

Computer Networks

You will learn what is a network, how they work and what are the different types.

James Tam

What This Section Will And Will Not Cover

- What we will talk about:
 - The principles of how a network functions, the different parts of a network and the different types of networks
- What we won't talk about:
 - The step-by-step process of building a network
 - Typically you can find many sites that already provide this information
 - E.g.,
<http://www.microsoft.com/windowsxp/using/networking/setup/default.mspx>

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What Is A Network

- 2+ computers
- The hardware and software needed to connect them



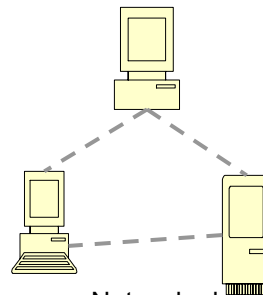
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Standalone Devices

- Are not hooked up to the network



Standalone
computer



Networked
computers

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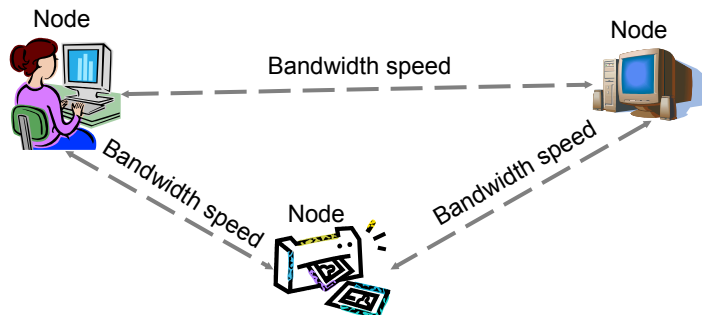
Introducing Some Basic Parts Of A Network

- **Nodes:**

- Hardware devices that are connected to the network (e.g., printers, computers)

- **Bandwidth:**

- Speed at which information transmits through the network
- Maximum typically 10 – 100 Mbps



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Benefits Of Networking Computers

- 1) Resource sharing
- 2) Reliability
- 3) Cost savings
- 4) Communication

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1. Resource Sharing

- Non-networked computers
 - Information is stored separately and locally on each computer

Do not accept cheques from this person!



Calgary branch



Edmonton branch



Bad cheque

1. Resource Sharing

- Networked computer system
 - Information is accessible from other locations as if it were available locally.

