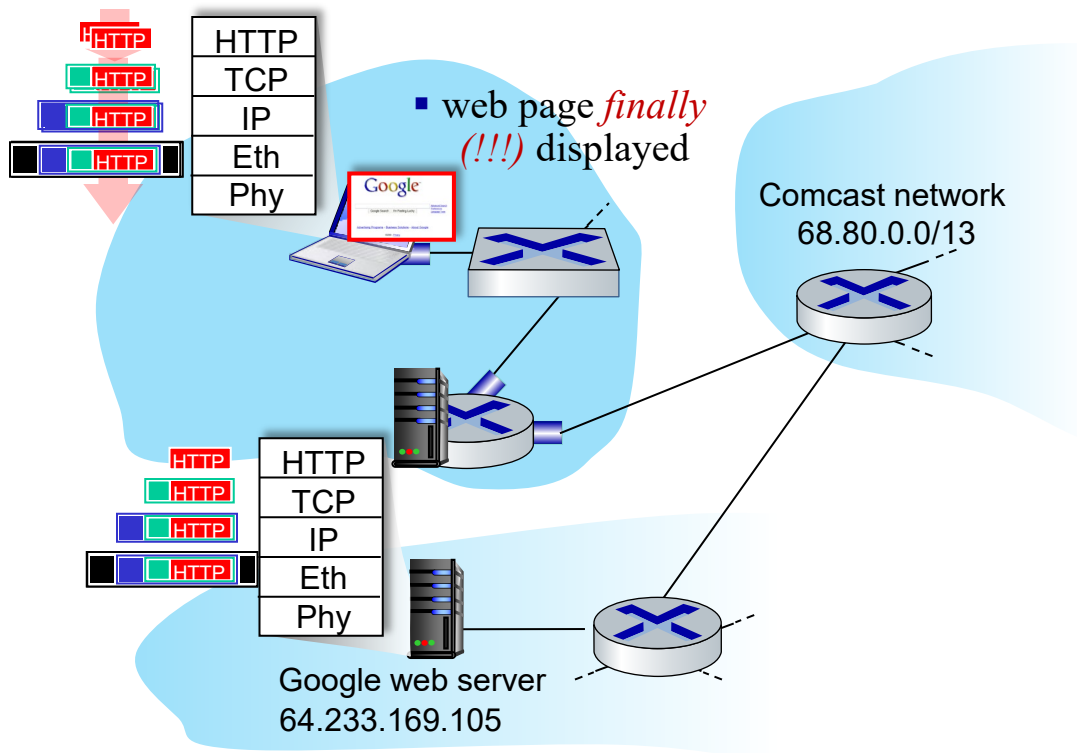
- IP datagram containing DNS query forwarded via LAN switch from client to 1<sup>st</sup> hop router
- IP datagram forwarded from campus network into Comcast network, routed (tables created by **RIP**, **OSPF** and/or **BGP** routing protocols) to DNS server

# A day in the life...TCP connection carrying HTTP



- to send HTTP request, client first opens **TCP socket** to web server
- TCP **SYN segment** (step 1 in TCP 3-way handshake) inter-domain routed to web server
- web server responds with **TCP SYNACK** (step 2 in TCP 3-way handshake)
- TCP **connection established!**

# A day in the life... HTTP request/reply



- **HTTP request** sent into TCP socket
- IP datagram containing HTTP request routed to `www.google.com`
- web server responds with **HTTP reply** (containing web page)
- IP datagram containing HTTP reply routed back to client



# Recommended Reading

- J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach, 8<sup>th</sup> ed., 2022, Chapters 4 and 6