System Administration

Week 05, Segment 2
Networking I: IPv4 Basics & CIDR Subnetting

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https://stevens.netmeister.org/615/

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IPv4 Basics

IPv4 addresses are 32-bit numbers

```
1 0 0 1 1 0 1 1 1 1 1 1 0 1 1 0 0 0 1 1 1 0 0 0 0 0 0 0 1 0 1 1
```
IPv4 Basics

Each IPv4 address consists of four octets.
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IPv4 addresses are divided into a *network part* and a *host part*.

Hosts on the same network (*broadcast domain*) can talk to each other without the help of a router.
There are three different classes of IPv4 networks.
There are three different classes of IPv4 networks. Well, five, really.
# IPv4 Basics

<table>
<thead>
<tr>
<th>Class</th>
<th>Leading bits</th>
<th>Size of network number bit field</th>
<th>Size of rest bit field</th>
<th>Number of networks</th>
<th>Addresses per network</th>
<th>Start address</th>
<th>End address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>0</td>
<td>8</td>
<td>24</td>
<td>128 ((2^7))</td>
<td>16,777,216 ((2^{24}))</td>
<td>0.0.0.0</td>
<td>127.255.255.255</td>
</tr>
<tr>
<td>Class B</td>
<td>10</td>
<td>16</td>
<td>16</td>
<td>16,384 ((2^{14}))</td>
<td>65,536 ((2^{16}))</td>
<td>128.0.0.0</td>
<td>191.255.255.255</td>
</tr>
<tr>
<td>Class C</td>
<td>110</td>
<td>24</td>
<td>8</td>
<td>2,097,152 ((2^{21}))</td>
<td>256 ((2^8))</td>
<td>192.0.0.0</td>
<td>223.255.255.255</td>
</tr>
<tr>
<td>Class D</td>
<td>1110</td>
<td>not defined</td>
<td>not defined</td>
<td>not defined</td>
<td>not defined</td>
<td>224.0.0.0</td>
<td>239.255.255.255</td>
</tr>
<tr>
<td>(multicast)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class E</td>
<td>1111</td>
<td>not defined</td>
<td>not defined</td>
<td>not defined</td>
<td>not defined</td>
<td>240.0.0.0</td>
<td>255.255.255.255</td>
</tr>
<tr>
<td>(reserved)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A netmask splits the IPv4 address into network and host parts.
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IPv4 Basics

The netmask need not end on a quad boundary, however.

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IPv4 Basics

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Broadcast: 155.246.56.223
Hosts/Net: 30

2. Requested size: 64 hosts
Netmask: 255.255.255.128 = 25 11111111.11111111.11111111.1111111.1 0000000
Network: 155.246.56.0/25 10011011.11101110.00111000.0 0000000
HostMin: 155.246.56.1 10011011.11110110.00111000.0 0000001
HostMax: 155.246.56.126 10011011.11110110.00111000.0 1111110
Broadcast: 155.246.56.127 10011011.11110110.00111000.0 1111111
Hosts/Net: 126

3. Requested size: 48 hosts
Netmask: 255.255.255.192 = 26 11111111.11111111.11111111.1111111.11 0000000
Network: 155.246.56.128/26 10011011.11110110.00111000.10 0000000
HostMin: 155.246.56.129 10011011.11110110.00111000.10 000001
HostMax: 155.246.56.190 10011011.11110110.00111000.10 111110
Broadcast: 155.246.56.191 10011011.11110110.00111000.10 111111
Hosts/Net: 62

Needed size: 224 addresses.
Used network: 155.246.56.0/24
Unused:
155.246.56.224/27
$
CIDR Cheat Sheet

A.B.C.D / N
• N = bits describing network portion of address
• M = 32 – N = bits in host portion of address
• $2^M$ = number of addresses on this subnet
• $2^M - 2$ = number of possible hosts
  • first address on subnet = network address
  • last address on subnet = broadcast address

155.246.11.56/27
N = 27
M = 32 - 27 = 5
$2^5$ = 32
$2^5 - 2$ = 30
Network: 155.246.11.32/27
Broadcast: 155.246.11.63
Netmask: 255.255.255.224
Summary

• Classful networking largely for historical context, although see https://en.wikipedia.org/wiki/List_of_assigned_/8_IPv4_address_blocks

• Classless Inter-Domain Routing (CIDR) introduces the concept of a subnet and a netmask

Coming up: IPv6, where things are... different. But not all things.
Links

• IPv4 Address Representation
  https://en.wikipedia.org/wiki/IPv4#Address_representations

• Classful network
  https://en.wikipedia.org/wiki/Classful_network

• Classless Inter-Domain Routing:
  https://en.wikipedia.org/wiki/Classless_Inter-Domain_Routing