

Lecture 16 - Internet Protocol (IP)

Exercise 1: What is the difference between IP and "The Internet"? Does a network using IP have to be on the Internet?

Does someone using the Internet have to use IP?

→ no, can have private networks

→ yes, at least to route packets.

IP - protocol, older

The Internet - network, newer

Exercise 2: What is the value of the first byte of an IP packet that uses the shortest possible header? If first byte is 0x46, what is the length of the Options field in bytes?

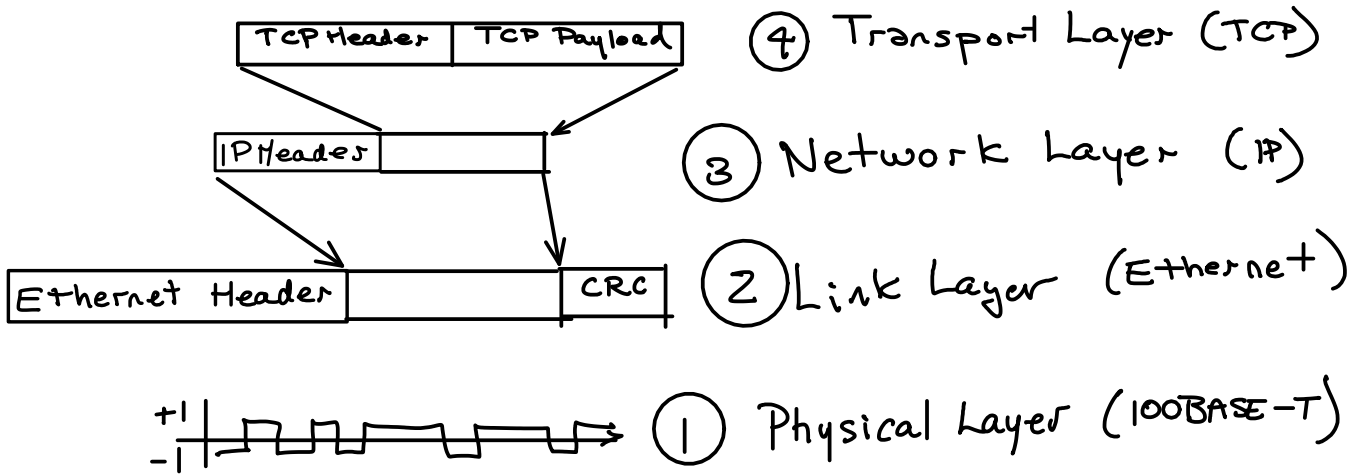
first byte is $\left. \begin{array}{l} \text{Version} = 4 \\ \text{IHL} = 5 \end{array} \right\} = 0x45$