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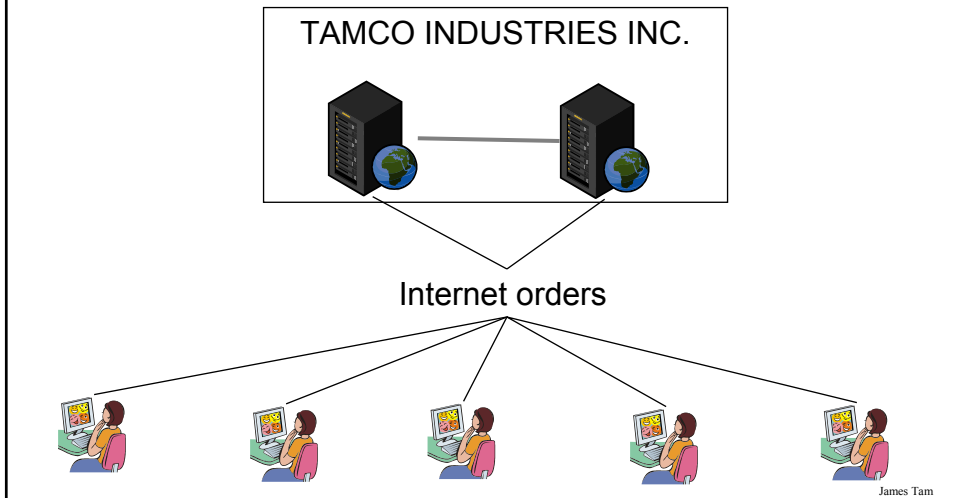
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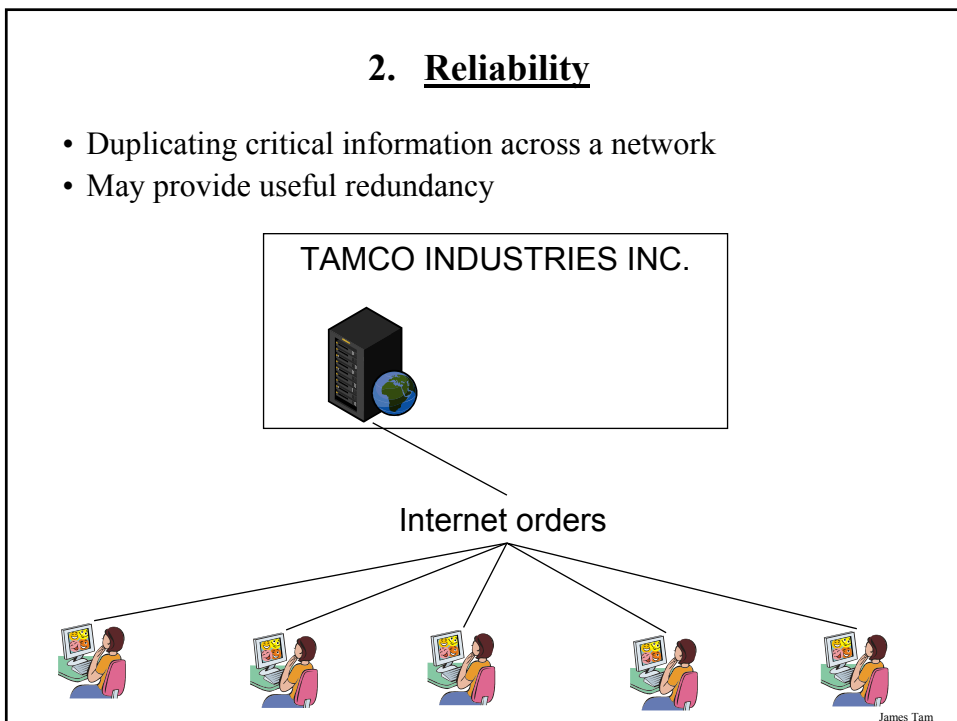
2. Reliability

- Duplicating critical information across a network
- May provide useful redundancy

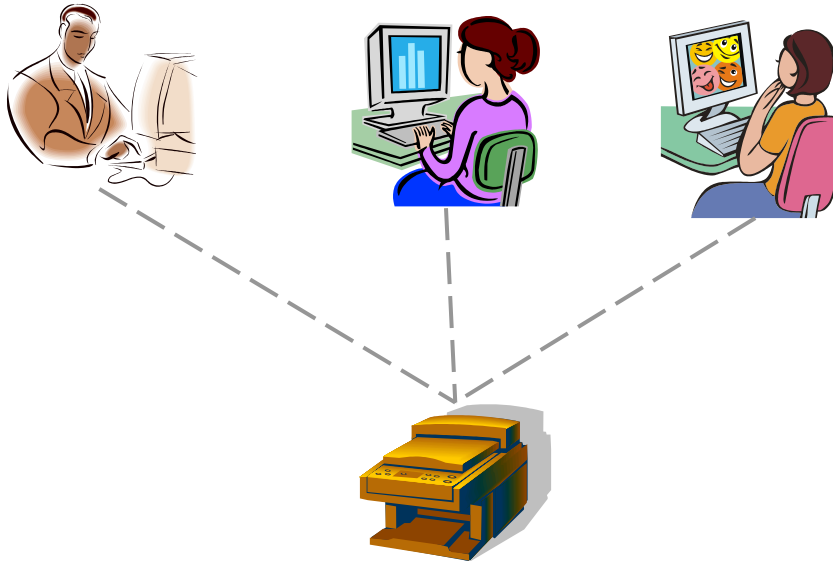


2. Reliability

- Duplicating critical information across a network
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3. Cost Savings



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4. Communication

- Electronic communication may allow for faster responses.
- Electronic communication may provide benefits not derived from traditional methods of communication.

