

ET0730

Chapter 1

Introduction to Computer Networking

Singapore Polytechnic
School of Electrical & Electronic Engineering

Objectives

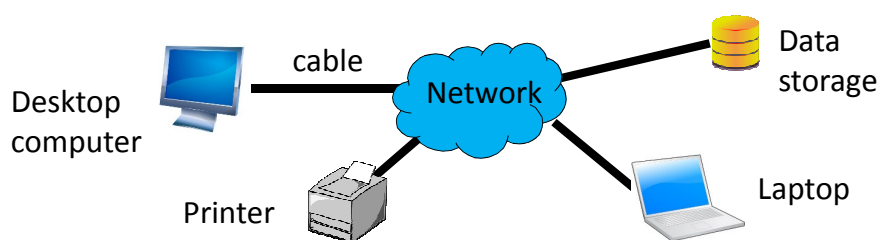
- To identify the four basic elements of networks.
- To distinguish different types of networks (LAN, WAN, Internet, and Intranet).
- To describe the differences among hubs, switches, and routers.
- To describe different models of Distributed Computing.

Outline



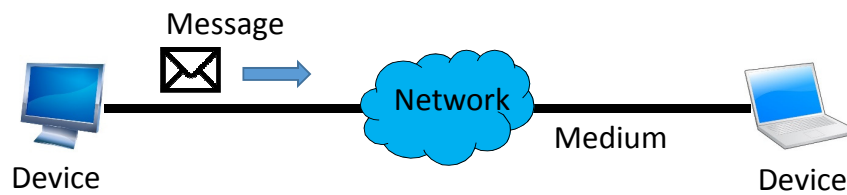
- Basic Elements of Networks
 - Devices, media, messages, rules
- Types of Networks
 - LAN, WAN, Internet, Intranet
- Networking Devices
 - Hubs, switches, routers
- Models of Distributed Computing
 - Client-server, peer-to-peer

What are Computer Networks?



- Computer networks connect computers, printers and other peripherals together, allowing people to **communicate** or **share resources**.
- We use computer networks for learning, working, playing, etc.
- Computer networks carry voice, video streams, text, and graphics between many different types of devices.

Basic Elements of Networks

**Rules:**

- Max. length of message=?
- Must start with ...
- What if fails to send...

- All networks have four basic elements in common:

- Devices
 - Used for exchange messages with each other.
- Media
 - A means of interconnecting devices.
- Messages
 - Information that travels from one device to another.
- Rules
 - How messages are sent, directed, received and interpreted.

Devices (1)

- Two types: **End Devices** and **Intermediary Devices**.
- End Devices
 - Devices that often originate/consume messages in our communication.
 - Also referred to as “**hosts**”.
 - A host device is either the source or destination
 - Examples: computers, servers, IP phones, network printers, IP cameras.



Computer



Server



IP Phone

Network
printer

IP Camera

Devices (2)

- Intermediary Devices

- Devices used for **directing** and **managing** messages across the network.
- Examples: Switches, routers, firewall devices, modems.

Intermediary devices from Cisco

Switch



Firewall device

Router

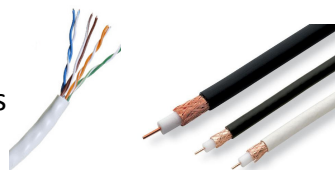


Modem

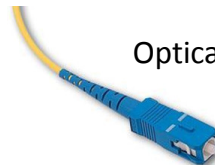
Media

- The medium that interconnects devices can be **wired** or **wireless**.
- Wired media can be **copper cables** or **optical fibres**.
 - Copper cables carry electrical signals.
 - Optical fibres carry light signals.

Copper cables



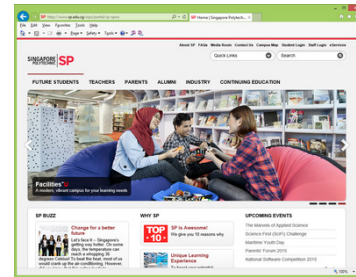
Optical fibre



- Wireless media can be the Earth's atmosphere or space.
 - The signals are microwaves.

