```
 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   192.168.48.128/25
29   192.168.49.0/25
30   192.168.49.128/25
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           O: 12.128.64.9
 98           Computer: 12.128.64.10
 99        T: 12.128.64.12/30
100           P: 12.128.64.13
101           Computer: 12.128.64.14
102
103        The routing table for R1 will include M, N, O, P and the directly
104        connected computers.
105
106        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
116   3. IPv4 forwarding
117
118        a) 167.14.81.9
119
120        No prefix matches 167. so default route, next hop is 93.171.89.1 on m0.
121
122        b) 192.121.17.13
123
124        Matches 192.121.17.13/32, next hop is 111.92.92.127 on m2.
125
126        c) 7.152.35.14
127
128        This fucker is down, either fall back to default and send to 93.171.89.1
129        on m0 or drop that shit.
130
131        d) 111.92.66.178
132
133        Matches 111.92.64.0/18, direct delivery on m2.
134
```

```
135        e) 133.10.165.254
136
137        Matches 133.10.165.0/24, next hop is 62.88.93.33 m1.
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 asyncroneously. 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.
```