

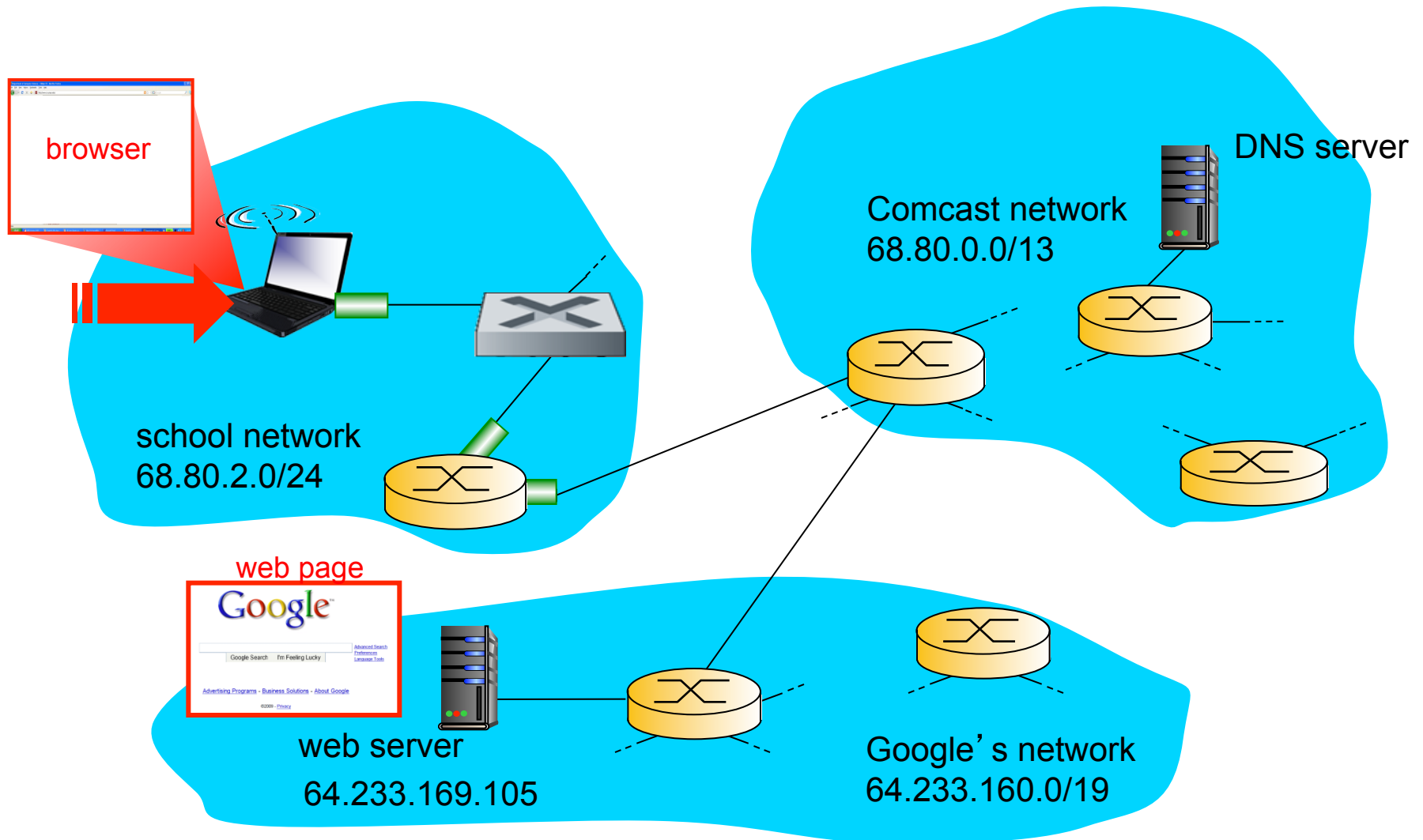
DATA LINK LAYER

Putting it all together

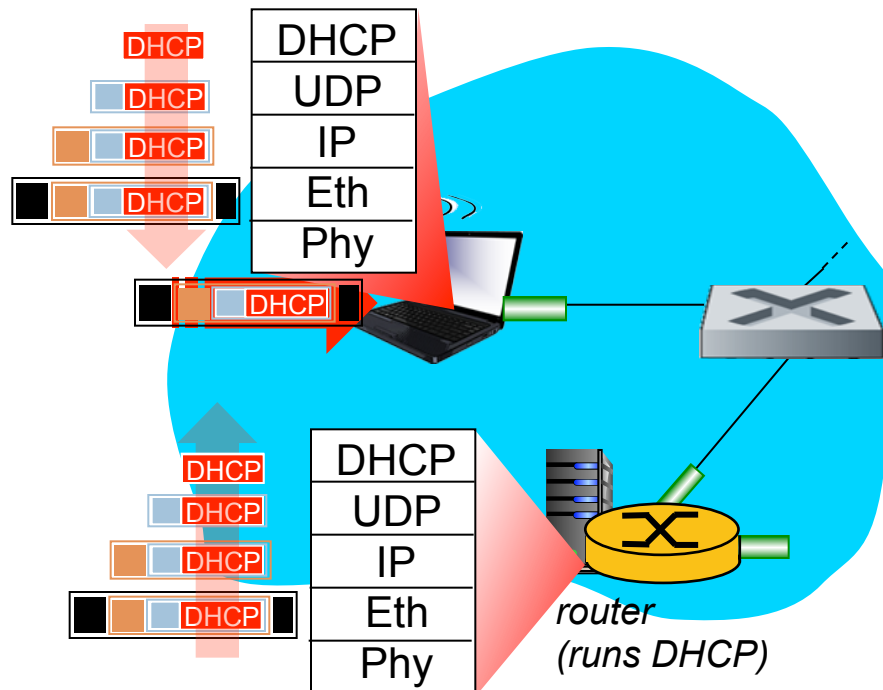
Synthesis: a day in the life of a web request

- journey down protocol stack 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

