TCP/IP Networking

- Recall that local networks (LAN) are a collection of connected computers.
- Can use the same rules as used on the Internet (TCP/IP) for local network connections.
- IP requires each computer to have a unique IP address.

### IP Address

- A dotted quad of four numbers (each from 0 - 255).
- Technically has two parts, a subnet portion that identifies the entire local network and then individual numbers for each machine on the network.

<table>
<thead>
<tr>
<th>Subnet</th>
<th>Machine Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.1</td>
<td>101</td>
</tr>
</tbody>
</table>

Entire IP Address: 192.168.1.101 (for subnet mask 255.255.255.0)
Networking Devices

Connecting computers

Private IP Addresses

- Special ranges of addresses are reserved as "private" addresses, not available on the public Internet.
- These addresses cannot be used to connect directly to the Internet, but will work with TCP/IP for local networks.
- Ex: 192.168.X.X
- Note: If you are directly connected to the Internet through an Internet Service Provider (ISP) you may be using a public IP address.
Could directly connect two computers together.
Assign each an IP address (with same subnet) and connect using a special "crossover" network cable.
To connect more than two computers typically use a hub topology, connecting multiple computers through a central device.

Central device is either a “Hub” or a “Switch”.

All machines are connected to Hub/Switch using a standard network cable.

All machines must have unique IP address but same subnet.
Network Hub

- Accepts IP packets from a machine and re-transmits to all other connected machines (broadcast).
- Whichever machine is the destination can use the packet, the others forward (or simply ignore).
- Wastes connection bandwidth on unnecessary transmissions.
Network Switch

- Accepts IP packets from a machine and re-directs it only to the destination machine.
- Leaves connections to other machines open for other data.
Connection Types

- Hub/Switch has ports to connect to network cards in machines (typical port numbers are 4 and 8 for small Hub/Switch).
- Machine network cards support various connector types/transfer speeds.

<table>
<thead>
<tr>
<th>Connection Type/Speed</th>
<th>Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Mbps</td>
<td>CAT 3 Network Cable</td>
</tr>
<tr>
<td>100 Mbps</td>
<td>CAT 5/5E Network Cable</td>
</tr>
<tr>
<td>Gigabit Ethernet</td>
<td>CAT 5E, Fiber Optic</td>
</tr>
</tbody>
</table>

- Most Hubs/Switches support 10 Mbps, 100 Mbps or 1 Gbps and are auto-sensing (will detect what machine is capable of).
Networking Devices

Full Duplex Port
- Allows for simultaneous send and receiving of data over connection (as opposed to half duplex).
- In theory can achieve up to 200 Mbps.

MDI/MDI-X Crossover Detection
- Some ports can automatically detect crossover connections (machine-to-machine, for example, from another switch).
Routers have connections to different networks (subnets), and can transfer information from one to another.

Must keep information to track “where” different networks are located, then forward packets.

Has two (or more) IP addresses, one on each network directly connected to Router.

Analogous to simply having two network interfaces (cards).
Routers

192.168.1.102

To: 192.168.100.4
From: 192.168.1.102
Number: 3 of 10

192.168.100.4

192.168.1.101

192.168.1.104

P

192.168.1.X side

Router (2 interfaces)

192.168.100.X