if 0x46

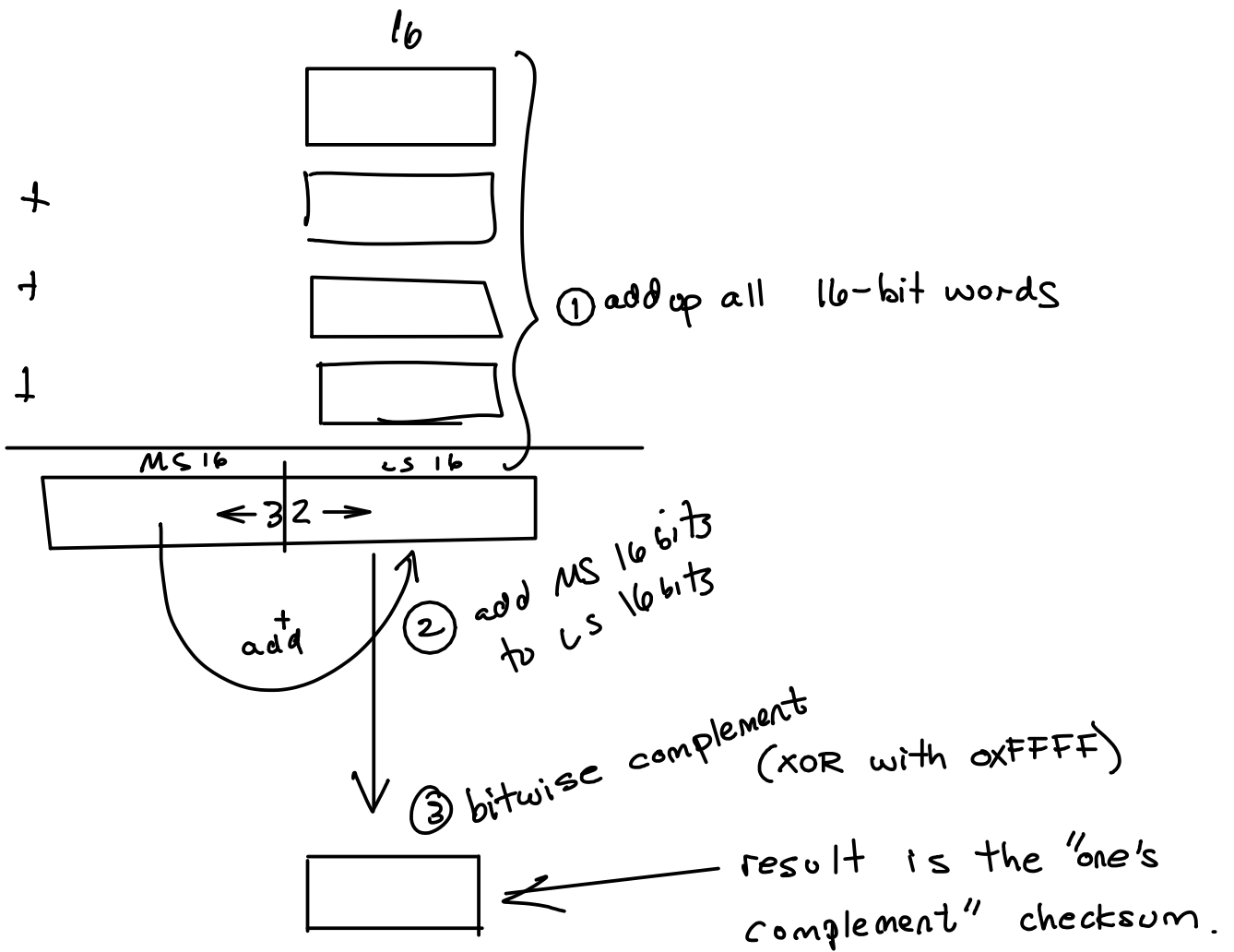
IHL = 6

∴ have $(6 - 5) \times 4$ bytes of options
total non-option words.

Protocol Layers

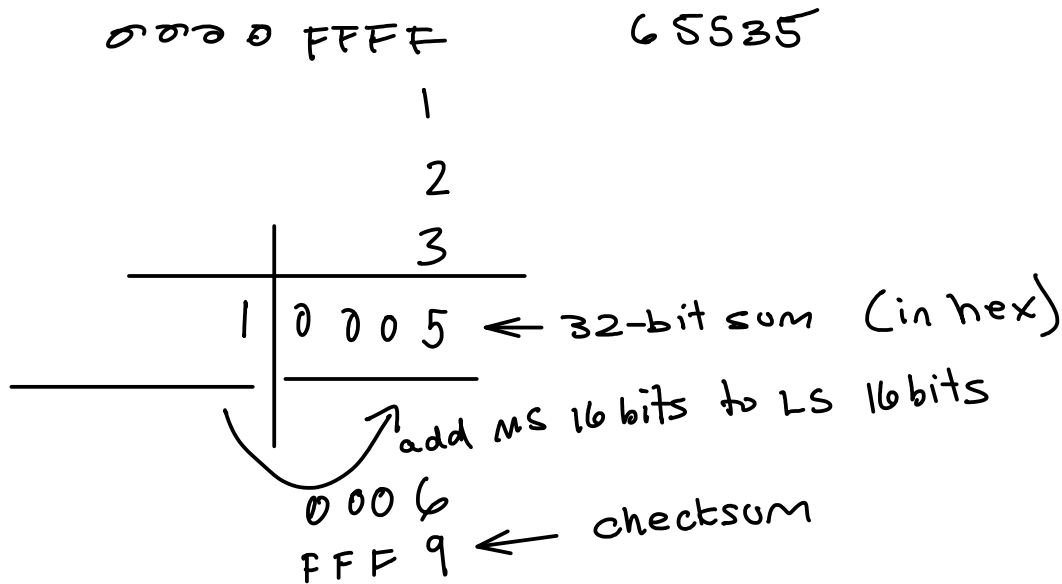


IP (One's Complement) Checksum Algorithm:

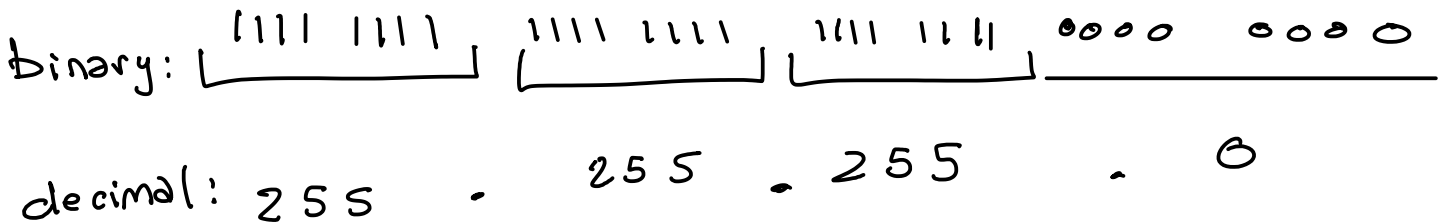


Exercise 3: A protocol header contains four 16-bit fields with decimal values 65535, 1, 2, and 3 that are to be included in an IPv4 checksum. What is the value of the header checksum?

$$2^{16} - 1$$



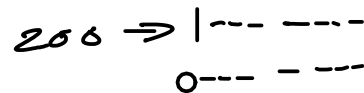
Exercise 4: What is the netmask in binary for a /24 network? What is it in decimal? How can the netmask be used to determine if one IP address is on the same network as another? Is the address 192.168.2.200 in the 192.168.2.0/25 network?