A day in the life: scenario

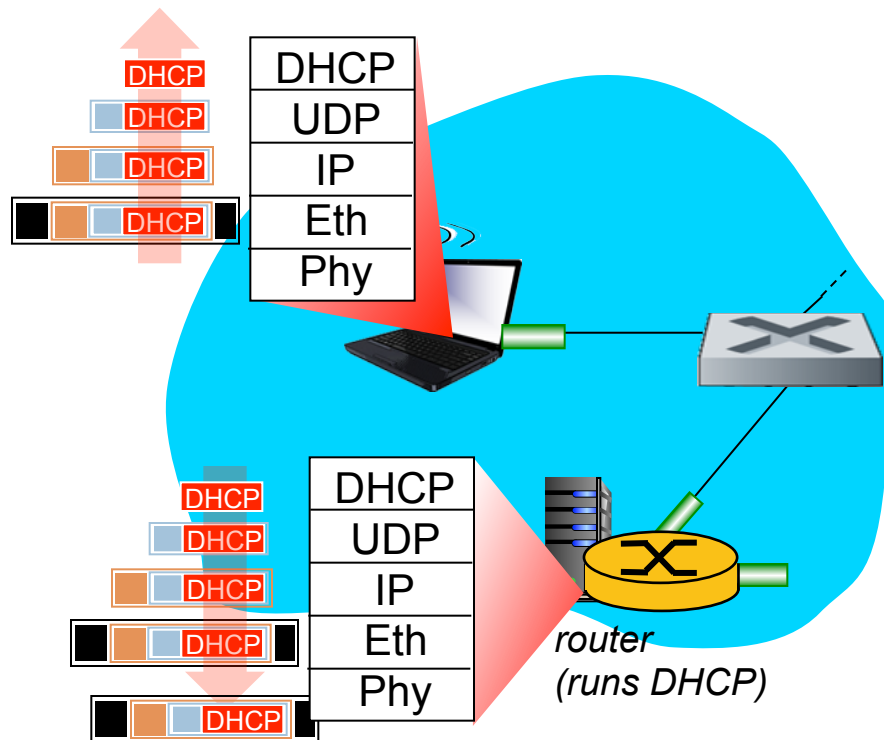


A day in the life... connecting to the Internet



- 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

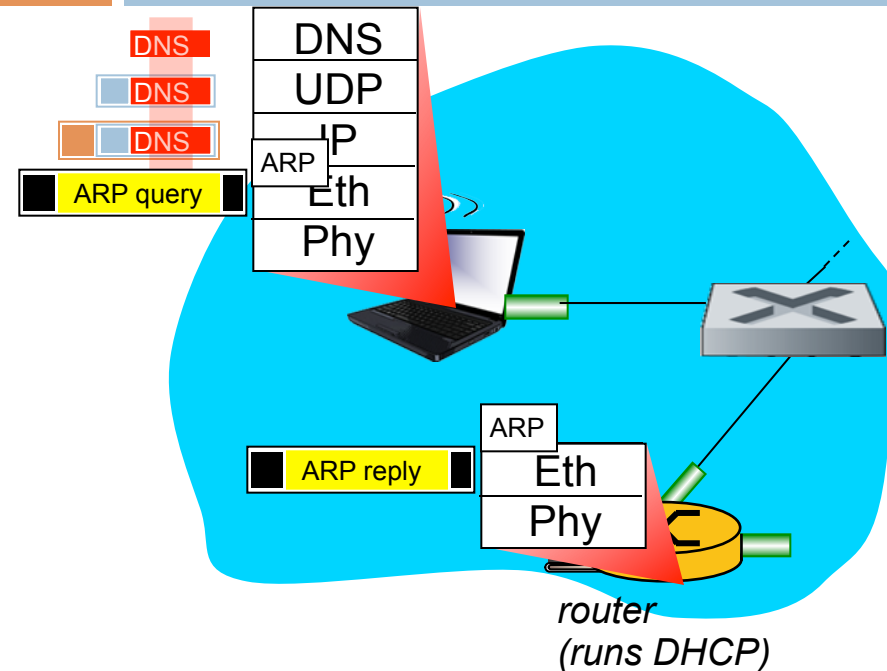
