IP ADDRESSING
Outline

- Network architecture
- Address format
- Netmask
NETWORK ARCHITECTURE
Logical IP Subnet (LIS)

Set of interfaces with common address prefix

Prefix

1 physical network

↓

1 logical IP network
Logical and Physical Networks

→ All interfaces with the same address prefix must be connected to the same physical network
All interfaces of the same physical network must have the same address prefix

What does this imply?
A Network Identifier

Address prefix is unique to a given (physical/logical) network

- Network part
- Host part
Scalability!

Addressing and routing are closely related.
Does It Come for Free?

- Address space waste
- Addressing efficiency
- Commonly below 25%
ADDRESS FORMAT
IP Addresses

- 32 bits (4 bytes)
- Represented in dotted decimal notation
Each byte expressed as a decimal number separated by a dot
12.4.56.38  193.129.3.215
Each element from 0 to 255
How Large is the Prefix?

→ Fixed size is too limited
→ Three sizes:
  → Class A: 1 byte
  → Class B: 2 bytes
  → Class C: 3 bytes

Check the first byte!
Class A

- E.g., 84.240.20.1
- Max 128 network prefixes
- Max 16M host addresses
Class B

→ E.g., 153.240.20.1

→ Max 16K network prefixes

→ Max 64K host addresses
Class C

E.g., 203.240.20.1

- Max 2M network prefixes
- Max 255 host addresses
And It Goes On …

- Class D
  - E.g., 225.240.20.1

- Used for multicast
- Class E: anycast
- Not associated to interfaces
Reserved Host Field Values

→ All ones: directed broadcast
→ E.g., 203.240.20.255
→ Routed
→ Cannot be associated to an interface
→ All zeros: the LIS
→ E.g., 203.240.20.0
→ Called network address or network identifier
→ Could be associated to an interface
Available Host Identifiers

\[ n \text{ bit host field} \]

\[ 2^n - 2 \text{ available identifiers} \]

Possibly \(2^n - 1\) if network address is associated to an interface
Reserved Addresses

- All ones: limited broadcast
  - 255.255.255.255
  - Not received by all stations
  - Not routed
- This host: O.O.O.O.O
- Loopback: 127.*.*.*
NETMASK
Issues With Classful Addressing

- Lack of flexibility
- Low addressing efficiency
- Centralized address space assignment
Netmask and Classless Addressing

- Associated to IP address
- Marks boundary of network and host parts
Any size network/host part
## Valid Netmask Byte Values

<table>
<thead>
<tr>
<th>Value</th>
<th>Binary</th>
<th>Netmask Byte Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0000 0000</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>1000 0000</td>
<td></td>
</tr>
<tr>
<td>192</td>
<td>1100 0000</td>
<td></td>
</tr>
<tr>
<td>224</td>
<td>1110 0000</td>
<td></td>
</tr>
<tr>
<td>240</td>
<td>1111 0000</td>
<td></td>
</tr>
<tr>
<td>248</td>
<td>1111 1000</td>
<td></td>
</tr>
<tr>
<td>252</td>
<td>1111 1100</td>
<td></td>
</tr>
<tr>
<td>254</td>
<td>1111 1110</td>
<td></td>
</tr>
<tr>
<td>255</td>
<td>1111 1111</td>
<td></td>
</tr>
</tbody>
</table>
Natural Netmaks/Prefixes

→ Class A ➞ 255.0.0.0
→ Class B ➞ 255.255.0.0
→ Class C ➞ 255.255.255.0
Subnetting and Supernetting

- Subnetting: prefix longer than natural one
- Supernetting: prefix shorter than natural one
Subnetting Examples

From 65 to 126

From 129 to 190

From 192 to 198

Net (natural prefix)

Network field

Host

Netmask

Subnet
Subnetting and Centralized Address Assignment

→ Addresses assigned to organization in natural prefixes
One large set of addresses
Organizations use subnetting to devise a prefix for each network.