

Solutions to Exercises on IP Layer

1. The following is an ethernet frame carrying an IP datagram. Identify if it is TCP/UDP/ICMP data. Identify and verify the correctness of the IP checksum field. 0800 20e7 ccc5 0800 209c 874d 0800 4500 00cc f20d 4000 4006 2cff 898c 0401 898c 0406 0801 03c6 226b ddb8 aeec 15c8 5018 60f4 542a 0000	Setting checksum field, 2cff, to zero, sum the rest of IP header to get 2 D2FE; Add the 2 back in to get D300, complement of which is 2CFF, the Since Protocol field has value 6, the datagram is carrying a TCP segment.								
2. The MTU of a link layer is 576 bytes. If a UDP application writes 2040 bytes of data (note: this doesn't include the UDP header), what is the size, fragment offset and MF (More Fragments) flag in each fragment that IP produces?	Total 2048 bytes of UDP data+UDP header – fragment into 4 pieces of 552, 552, 552 and 392 bytes. <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="background-color: yellow; padding: 5px;">MF=1 FragOffset=0</td><td style="background-color: lightblue; padding: 5px;">bytes 0-551</td></tr> <tr> <td style="background-color: yellow; padding: 5px;">MF=1 FragOffset=552</td><td style="background-color: lightblue; padding: 5px;">bytes 552-1103</td></tr> <tr> <td style="background-color: yellow; padding: 5px;">MF=1 FragOffset=1104</td><td style="background-color: lightblue; padding: 5px;">bytes 1104-1655</td></tr> <tr> <td style="background-color: yellow; padding: 5px;">MF=0 FragOffset=1656</td><td style="background-color: lightblue; padding: 5px;">bytes 1656-2047</td></tr> </table>	MF=1 FragOffset=0	bytes 0-551	MF=1 FragOffset=552	bytes 552-1103	MF=1 FragOffset=1104	bytes 1104-1655	MF=0 FragOffset=1656	bytes 1656-2047
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MF=0 FragOffset=1656	bytes 1656-2047								

3. If 137.140.8.0/23 is sub-netted with mask 255.255.255.192, list range of IPs that each of the resulting subdomains can have.

The original 23 mask bits are shown in blue in the following diagram:

137	140	0000 1000	0000 0000
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255.255.255.192 is a 26 bit mask (since the first 26 bits are 1 in this mask) – so three more bits, shown in red below, are available to be allocated as mask bits.

137	140	0000 1000	0000 0000
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There are $2^3=8$ ways of assigning the 3 red bits, resulting in 8 subdomains:

137	140	0000 1000	0000 0000	137.140.8.0/26 Network address 137.140.8.011 1111=137.140.8.63 B'cast
137	140	0000 1000	0100 0000	137.140.8.63/26 Network address 137.140.8.011 1111=137.140.8.127 B'cast
137	140	0000 1000	1000 0000	137.140.8.128/26 Network address 137.140.8.1011 1111=137.140.8.191 B'cast
137	140	0000 1000	1100 0000	137.140.8.192/26 Network address 137.140.8.111 1111=137.140.8.255 B'cast
137	140	0000 1001	0000 0000	137.140.9.0/26 Network address 137.140.9.0011 1111=137.140.9.63 B'cast
137	140	0000 1001	0100 0000	137.140.9.63/26 Network address 137.140.9.011 1111=137.140.9.127 B'cast
137	140	0000 1001	1000 0000	137.140.9.128/26 Network address 137.140.9.1011 1111=137.140.8.191 B'cast
137	140	0000 1001	1100 0000	137.140.9.192/26 Network address 137.140.9.111 1111=137.140.9.255 B'cast
Black represents host bits except for the lowest and highest which are reserved for network and broadcast addresses.				

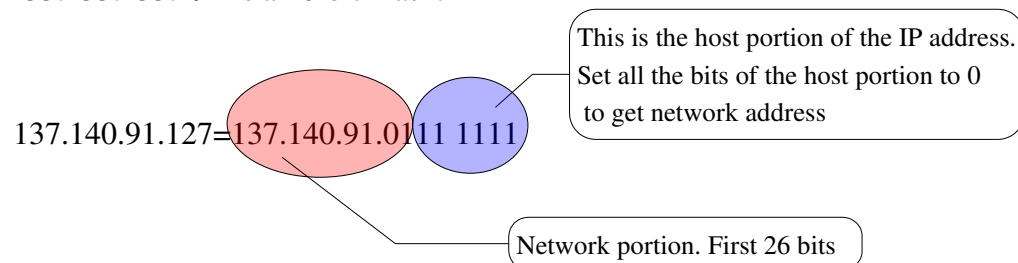
4. If the HeaderLength and TotalLength fields in an IP header are 1101 and 11110000 respectively, what is the length of options (if any) and data in this IP datagram?