A day in the life... connecting to the Internet



- 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

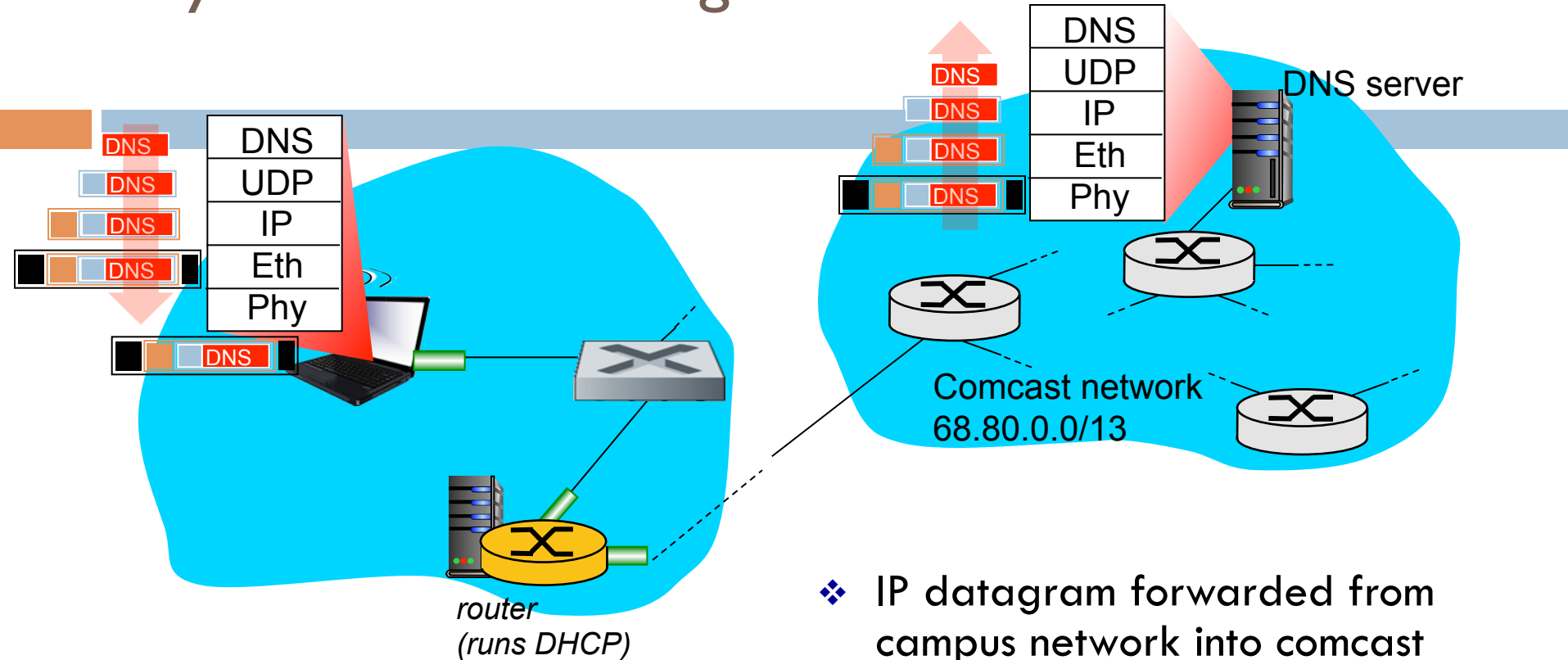
Client now has IP address, knows name & addr of DNS server, IP address of its first-hop router

