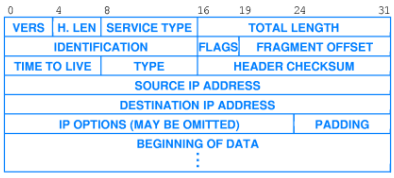
IP Datagram and Support Protocols

Info 341 Networking and Distributed Applications

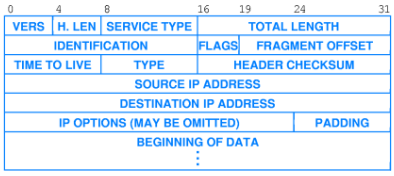
IP Datagrams

- Datagram
  - Term for basic IP packet
  - Variable size
  - Get broken up into smaller packets with header information in each packet



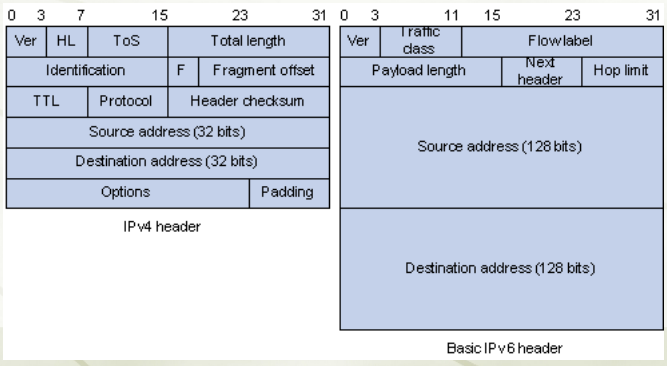
IP Datagrams

- Sample Header Fields
  - VERS – (4 bits) version (IPv4)
  - LENGTH – (16 bits)
  - TIME TO LIVE – (8 bits) count down counter
  - TYPE – (8 bits) the type of the protocol packet
  - SOURCE IP ADDRESS - (32 bits)
  - DESTINATION IP ADDRESS - (32 bits)



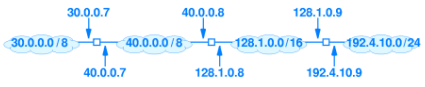
IPv6 Header

- Slightly different fields



Forwarding IP Packets

- Routers use addresses and network masks to determine where to send the packet
- Example, network and routing table for middle router



(a)

Destination	Mask	Next Hop
30.0.0.0	255.0.0.0	40.0.0.7
40.0.0.0	255.0.0.0	deliver direct
128.1.0.0	255.255.0.0	deliver direct
192.4.10.0	255.255.255.0	128.1.0.9

(b)

Routers Connect Different Networks

- What happens when a router connects two networks where the physical frame size is different?
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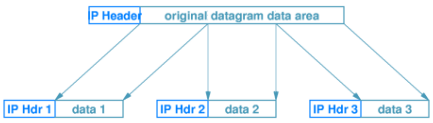
  - MTU are different sizes
  - IP Datagram Fragmentation



IP Support Protocols

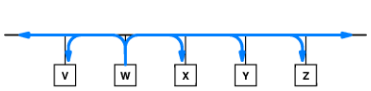
- ARP
- ICMP
- DHCP
- NAT

Address Resolution Protocol (ARP)

- ARP solves the problem of associating physical MAC addresses with Internet Protocol (IP) addresses
- ARP is a Network Access layer protocol, just above the Physical layer

Basic ARP

- ARP provides a mechanism for one device to discover the MAC address of another device when all you know is an IP address
  - ARP works by sending a "broadcast" packet
  - Every machine receives that packet and the Network Access layer processes it and checks it if is 'this' device.



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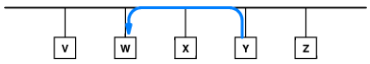
  - If it is, 'this' device responds with a packet giving the requesting machine 'this' devices' MAC address



ARP Frame Format

- ARP must be encapsulated in an Ethernet frame

Dest. Address	Source Address	Frame Type	Data In Frame	
		806	complete ARP message	CRC

0	8	16	24	31
HARDWARE ADDRESS TYPE		PROTOCOL ADDRESS TYPE		
HADDR LEN	PADDR LEN	OPERATION		
SENDER HADDR (first 4 octets)				
SENDER HADDR (last 2 octets)		SENDER PADDR (first 2 octets)		
SENDER PADDR (last 2 octets)		TARGET HADDR (first 2 octets)		
TARGET HADDR (last 4 octets)				
TARGET PADDR (all 4 octets)				

Internet Control Message Protocol (ICMP)

- A protocol for helping to understand the status of the network
- Set of over 20 types of control messages, but only a small number are used regularly
- What are some examples?