Header= 13 4-byte words = 52 bytes. So Options=32 bytes (52-20 mandatory bytes)

Total length=240 bytes; Data=240-52=188 bytes.

The broadcast address of a local network with netmask 255.255.255.192 is 137.140.91.127. What is its network address?

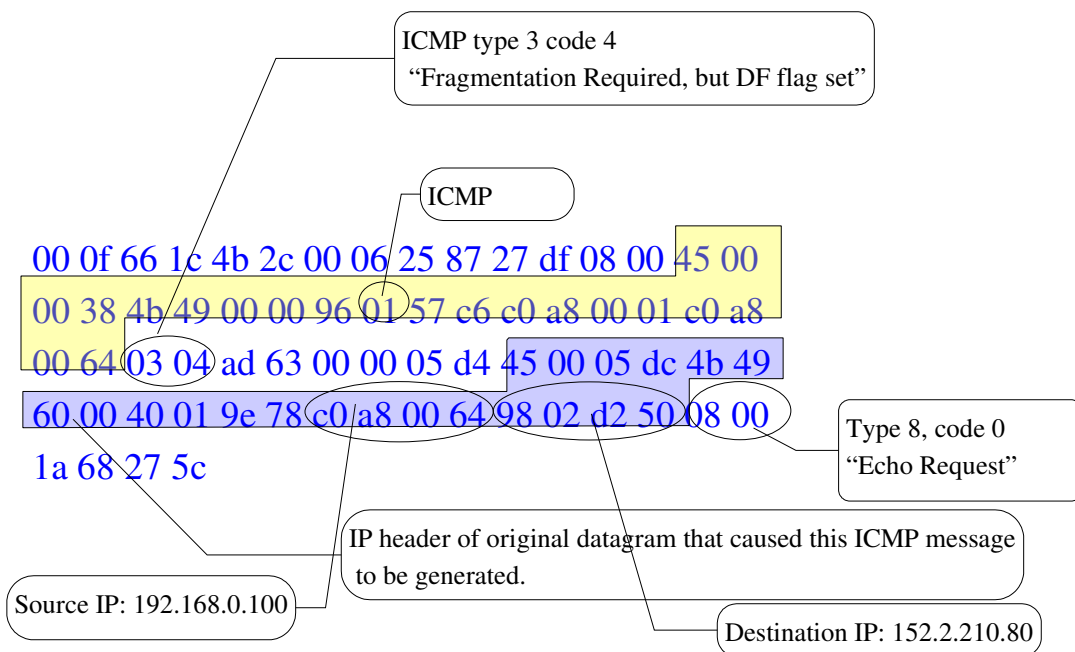
255.255.255.192 is a 26-bit mask.



Network address = 137.140.91.0100 0000=137.140.91.64

6. The following is an ICMP message. Decode it, giving all possible network-layer information. (What sort of error? Sender/Intended receiver of datagram? What was the sender trying to do? Who (IP) actually produced the error message?)

00 0f 66 1c 4b 2c 00 06 25 87 27 df 08 00 45 00
00 38 4b 49 00 00 96 01 57 c6 c0 a8 00 01 c0 a8
00 64 03 04 ad 63 00 00 05 d4 45 00 05 dc 4b 49
60 00 40 01 9e 78 c0 a8 00 64 98 02 d2 50 08 00
1a 68 27 5c



As the figure above shows this ICMP message was generated by 192.168.0.1 in response to an echo request from 192.168.0.100 to 152.2.210.80. 192.168.0.1 is a router that needed to fragment the datagram but the do not fragment (DF) flag (second of three flags in the IP header, bit 50 from the beginning end) was set.

7. Why is the subnet mask associated with an IP address significant?

Read the notes. The netmask tells a host's IP layer whether the destination of a datagram is on its own network, or on another network. If it's on another network, the appropriate routing decision (in many cases this might simply involve sending to a default router) will be taken by the IP layer.