Computer Networks

Topic 6:

Network Hardware

Computer Networks

Topic 6 – Lecture 1:

Network Hardware

V1.0

Scope and Coverage

This topic will cover:

- Network hardware
- Hardware selection
- Creating a network

Learning Outcomes

By the end of this topic, students will be able to:

- Select the hardware components of a network
- Assemble the necessary hardware components to create a network according to a design specification
- Test the connectivity of a network
- Troubleshoot client-side connectivity issues using appropriate tools

A Simple Network

- A simple network could consist of two computers connected by a transmission medium.

- For even a small business, it is likely that something more complex is required, including:
  - Several computers
  - Peripheral devices
  - Connection to the Internet

Wireless or Physical Media

- Advantages to both systems
- Depends upon many factors:
  - Need for mobility within network
  - Requirements for ad hoc devices
  - Geography of network
- This topic looks at networks that use ***physical cables***.

Peer-to-Peer vs. Server-Client

- A decision must be made as to whether a peer-to-peer network or server network is required.
- Very small networks can be peer-to-peer.
- Larger networks should be server based
  - More than 10 users
  - Heavy network use
  - Security is important.

Controlling Network Traffic

- A key feature of any network is the control of the traffic between nodes.
- A number of devices can be utilised to efficiently pass signals around the network:
  - Repeaters
  - Hubs
  - Bridges
  - Switches
  - Routers
  - Gateways

Repeaters

- On the physical layer of the OSI model
- Extend the distance a signal can travel over a network segment
- Analogue devices that connect two cable segments
- Signal is received on one segment
- Amplified and sent along the other segment
- No intelligence:
  - Deals in volts not packets, headers, etc

Hubs

- On the physical layer of the OSI model
- Connect nodes together in a physical star topology
- Echo data coming in to all other connected nodes
- Do not have addressing capability
- Can cut off problem nodes, e.g.
  - Cable break
  - Flooding network with traffic
- Can have internal bus or ring topology
- Does not prevent collisions

Bridges

- On the data link layer of the OSI model
- Like an "***intelligent hub***" that routes messages between two LANs
- When a message arrives, the bridge software looks at the header to find the destination.
- Message is then routed to the correct LAN by using its routing tables.
- Typically allows four or eight input lines
- Modern hubs also act as bridges.

Switches

- On the data link layer of the OSI model
- Route messages based on header address
- Establishes a one-to-one connection between two ports
- A switch contains many ports.
- Usually, each port links to an individual computer.

Routers

- Routers use software to choose an output line for an incoming message.
- Connects two or more networks
- The message is stored until complete.
- ***Routing algorithms*** are used to determine the next destination.
- The message is forwarded.

Gateways

- Gateways are used to connect two computers using different transport protocols.
- Capable of taking packets from one format and translating them into packets in a different format.
- Because they translate data, there is a processing time required to do this.

PCs and Laptops

- Computers are required on the network.
- The specification and model required is largely dependent upon what the computers will be used for.
- Computers require a network adapter in order to link into a network
  - Included in modern computers
  - USB adapters are available if a computer does not have one.

Servers

- A server is a computer or series of computers that provides services across the network.
- The server is at the centre of a network.
- Most large networks with more than a few dozen workstations rely on several network servers.
- The requirements of the server hardware are determined by size of network, network operations, network operating system, etc.

Specialist Servers

- It is possible to assign servers to specific roles such as:
  - Application servers
  - Communication servers
  - Domain controllers/directory servers
  - Fax servers
  - File servers
  - Print servers
  - Mail servers
  - Web servers

Computer Networks

Topic 6 – Lecture 2:

