

## 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**

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### 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

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### 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

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## 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

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## 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

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## 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

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## 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**

```
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
```

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## 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

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## 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)

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## 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

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