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What You Need For A Two Computer Network

- Two computers (obvious)



- A network interface card (NIC) for each computer



- Ethernet connection (or at least a cross over cable)



- Software to support the network connection

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What You Need For A Multi (3+) Computer Network

- The items mentioned for a 2 computer network
- Plus a network hub



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Hub

- Brings all of the connections together and routes information internally



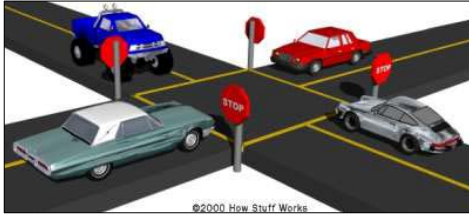
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Hub (2)

- Rule of thumb when a hub is needed/appropriate:
 - Needed to route information in a network consisting of 2+ computers (strictly speaking not mandatory for a 2 computer network)
 - Works well for smaller networks or when there isn't a great deal of information passing through the network

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Hub (3)



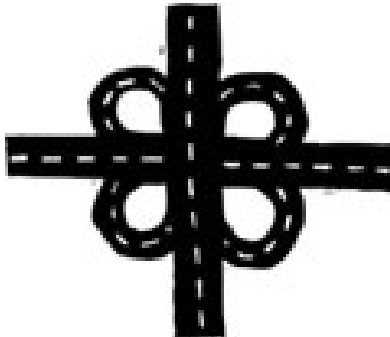
- Drawbacks of using network hubs:
 - Scalability
 - Latency and collisions
 - Network failure

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Switch



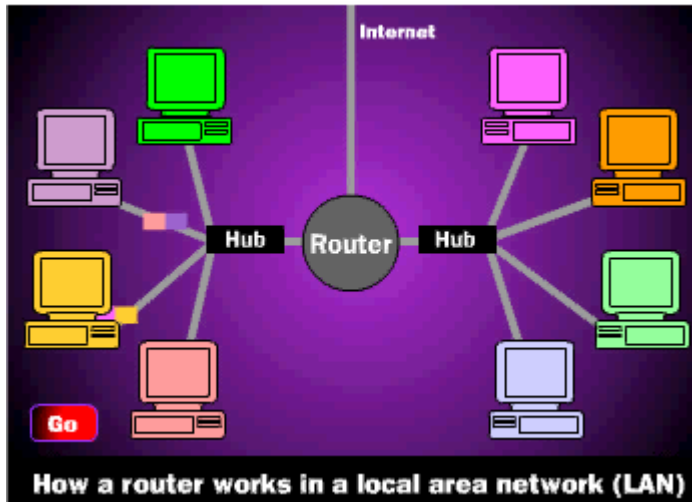
- Similar to a hub it connects the computers in a network and routes information internally.
- They are employed to overcome some of the drawbacks of hubs:



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Router

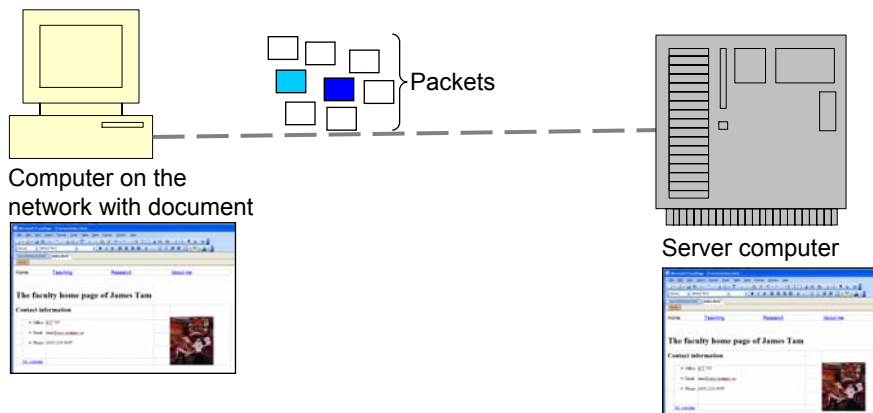
- Used to *connect multiple networks*.



