

```
1 Homework #1 for protok11
2 Peter Boström <pbos@kth.se>
3 2011-09-04
4
5 1. IPv4 Addressing
6
7     a) Propose the best fit netmask (i.e. resulting in as few host addresses as
8         possible) for a network with 15 hosts in it!
9
10    This network will need room for 15 hosts, however as two addresses of every
11    network larger than /31 are reserved for broadcast and to identify the
12    network itself, using a /28 network would yield only 14 addresses for use.
13    Therefore a /27 network is required, which yields  $32-2=30$  addresses for use
14    by hosts in the network.
15
16    A /27 network has the netmask: 255.255.255.224
17
18    b) How many hosts can you have in a /26 network?
19
20    A /26 network contains 64 addresses of which 2 are reserved for broadcast
21    and to identify the network itself. 62 of these addresses can be used by
22    hosts in the network.
23
24    c) Split up the network 192.168.48.0/23 into four equally sized /25
25        networks!
26
27    192.168.48.0/25
28    192.168.48.1/25
29    192.168.49.0/25
30    192.168.49.1/25
31
32    d) What is the directed broadcast address of the network 121.2.20.0/22?
33
34    121.2.23.255
35
36    e) What is the limited broadcast address of the network 121.2.20.0/22?
37
38    255.255.255.255
39
40    f) Use the services of IANA and a regional registry to figure out to whom
41        the network 130.237.0.0/16 belongs. Provide the name of the organization
42        and the AS number.
43
44    SUNET/NORDUnet, AS1653
45
46 2. Address allocation
47
48 Make a network on 12.128.0.0/17.
49
50 1) The local offices require 900 addresses each. Create a minimal block for
51     each local office A to L. Start with the lowest address for network A.
52
53 We'll allocate 1024-blocks for each local office. That's a /22 subnet for
54 each office.
55
56 2) There are no unnumbered point-to-point links: all Ethernet networks have
57     IP sub-networks and all nodes (routers and hosts) have an IP address on
58     all their network interfaces.
59
60 (M, N, O, P) need IP addresses from R1 as well.
61
62 To aggregate and include three /22 well, these'll be /20 networks. M's
63 network will encompass A, B and C, etc.
64
65 3) The address allocation should be such that the sub-networks can be
66     aggregated. The central router R1 should have at most eight entries in
67     its forwarding table (plus possibly a default route).
```

```

68
69     M: 12.128.0.0/20
70       A: 12.128.0.0/22
71       B: 12.128.4.0/22
72       C: 12.128.8.0/22
73
74     N: 12.128.16.0/20
75       D: 12.128.16.0/22
76       E: 12.128.20.0/22
77       F: 12.128.24.0/22
78
79     O: 12.128.32.0/20
80       G: 12.128.32.0/22
81       H: 12.128.36.0/22
82       I: 12.128.40.0/22
83
84     P: 12.128.48.0/23
85       J: 12.128.48.0/22
86       K: 12.128.52.0/22
87       L: 12.128.56.0/22
88
89
90     Q: 12.128.64.0/30
91       M: 12.128.64.1
92       Computer: 12.128.64.2
93     R: 12.128.64.4/30
94       N: 12.128.64.5
95       Computer: 12.128.64.6
96     S: 12.128.64.8/30
97       N: 12.128.64.9
98       Computer: 12.128.64.10
99     T: 12.128.64.12/30
100      N: 12.128.64.13
101      Computer: 12.128.64.14
102

```

The routing table for R1 will include M, N, O, P and the directly connected computers.

Routing table (Destination, Next hop, Flags, Interface):

```

107 12.128.64.0/30, -, U, m0
108 12.128.64.4/30, -, U, m1
109 12.128.64.8/30, -, U, m2
110 12.128.64.12/30, -, U, m3
111 12.128.0.0/20, 12.128.64.1, UG, m0
112 12.128.16.0/20, 12.128.64.5, UG, m1
113 12.128.32.0/20, 12.128.64.9, UG, m2
114 12.128.48.0/20, 12.128.64.13, UG, m3
115

```

3. IPv4 forwarding

a) 167.14.81.9

No prefix matches 167. so default route, next hop is 93.171.89.1

b) 192.121.17.13

Matches 192.121.17.13/32, next hop is 111.92.92.127.

c) 7.152.35.14

This fucker is down, either fall back to default and send to 93.171.89.1 or drop that shit.

d) 111.92.66.178

Matches 111.92.64.0/18, direct delivery.

135 e) 133.10.165.254
136
137 Matches 133.10.165.0/24, next hop is 62.88.93.33.
138
139 4. IPv4 options and IPv6 extension headers
140
141 Connected with IPv4 and IPv6.
142 Path MTU on both networks: 100,000 octets.
143 Would like to send a datagram of 120,000 octets.
144 (Check RFC2460 and RFC2675 to see how fragmentation and jumbo payloads can/can
145 not coexist in IPv6.)
146
147 a) Assume you choose the IPv4 network. Do the IP datagrams need to carry
148 IPv4 options? If yes, how many?
149
150 The MF (more fragments) flag for all but the last packet and a non-zero
151 fragmentation offset for all but the first packet. Fragmentation specifies
152 an 8-octet offset from the original payload. The maximum offset we can have
153 is $(2^{13}-1)*8 = 65528$ octets. Max size for one packet is $2^{16}-1 = 65535$
154 octets, so the largest possible ipv4 datagram can contain is $65528+65535 =$
155 131063 octets. This is enough to store our datagram. How lucky!
156
157 The largest possible IPv4 packet fits within a transmission, so we'll have
158 two packets sent. The last packet will have a large fragmentation offset,
159 and the first one will have the MF flag set and a fragmentation offset of
160 zero.
161
162 This does not require additional options, so we can have 20-octet headers,
163 which gives us a 40-octet "header cost".
164
165 b) Assume you choose the IPv6 network. Do the datagrams need to carry IPv6
166 extension headers? If yes, how many? How many options would they carry?
167
168 Jumbograms will not help, we can split into a fragmented package just the
169 same way as IPv4 and still fit the load. We can't send a fragmented
170 jumbogram, which in this case wouldn't even help, and as the datagram
171 is larger than the MTU, a jumbogram with it would not fit. So we need 2
172 packets here as well. And it just about fits, analogous to how IPv4 worked
173 out.
174
175 To use fragmentation in IPv6, a fragmentation header needs to be included
176 which includes offset, a M flag (more fragments flag, again) and also an
177 identifier, as these could be sent asynchronously. This is an 8-octet
178 header required in both two packets, which gives a total header size of 48
179 octets, or 96 for both.
180
181 c) Which network should you choose to minimize the total number of octets
182 sent in datagram headers?
183
184 IPv4, ($40 < 96$) though it isn't a large cost either way.