IP Addresses

- Chapter 21

Host Identifiers

- A unified network requires a universal communication service.
- Host identifiers:
  - Name: identifies what the object is
  - Address: identifies where it is
  - Route: identifies how to get there
IP Addresses

• IP Addresses are 32 bit.
• Written in dotted decimal format: X.X.X.X
  • Example: A Clemson address: 130.127.48.4

• An address encodes the identification of the network as well as the host
  (network id, host id)

• What is a host?

• How does an address relate to a host?

• Three types of addresses?

Original Classful Addressing Scheme

<table>
<thead>
<tr>
<th>bits</th>
<th>0 1 2 3 4</th>
<th>8 16 24 31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>prefix</td>
<td>suffix</td>
</tr>
<tr>
<td>Class B</td>
<td>[1]0</td>
<td>prefix</td>
</tr>
<tr>
<td>Class C</td>
<td>[1]10</td>
<td>prefix</td>
</tr>
<tr>
<td>Class D</td>
<td>[1]1[1]0</td>
<td></td>
</tr>
<tr>
<td>Class E</td>
<td>[1]1[1]1</td>
<td>reserved for future use</td>
</tr>
</tbody>
</table>

Original address scheme was classful:
• Class A for large networks (>64K hosts)
• Class B for medium networks (>256 hosts)
• Class C for small networks (<256 hosts)
• Class D for multicast
• Class E reserved
Original Classful Addressing Scheme

- What’s the total address space?
- Example: Clemson address: 130.127.49.225
  - Class?
  - Network ID?
  - Host ID?
- Example: 192.168.1.100

Broadcast Addresses

Two Types of broadcasts:
- A network or a directed broadcast
  - contains a valid network and host id.
  - class C example: 192.168.1.255
- A local or limited broadcast does not require knowledge of the network address.
  - Referred to as the all 1’s broadcast: 255.255.255.255
  - A limited broadcast useful for certain startup protocols
Special Addresses

- Conventions…. The ‘this’ rule and the ‘all’ rule:
  - A netid or a host id of ‘0’ implies ‘this’
  - A netid or a host id of ‘1’ implies ‘all’

- Class C example: 192.168.1.0
  
  The ‘this’ rule: ‘This host’ on the network

- Class C example: 192.168.1.255
  
  The ‘1’s’ rule: ‘All’ hosts on the network

Host Addresses with Special Meaning

- All 0’s and all 1’s
- Loop Back : 127.x.x.x (e.g., 127.0.0.1)
  - What address class?
- Private address space:
  - RFC 1918 defines certain address ranges for private use.
    - 10.0.0.0 - 10.255.255.255 (Class A space)
    - 172.16.0.0 - 172.31.255.255(Class B space)
    - 192.168.0.0 - 192.168.255.255 (Class C space)
Special Addresses

So, how many valid host ids are available with the following address:

192.1.1.0/24

What happens if you ping 0.0.0.0?

Classful Address Ranges

<table>
<thead>
<tr>
<th>Class</th>
<th>Lowest Address</th>
<th>Highest Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.0.0.0</td>
<td>126.0.0.0</td>
</tr>
<tr>
<td>B</td>
<td>128.1.0.0</td>
<td>191.255.0.0</td>
</tr>
<tr>
<td>C</td>
<td>192.0.1.0</td>
<td>223.255.255.0</td>
</tr>
<tr>
<td>D</td>
<td>224.0.0.0</td>
<td>239.255.255.255</td>
</tr>
<tr>
<td>E</td>
<td>240.0.0.0</td>
<td>247.255.255.255</td>
</tr>
</tbody>
</table>

Dotted Decimal Class Address Ranges
Classful Addresses

• Addresses do not specify computers, but rather connections to particular hosts.
• Multihomed: A host that has >1 physical connection.

Basic mechanism: A two level class hierarchy.
• requires a unique network prefix for each physical interface.
• Two additional schemes designed to conserve net addresses: subnet and classless addressing (CIDR).

Other issues:
➢ Mobility
➢ Flexibility
➢ Naming
➢ And of course the IP Address shortage problem...
Network Byte Order

Network Byte Order: concept to isolate a network from machine architectures.

- Big Endian machines: lowest memory has high-order byte.
- Little Endian machines: lowest memory has low-order byte.
- Functions: htons(), htonl(), ntohs(), ntohl()

Network Byte Order is Big Endian. The MSB of an integer gets sent first.

Protocol Data must be in Network Byte Order but User Data does not have to be.

Based on notes by Jim Martin