Review of Protocols

Comcast network 68.80.0.0/13

Google’s network 64.233.160.0/19

web server 64.233.169.105

DNS server

school network 68.80.2.0/24

web page

browser
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: FFFFFFFFFFFFFF) on LAN, received at router running **DHCP server**

- Ethernet demuxed to **IP** demuxed, UDP demuxed to **DHCP**
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

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

- web page finally (!!!) displayed

- 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

web server 64.233.169.105

HTTP request/reply diagram:
- 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