Chapter 18
IP Service Model and Addressing

**IP Protocol Objectives**

1. Connect physical networks of every possible type (even future network technologies not yet developed)
2. Scale to a WAN connecting many hosts
   - How many is “many”?
3. To succeed, IP had to make minimal assumptions about the physical networks it connects

**Physically Network Assumptions**

- IP makes the following assumptions about the physical network technology
- What if the network does not provide this?
Global Addressing

• An internetwork requires a Global Addressing mechanism

• Solution:
  
  • IP uses 32-bit logical address
  • IP uses hierarchical addressing

IP Address Classes

• How do you partition the 32 bits?

• Each format is called an IP Address Class

• The class is identified by the first four bits of the IP Address

IP Address Classes: (continued)

• Classes A, B, and C are called primary classes and are used to identify individual hosts

<table>
<thead>
<tr>
<th></th>
<th>Net ID</th>
<th>Host ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>0</td>
<td>8-31</td>
</tr>
<tr>
<td>Class B</td>
<td>10</td>
<td>16-31</td>
</tr>
<tr>
<td>Class C</td>
<td>110</td>
<td>23-31</td>
</tr>
</tbody>
</table>

Figure 1: IP A, B, and C address classes

Network and Host IDs

• Every physical network in a TCP/IP internet is assigned a unique network number

• Each host on a specific network is assigned a host number or host address that is unique within that network

• Host's IP address is the combination of the network number (prefix) and host address (suffix)

• Network numbers are unique

• Assignment of network numbers must be coordinated globally; assignment of host addresses can be managed locally

• Host addresses may be reused on different networks

• Really isn’t a Host ID. It is really an
**Dotted Decimal Notation: (continued)**

- How can you easily tell the address class?

**Special IP Addresses**

- use 1’s to mean “ALL”
- use 0’s to mean “THIS”

<table>
<thead>
<tr>
<th>Network ID</th>
<th>Host ID</th>
<th>The Address Meaning</th>
<th>The Purpose (used for)</th>
</tr>
</thead>
<tbody>
<tr>
<td>all 0’s</td>
<td>all 0’s</td>
<td>Net ID</td>
<td>Host ID</td>
</tr>
<tr>
<td>all 0’s</td>
<td>Host ID</td>
<td>all 1’s</td>
<td>Net ID</td>
</tr>
<tr>
<td>all 1’s</td>
<td>all 0’s</td>
<td>Net ID</td>
<td>all 1’s</td>
</tr>
<tr>
<td>127</td>
<td>anything</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dotted Decimal Notation**

- Class A, B and C all break between prefix and suffix on byte boundary
- **Dotted Decimal Notation** is a convention for representing 32-bit internet addresses in a readable format
- Convert each byte of the address into a decimal number
- Separate byte by periods (“dots”)
- Example

<table>
<thead>
<tr>
<th>32-bit IP Address (binary)</th>
<th>Dotted Decimal Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10000001 00101000 00000110 00000000</td>
<td>10.10.11.0</td>
</tr>
<tr>
<td>00001010 00000100 00000000 00100101</td>
<td>10.10.0.21</td>
</tr>
<tr>
<td>10000000 10100111 10011010 01010101</td>
<td>10.1111.0101.0101</td>
</tr>
<tr>
<td>11001100 11001100 01001110 00001011</td>
<td>20.20.0.183</td>
</tr>
</tbody>
</table>

**IP Address Classes: (continued)**

- IP also defined two other addresses classes
  - **Class D**
  - **Class E**
  - Figure 2: IP D and E address classes

- Class D is used for multicasting to a group of machines connected to the internet
- Class E is reserved.

- What type of network are the following hosts connected to?
  - argus.stanford.edu
  - cs.purdue.edu
  - intel.com
  - www.ibm.edu
  - dcs.uky.edu
  - beta.xerox.com

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Special IP Addresses: (continued)

- The first BSD UNIX (Berkeley Software Distribution) used all 0’s for the broadcast address instead of all 1’s
- This non-standard implementation spread
- It is still common to see 0’s as the broadcast address today.

Router IP Addresses

- Routers connect to multiple networks
- Need and IP address for each interface
- So what we have been calling the “host” part of the IP address is really the “interface” part of the address
- What is the IP address of your router?
- What other IP addresses does your router have?

Multi-homed Hosts

- What is a multi-homed host?
- Is there any reason to do this?
- How do they differ from routers?