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Transmitting Information On A Network

- Information is broken down into parts (packets).

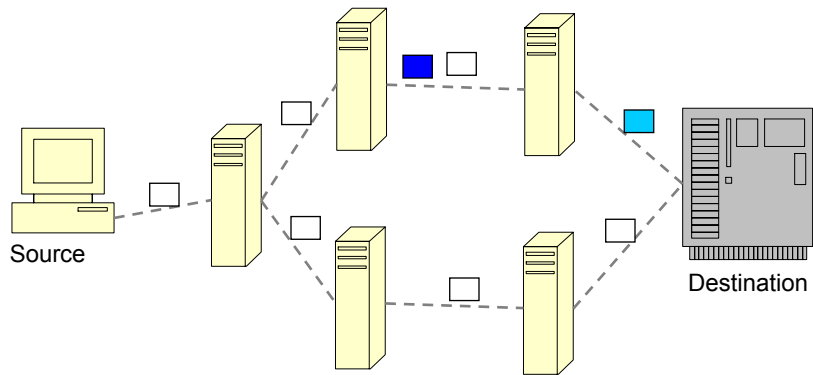


- The packets are sent over the network in groups
- When the packets reach their destination they are reassembled into their original forms.

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Transmitting Information Over A Network (2)

- The route taken can vary from packet-to-packet



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Firewall

- Protects the network against incoming information
- Some may screen outgoing data
- Filters information



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Network Sizes

- Local Area Network (LAN)
 - May be located within a single building or campus
- Metropolitan Area Network (MAN)
 - A larger version of a LAN
 - May span several corporate offices or an entire city
- Wide Area Network (WAN)
 - May span a country or even a continent

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Types Of Network Connections

- Wired
 - Twisted pair
 - Coaxial cable
 - Fiber optic
- Wireless

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Twisted Pair Network Connections

- The transmitting wire consists of a collection of paired wires



Category	Max bandwidth
Category 1	< 1 Mbps
Category 2	4 Mbps
Category 3	10 Mbps
Category 4	20 Mbps
Category 5	100 Mbps
Category 5E	100 – 1000 Mbps
Category 6	1000 Mbps

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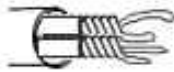
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Twisted Pair Network Connections (2)

- The twisted pair connections can be shielded or not.
 - Unshielded (UTP)

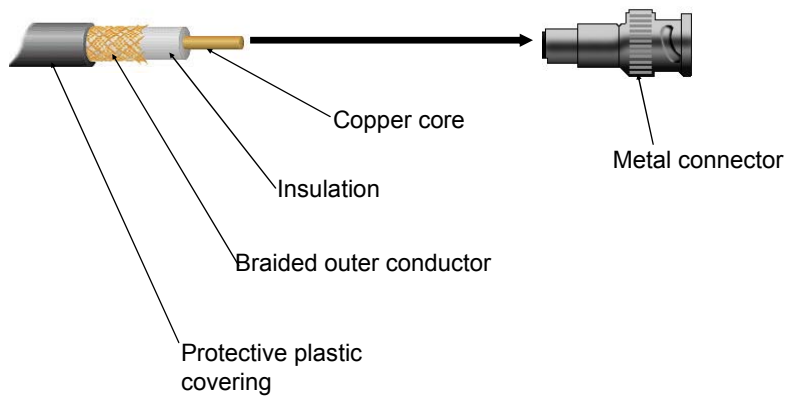


- Shielded (STP)