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

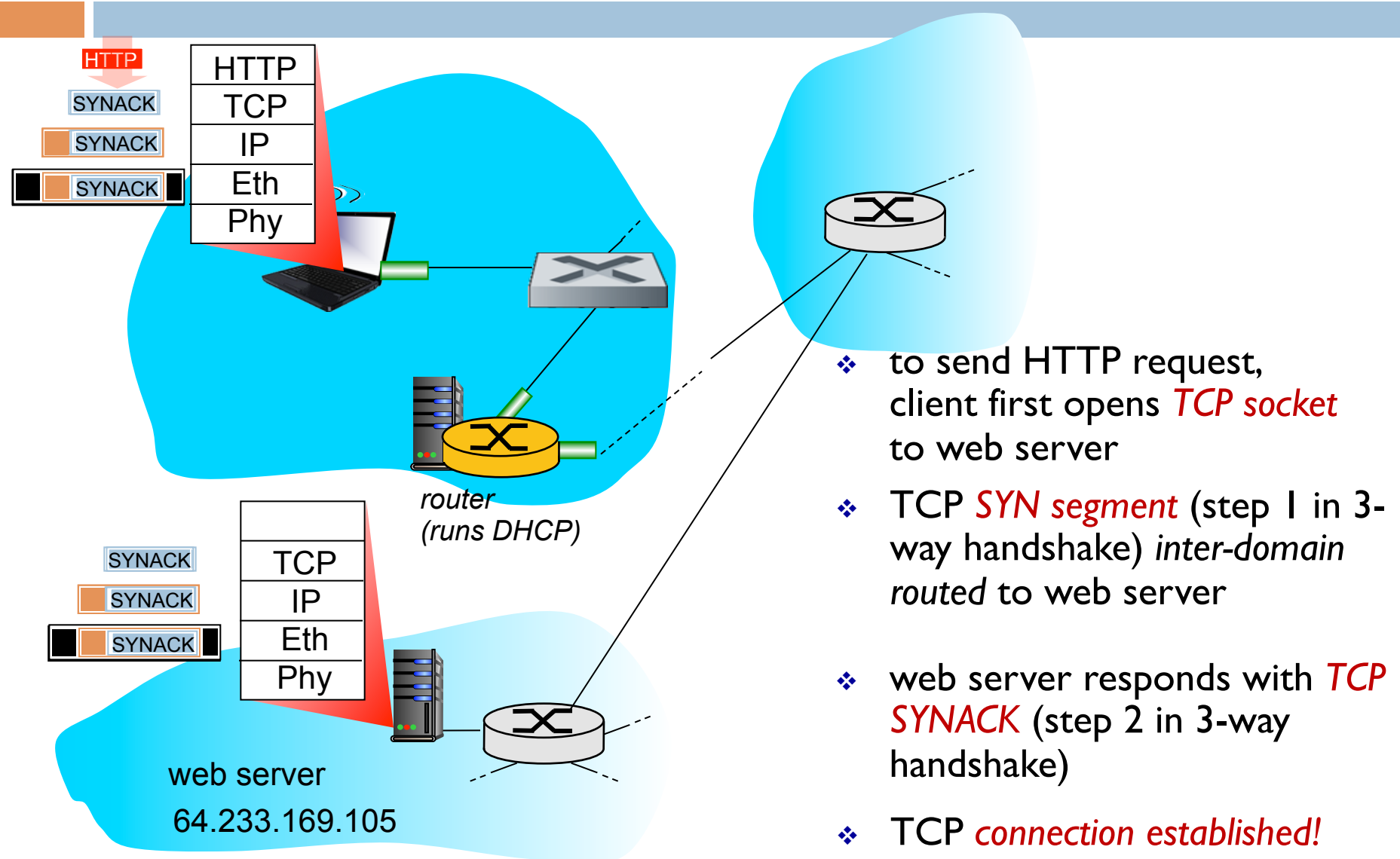
A day in the life... using DNS



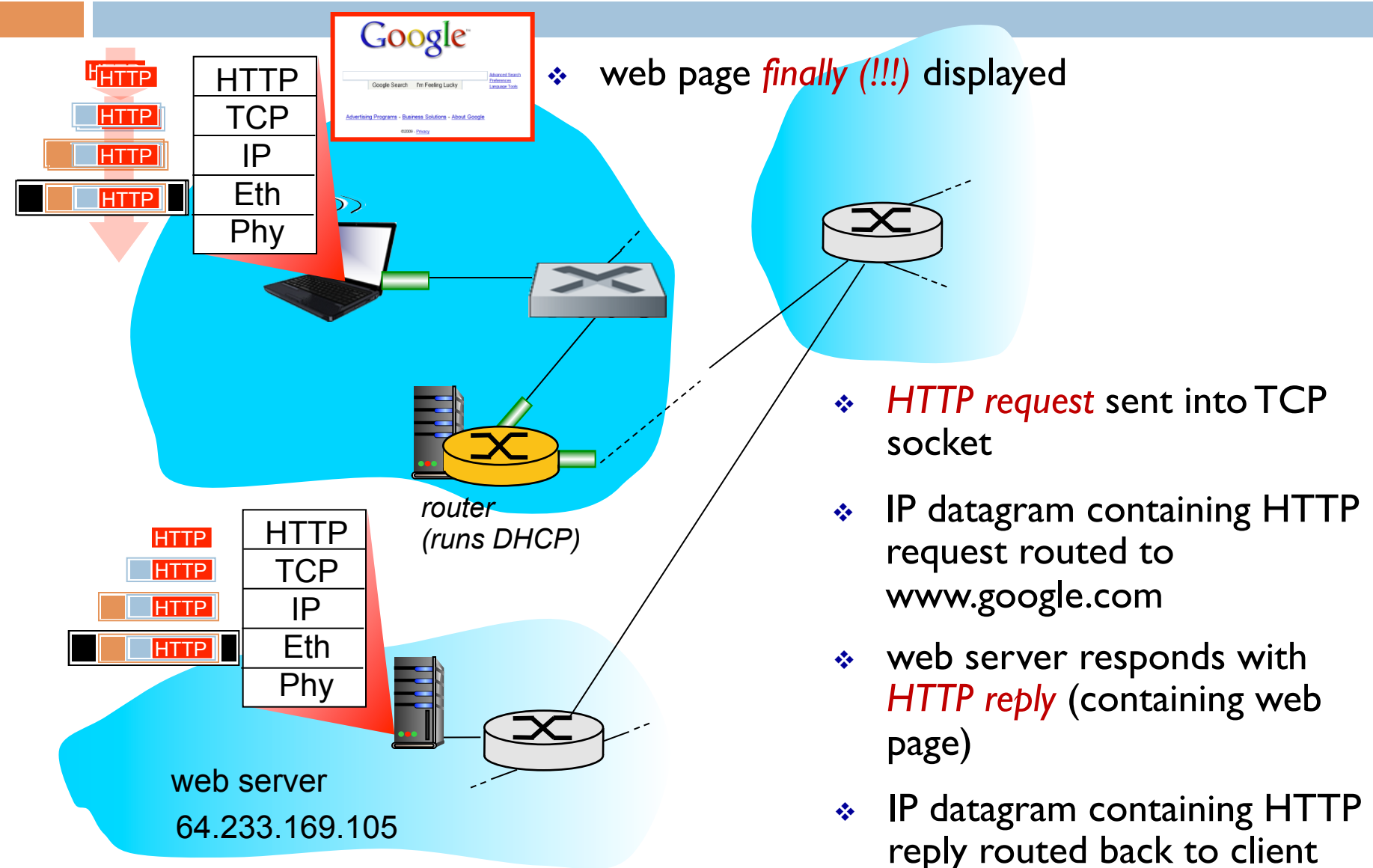
- ❖ IP datagram containing DNS query forwarded via LAN switch from client to 1st hop router

- ❖ IP datagram forwarded from campus network into comcast network, routed (tables created by *RIP*, *OSPF*, *IS-IS* and/or *BGP* routing protocols) to DNS server
- ❖ demux'ed to DNS server
- ❖ DNS server replies to client with IP address of www.google.com

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



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



Summary

- principles behind data link layer services:
 - ▣ error detection, correction
 - ▣ sharing a broadcast channel: multiple access
 - ▣ link layer addressing
- instantiation and implementation of various link layer technologies
 - ▣ Ethernet
 - ▣ switched LANS, VLANs
 - ▣ virtualized networks as a link layer: MPLS
- synthesis: a day in the life of a web request