

Chapter 3 Exercises:

33) IP addresses have network different parts; they are hierarchical. One part of the address corresponds to the network interface and one part corresponds to the host. If an IP address had addresses for each host, we wouldn't be able to route IP messages because a router just looks for the network part, not the specific host part. Sending the message from the network to the host is done after the router has done its job.

Point to point communication with non-unique addresses is tolerated because the message will be sent over a physical link, rather than routing.

34) The maximum IP packet size fits in 2^{16} bits, and the offset is 2^{13} bits. The offset is 3 bits shorter, and 2^3 is 8. Every fragment except for the last one must hold a multiple of 8 bytes of data, to account for the difference between the length and the offset.

36) We have two networks: N1 and N2. First network has MTU of 1024 bytes. Second has MTU of 576 bytes. 20 bytes of TCP header is passed to IP. We have 1024 bytes of data to send, plus the TCP header, plus the IP header = 1064 bytes of data to be sent total. The IP datagram to be sent will be 1044 bytes.

- a. First fragment from N1: **Size:** 1000 bytes **Offset:** 0
- b. Second fragment from N1: **Size:** 24 bytes, **Offset:** $1000/8 = 125$
- c. At N2, we need to fragment the first fragment from N1:
 - i. First fragment into N2: **Size:** 552 bytes, **Offset:** 0
 - ii. Second fragment into N2: **Size:** 448 bytes, **Offset:** $552/8 = 69$
- d. At N2, the second fragment of 44 bytes doesn't need to be fragmented. **Size:** 24 bytes. **Offset:** 125

40) Ident is 16 bits in an IP packet. Because of this, we can send a maximum of 2^{16} packets without having a packet with another Ident value. $576 \text{ bytes} \times 2^{16} = 36 \text{ MB}$. MSL is 60 seconds, so the bandwidth would be $36 \text{ MB}/60 \text{ seconds} = 0.6 \text{ MB/s}$ or 5 Mbps.

If you exceed this bandwidth, then you will have non-unique ident values, so there will be issues with data on the receiving end.

41) Routers should not have to reassemble fragments because they should be using all of their capacity towards forwarding. This is why fragment reassembly is not done at the routers. With IPv6, fragmentation was thrown out altogether because of security concerns, and the fact that it would have been a very large load on the routers.