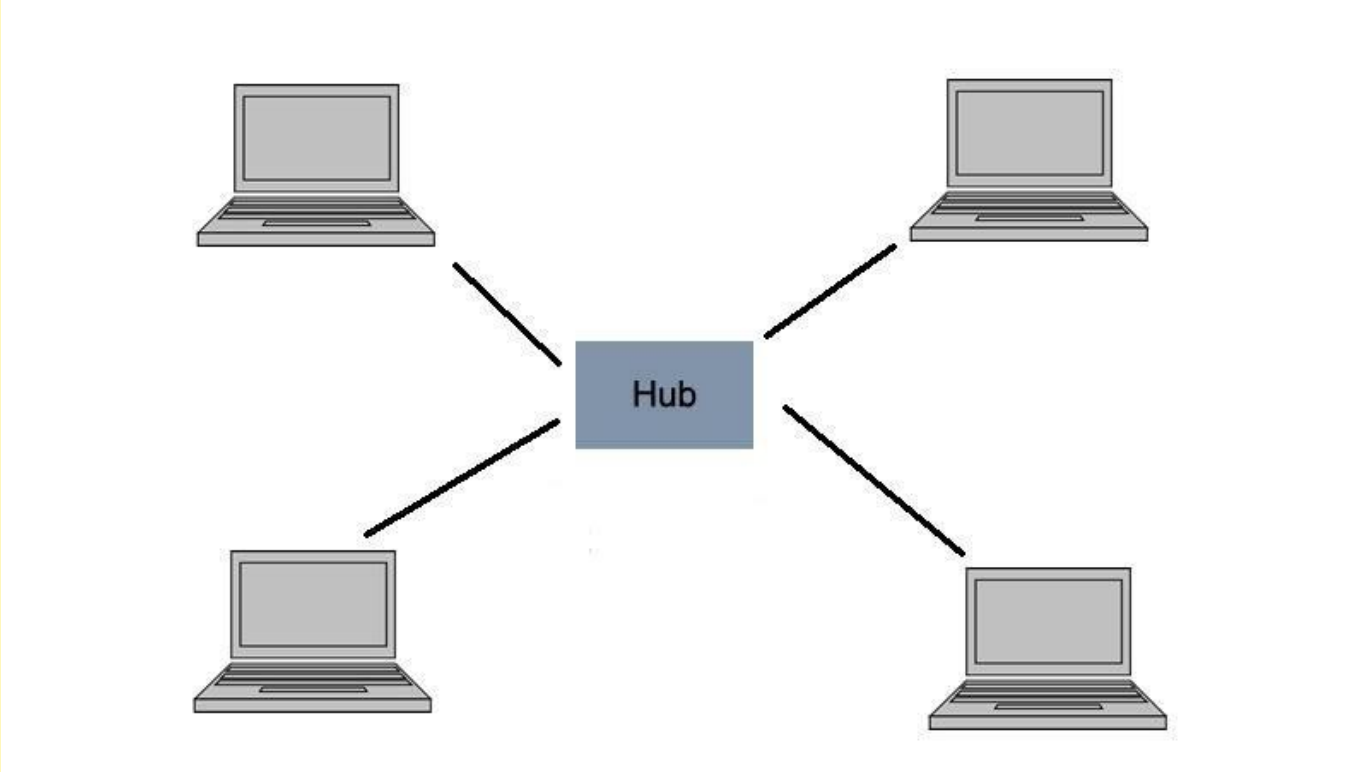
Choosing Hardware & Creating a Network

V1.0

Peer-to-Peer v Server-Client

- Before choosing equipment, decide on what type of network is required
  - Do you need a server?
- Very small networks can be peer-to-peer.
- Larger networks should be server based
  - More than 10 users
  - Heavy network use
  - Security is important.

Peer-to-Peer Networks - 1



Peer-to-Peer Networks - 2

- Works well in small networks
- Every user acts as a network administrator.
- Are flexible but can become chaotic as they grow
- Security can be a major concern as it is difficult to enforce security across the whole network.
- Computers can be grouped into workgroups.
- As the network grows, it can be very difficult to manage.