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Coaxial Cable Network Connections



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Coaxial Cable Network Connections (2)

- Bandwidth
 - Typically at 10 Mbps
 - May reach 100 Mbps

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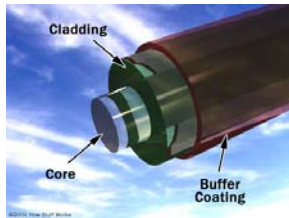
Twisted Pair Vs. Coaxial Connections

- Coaxial
 - Longer range (~double)
 - Linear
- Twisted pair
 - Shorter range
 - Non-linear

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Fiber Optic Network Connections

- Unlike twisted pair and coaxial connections which use electricity, fiber optic connections use light.

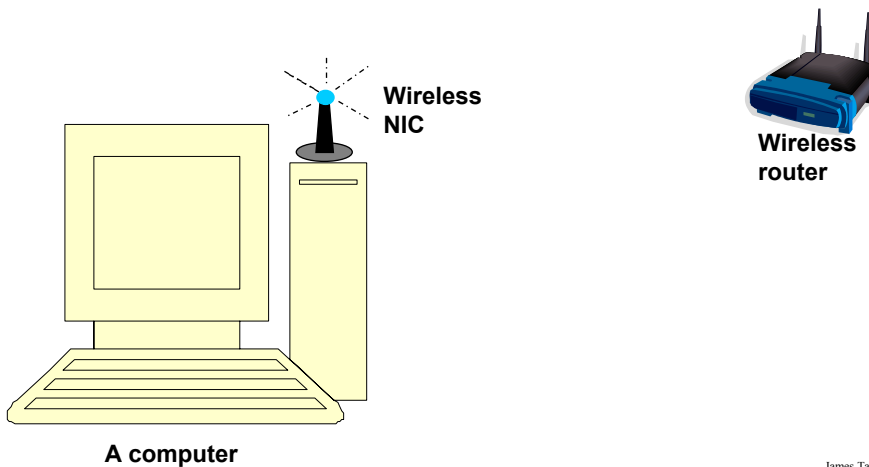


- Fast transmissions with few errors
- Very long range connections are possible
- Expensive

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Wireless Network Connections

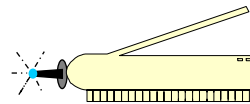
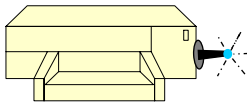
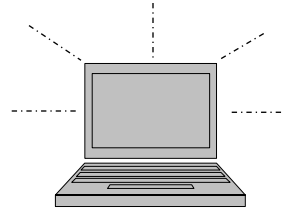
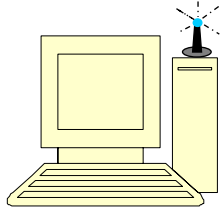
- The network is connected via radio waves
- The general requirements for setting up a wireless network are similar but not identical to a wired network:



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Nodes On A Wireless Network

- Need not be restricted to just computers:



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Types Of Wireless Network Connections

- All are based on the 802.11 standard for wireless transmissions

Transmission protocol	Maximum bandwidth
802.11b	11 Mbps
802.11a	54 Mbps
802.11g	52 Mbps
802.11n	~100+ Mbps

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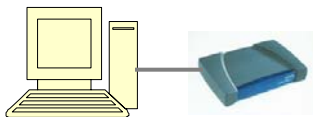
Wired Vs. Wireless Networks

- **Wired:**
 - Speed
 - Security
 - Less likely to be subject to common sources of interference
- **Wireless:**
 - Convenience

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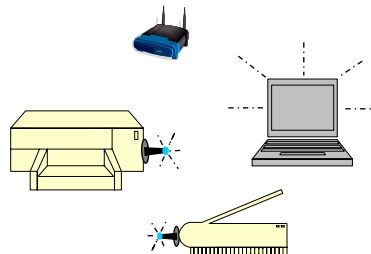
Mixed Networks

- To balance the strengths of wired networks vs. the strength of wireless networks a network can mix-and-match between wired and wireless connections.