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- What are some examples?
  - ping (request)
  - ping (response)
  - traceroute

DHCP

- DHCP - Dynamic Host Configuration Protocol
  - On boot-up the machine broadcasts a request for an IP address
  - If a DHCP server is listening on that network, it will assign an IP address
  - DHCP can be configured to just give an address at random from a pool of available addresses, or it can be setup to supply the same address all the time to a particular MAC address like BOOTP

Additional DHCP info

- DHCP uses the concept of a lease that can be renewed or that can timeout after a specified time period
- DHCP is the dominant protocol used today for dynamic assignment of addresses
- DHCP does not require a static list of MAC addresses
- Most commercial ISP's use DHCP for address assignment.

Advantages of DHCP

- DHCP makes it easier to setup your machine if you move from place to place. In a static assignment, your address is very much tied to the physical topology of your network.
  - The iSchool network was assigned the addresses 128.208.100.x
  - CS has the addresses 128.95.1.x.
  - So what happens if I have a laptop and want to move from the iSchool network to the CS network?

NAT

- Network Address Translation
  - Allow many machines with private IP addresses to masquerade as one routable host
  - Map outgoing and incoming traffic based on IP address of sender/receiver
  - Has a problem

NAPT

- Network Address and Port Translation
  - Relies on IP address and protocol port numbers for each sender/receiver pair to fix the mapping

Some Tools

Linux/Mac OS

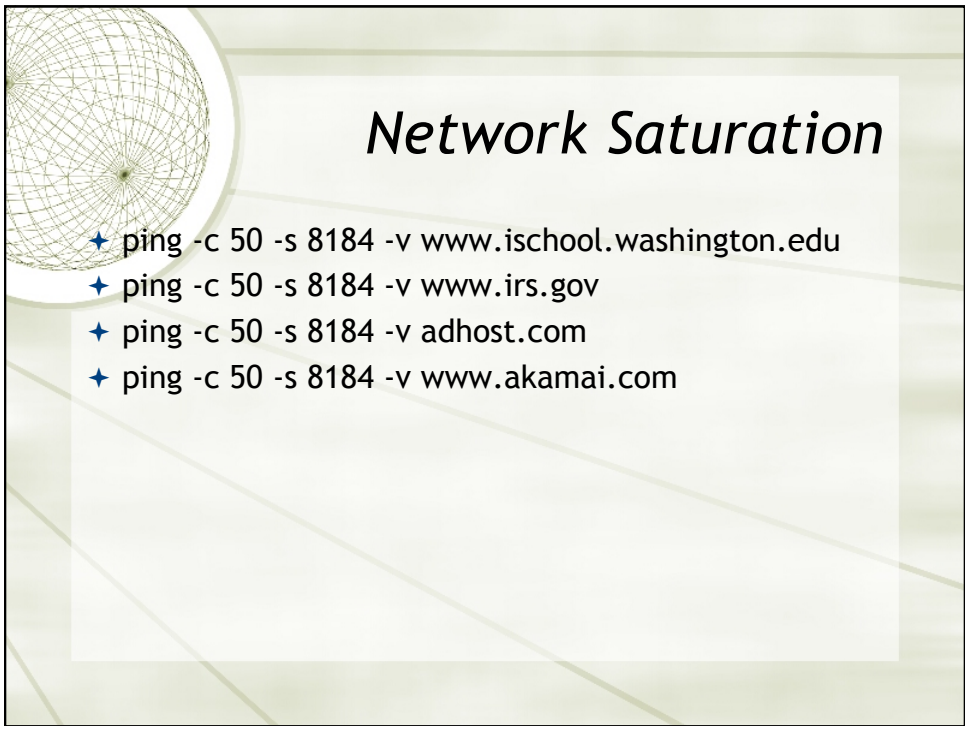
- ping
- ifconfig
- nslookup
- tcpdump
- traceroute
- netstat

Windows

- ping
- ipconfig
- WinDump

Configuration

- ifconfig (linux/mac), ipconfig (windows)


Network Saturation
ping -c 50 -s 8184 -v www.ischool.washington.edu
ping -c 50 -s 8184 -v www.irs.gov
ping -c 50 -s 8184 -v adhost.com
ping -c 50 -s 8184 -v www.akamai.com