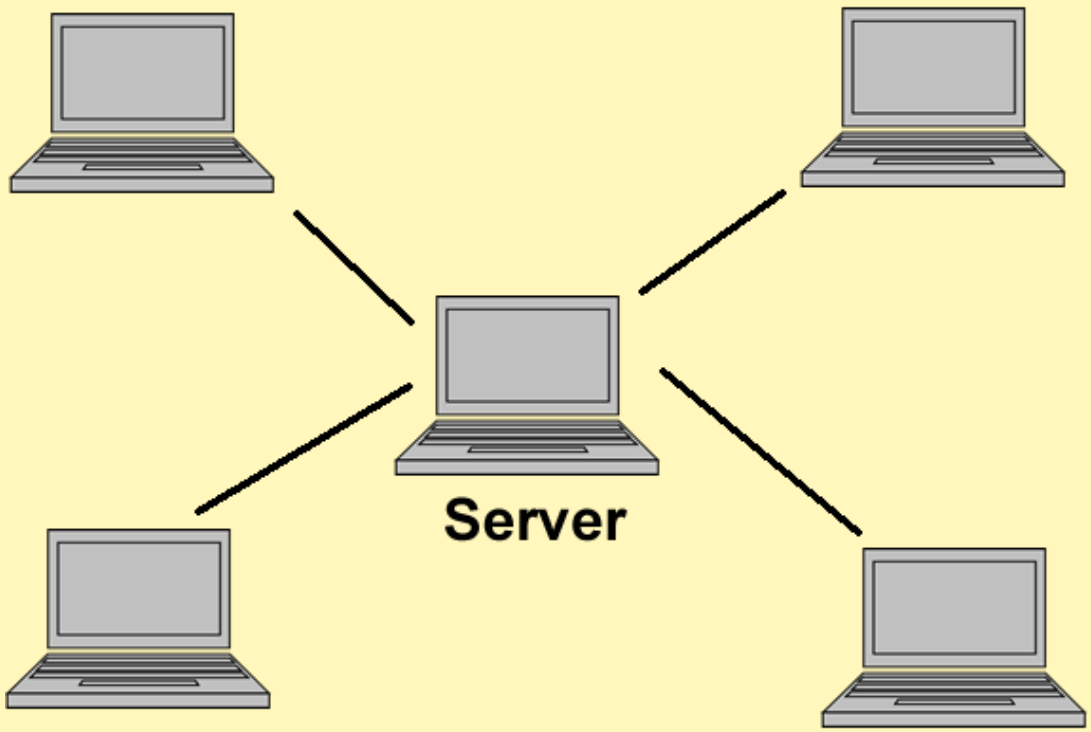
Advantages of Peer-to-Peer

- Easy to install and configure
- Users control their own shared resources.
- Inexpensive to purchase and operate
- Need no additional equipment or software
- No dedicated administrators are needed.

Disadvantages of Peer-to-Peer

- Security applied resource by resource
- May need as many passwords as there are shared resources
- Each PC must be backed up to protect shared data.
- PC performance is reduced when a shared resource is accessed.
- No centralised approach to store or control access to data.
- No access to a resource if PC storing it is unavailable

Client-Server Networks - 1



Client-Server Networks - 2

- Works well in larger networks
- Central server provides services and files
- Server-based networks are the most common.
- Servers can have specific functions, e.g.
  - File
  - Print
- Clients may be standard PCs or thin-clients with no storage media.

Advantages of Client-Server

- Network administration simplified by centrally controlled user accounts, security, etc.
- More efficient access to resources
- Server hardware design is more robust
- A single password gives access to network-wide resources.
- Used for networks with 10 or more users or any networks with high usage

Disadvantages of Client-Server

- Server failure causes major problems:
  - May make whole network unusable
  - Will at least result in loss of network resources
- Complex server software
  - Requires allocating expert staff
  - Increases costs
- Dedicated hardware and specialised software add to the cost of server-based networking.