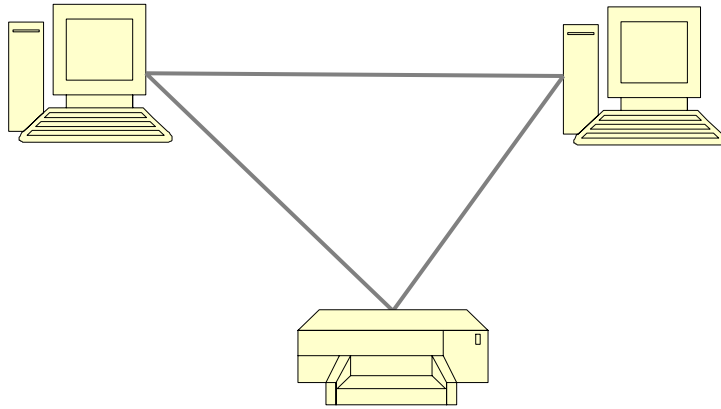
Wired portion of the network

Wireless portion of the network



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Peer-To-Peer Networks



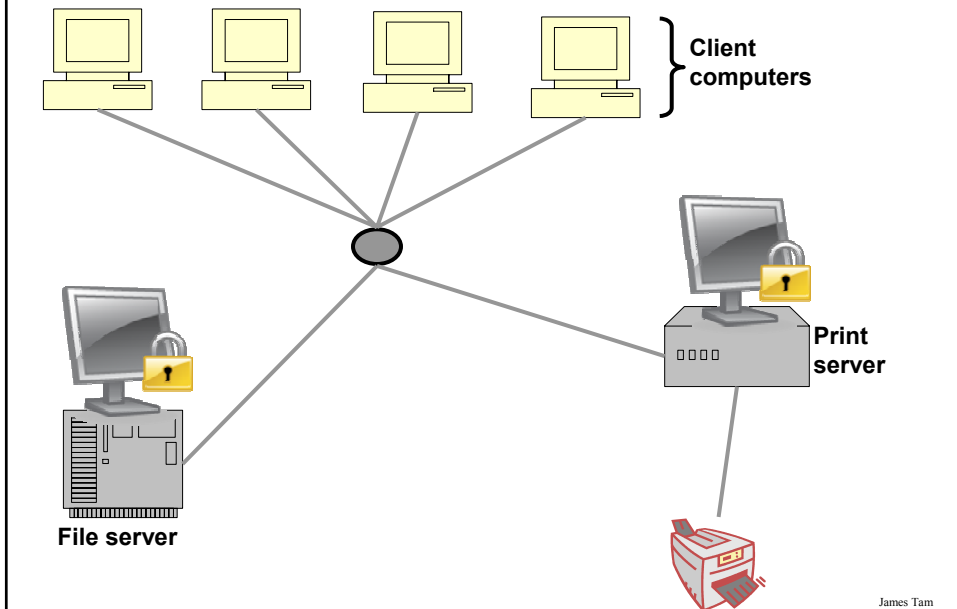
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Peer-To-Peer Networks (2)

- The easiest type of network to set up
- The most common type of configuration for home networks

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Client-Server Networks



Client-Server Networks (2)

- More complex than peer-to-peer but allows common network administrative tasks to be completed more efficiently.
- Typically used for larger networks.

You Should Now Know

- What is a network
- What is required to set up a network
- Common networking terminology
- What are different sizes of networks: LAN, MAN, WAN
- The hardware used in networks and how they work: hubs, switches, routers, firewalls
- How information is transmitted on a network via packets
- What are different types of networks
 - Peer-to-peer and client-server
 - How is each one set up, how they differ and when and why are they used
- The different type of network connections
 - How does each one work
 - What are the maximum bandwidths
 - What are their strengths and weaknesses