192.168.2.200

192.168.2.0 /25 network

255.255.255.128 — netmask.



(address AND N.Mask) $\stackrel{?}{=}$ network address

No. compare

example: $\left(\frac{192.168.2.200 \text{ AND } 255.255.255.128}{192.168.2.128} \right) \stackrel{?}{=} 192.168.2.0$
 $\stackrel{?}{=} 192.168.2.0 ?$ No.

Exercise 5: Who "owns" the 24.80.0.0/13 network?

Show

Exercise 6: For the routing table above, what port ("Interface") would be used by packets with the following destination IP addresses: 127.0.0.255? 192.168.1.1? 192.168.2.1?

204.191.10.32? → vlan1
→ lo → br0 → vlan1 (default)

Destination	Gateway	Subnet Mask	Metric	Interface
192.168.1.0	*	255.255.255.0	0	br0 (LAN)
204.191.0.0	*	255.255.0.0	0	vlan1 (WAN)
127.0.0.0	*	255.0.0.0	0	lo
default	204.191.1.1	0.0.0.0	0	vlan1 (WAN)

Exercise 7: What pairs of values are stored in an ARP cache?
What addresses from a received packet need to be examined to validate an ARP cache entry?

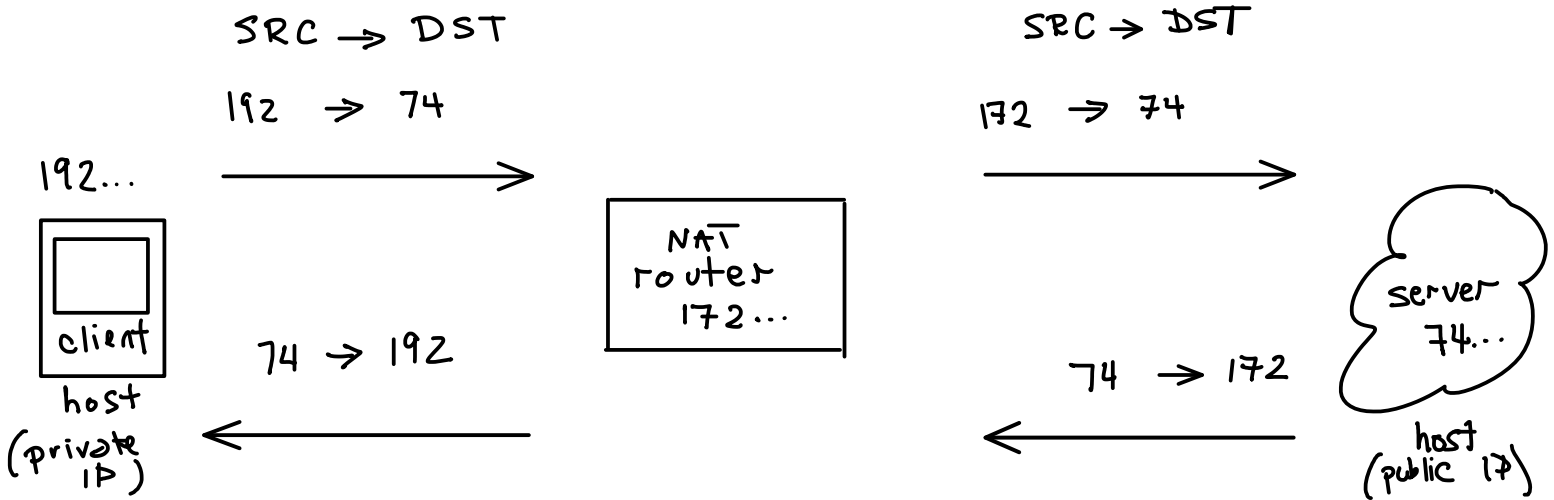
ARP cache stores IP address & MAC address pairs.
have to compare source IP & MAC addresses
(destination address is usually yourself!).

Exercise 8: When a host boots up, what must it send out first,
an ARP request or a DHCP request?

DHCP is a broadcast so ARP not required.

Exercise 9: A host with a (private) address 192.168.1.10 is behind a NAT router with an (public) address of 172.12.192.15. The host sends a frame to a host at address 74.125.225.113 requesting a web page. Show the source/destination address pairs of the request and response frames on the private and public sides of the router.

abbreviate: 192 = 192.168.1.10
 172 = 172.12.192.15
 74 = 74.125.225.113



Exercise 10: Can a host's DNS server be configured using a host name? Why or why not? Assuming a host has an empty DNS cache, what queries would it generate to look up the IP address of the host mx.bcit.ca?

① No. To reach the DNS server we need its IP address, but we can't get it without access to the DNS server.

② A recursive DNS query would require the following queries to look up mx.bcit.ca:

- ① query the root DNS server for the IP address of the DNS server for ".ca"
- ② query the DNS server for "ca" for the IP address of the DNS server for "bcit.ca"
- ③ query the DNS server for "bcit.ca" for the IP address of "mx.bcit.ca"