Networks II

IP address

- Recall, for a simple network:
  - Each computer must have some unique id
  - Each computer could be identified by a unique IP address
  - Could be thought of as a street address
- Example: 192.168.10.123

Finding computers on Internet

- Suppose you are in Montreal and want to talk to someone Melbourne.
- The IP of your computer is 206.230.20.15 and the IP of your friend's computer is 68.115.200.101
  - How does the message get from one computer to the other?
  - Simple solution: Send the message to everyone and let each computer on the Internet figure out if it wants the message

IP Breakdown

- What is wrong with this simple solution?
  - Limited capacity of the network
  - Time delay in receiving the message
  - No direct path between two computers
- More complicated solution:
  - Establish a system similar to postal codes (e.g. H3A 2T5) where each symbol or combination of symbols has some meaning

IP Breakdown

- The IP addresses we are used to seeing are called IPv4, total size 32 bits, can represent 4,294,967,296 unique addresses
- There is also new version called IPv6 capable of representing 340,282,366,920,938,463,463,374,607,431,768,211,456 unique addresses
- For this course we will only concern ourselves with IPv4

IP Breakdown

- In dot-decimal representation IP address consists of 4 octets (132.216.177.140)
- Each of the octets provides information about where a computer is located
- For example:
  - If a message is sent from 132.216.177.110 to 132.216.177.140, both computers are likely on the same network
  - If a message is sent from 132.216.177.110 to 206.230.20.15 the computers are located on different networks

Local Routing: High level

- Generally to go from one computer on the Internet to another requires the following steps:

1. Look at the destination's IP address
2. If destination is on the same network just send directly
3. If destination is outside the network give the message to a *gateway* which will know how to handle it

Routing table

- Tells the computer for each IP address if it belongs to a local network or if it should be sent to a gateway and where the gateway is located

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Active Routes:
Network Destination          Netmask          Gateway        Interface
          0.0.0.0            0.0.0.0      192.168.1.1    192.168.1.100
        127.0.0.0          255.0.0.0        127.0.0.1        127.0.0.1
      192.168.1.0      255.255.255.0    192.168.1.100    192.168.1.100
    192.168.1.100    255.255.255.255        127.0.0.1        127.0.0.1
    192.168.1.255    255.255.255.255    192.168.1.100    192.168.1.100
        224.0.0.0          224.0.0.0    192.168.220.1    192.168.220.1
  255.255.255.255    255.255.255.255    192.168.220.1    192.168.220.1
Default Gateway:         192.168.1.1
```

Gateway

- Also known as Router
- Accepts packets from computers for the purpose of forwarding them to the required destination
- Keeps its own routing table which helps it to determine where the packet should be forwarded
- Top level routers exchange routing information to maintain consistent picture of the network

Example

- Suppose computer A (206.230.20.15) wants to send a packet to B (68.115.200.101)
- A looks at its routing table and sees that B is not on the same network as A, so it sends the packet to its gateway C (206.230.20.1)
- C looks at its routing table: it does not know where B is, but it does know that all packets to IPs which start with 68.115 must be sent to D (68.115.1.1)
- D looks at its routing table and *Hurray!* It knows about B, so it forwards the packet to B (68.115.200.101)

Routing

- What we have seen is a somewhat *simplified but generally true picture*
- A packet might need to go through a number of computers to reach its destination, possibly more than we have seen in the example