Small Business

- A typical small business may be characterised by:
  - Having 100 computers or less
  - Being located in a single building
  - Not needing a complex and restrictive security policy
  - Not encrypting network data
  - Requiring a simple Internet connection
- Remember all businesses are not the same:
  - Some may have highly complex machines (engineering)
  - Some will need complex security (personal and/or financial data)

Small Business Networks

- Use a server if budget allows
- Designate few computers as file-sharing computers
- Users have their own home directory on the server.
- Users may have read-only access to each other's home directory to facilitate file sharing.
- Common folders with access for all users
- Applications can be shared across a network.
- Applications can be installed on a network file server and run from workstations.

Sharing Peripherals

- Networking allows hardware sharing as well as software and file sharing.
- Printers can be shared in a network
  - A typical issue in small businesses is sharing personal printers attached directly to a user's PC
  - Better: connect a printer directly to the network
- Scanners can also be shared

Internal Communication

- Users can use the network to communicate with each other in many ways:
  - Email
  - Instant messaging
  - Calendar sharing
  - Whiteboard sharing
  - Video conferencing
- These functions are also available via the Internet.

Buying Equipment

- Much network equipment is aimed at large companies.
- A small business will not generally require such high specification equipment.
- A typical small business might require:
  - One or two servers
  - A few dozen workstations
  - A few switches
  - A router to connect to the Internet

Buying Computers - 1

- Many large manufacturers have small business sections to help.

- Some general rules are:
  - Buy the best that the budget allows, to meet the business needs of the next 2-3 years
  - The ability to expand memory and storage is important

Buying Computers - 2

- General rules (cont.)
  - Look for fault-tolerant storage solutions, use RAID technology on servers
  - Business computers offer more than home computers
  - May get discount for multiple purchases

Wiring Connections

- Always use network jacks at the work area wired to a patch panel in the wiring closet
  - Never run cables from the back of the computer directly to the hub or switch
- Category 5e or 6 (ideally) cable should be used.
- Use switches instead of hubs
  - speed, support for multiple media types.
- Ensure the network is secure.

Larger Businesses

- Require larger networks
- Networks can be made larger by:
  - Physically expanding a current network to support additional computers
  - Segmenting the network into smaller pieces to filter and manage network traffic
  - Extending the network to connect separate LANs.
- Many devices can accomplish these tasks
  - Repeaters, bridges, switches, routers and gateways

Network Troubleshooting

- Network problems can come from a number of areas:
  - Cabling and components
  - Fluctuations in power
  - Upgrades to network components
  - General performance (data transfer rates)

Cabling & Components

- Problems with cables or computers
- Use the same type of UTP cable throughout the network
- Check cable lengths to make sure you do not exceed the maximum length limitation.
- Check for faulty or misconfigured NICs
  - If the NIC seems functional and you are using TCP/IP, use Ping to check connectivity to other computers

Power Fluctuations

- Power fluctuations in a building can adversely affect computers.
- Verify that servers are functioning
- If there is a power outage, it takes a few minutes for servers to come back online.
- Eliminate effects of power fluctuations by connecting devices to UPSs.
- Some packages perform shutdowns automatically if there are power issues.

Network Upgrades

- Adding new network devices may cause problems.
- Keep software current and do one upgrade at a time.
- Test upgrades before deploying on your production network.
- Do not forget to tell users about upgrades.

Network Performance

- Determine if there is anything different since the network last functioned normally:
  - New equipment
  - New applications
- Check network users:
  - New users
  - Game playing/videos
- Check for equipment that may cause interference.

Troubleshooting Method

1. Determine what the problem is
2. Gather relevant information
3. Consider possible causes
4. Devise a potential solution
5. Implement the solution
6. Test the solution
7. Document the solution
8. Implement methods to prevent reoccurrence

Troubleshooting Tools

- Experience
- Data sources (Internet, manuals)
- Network documentation
- Digital voltmeters
- Time-domain reflectometers
- Cable testers
- Network monitors
- Protocol analysers

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Topic 6 – Network Hardware

Any Questions?