Messages

- “Messages” include:
 - web pages
 - e-mail
 - instant messages
 - telephone calls
 - other forms of communication enabled by the Internet.



WhatsApp

Rules (Protocols)

- Devices interconnected by medium to provide services must be governed by rules.
- **Protocols** are the rules that the networked devices use to communicate with each other.
- Example: **TCP/IP** (Transmission Control Protocol/Internet Protocol).
- TCP/IP protocols specify the **formatting**, **addressing** and **routing mechanisms** that ensure the delivery of our messages to the correct recipient.

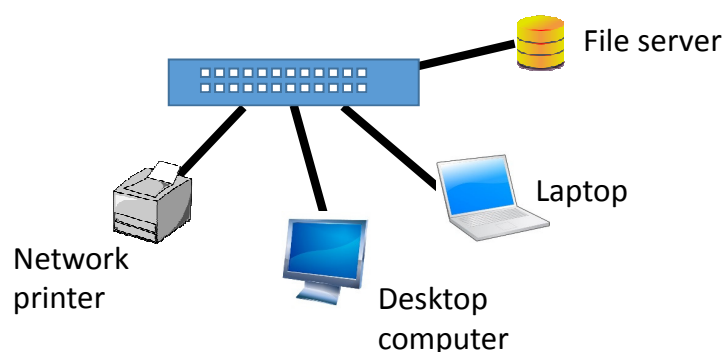
Types of Networks

- 2 main types of networks:
 - Local Area Network (**LAN**)
 - Wide Area Network (**WAN**)
- LANs and WANs differ in
 - geographic area
 - installation & equipment costs
 - Support/maintenance costs

Local Area Networks (LANs) (1)

- Used within small areas (e.g. within an office, building).
- Provide services and applications to people within a common organizational structure, such as a single business, campus or region.

**An example
of LAN**



Local Area Networks (LANs) (2)

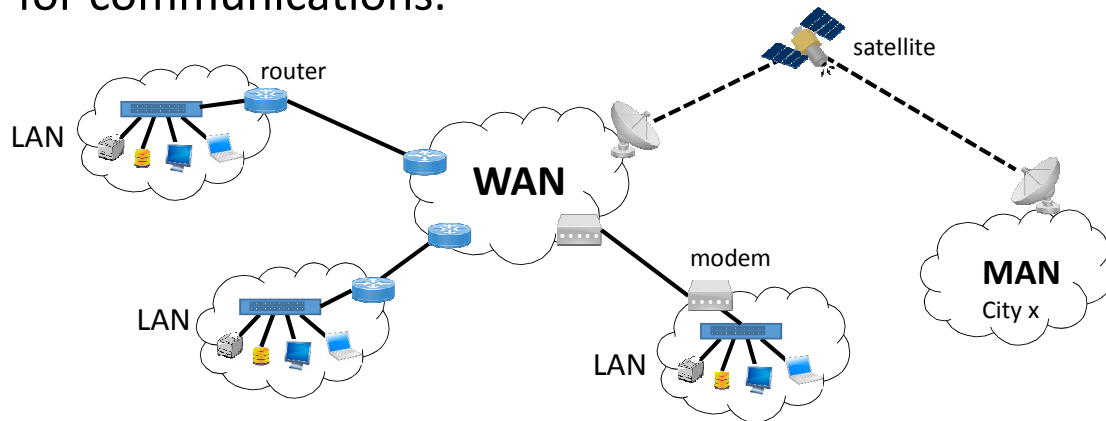
- A LAN is usually administered by a single organization.
- The administrative control that governs the security and access control policies are enforced on the network level.
- Offer high-speed communication, e.g. 1 Gbps.
- Use LAN-specific equipment (e.g. hubs or switches).

Wide Area Networks (WANs) (1)

- If a company or organization has locations that are separated by **large geographical distances**, it may be necessary to use a telecommunications service provider (TSP) to **interconnect the LANs** at the different locations.
- The networks that connect geographically separated LANs are referred to as Wide Area Networks (WANs).
- WANs use specifically designed network devices to make the interconnections between LANs.

Wide Area Networks (WANs) (2)

- Span very large geographic area (e.g. country).
- Connects 2 or more LANs/MANs together using relatively slow-speed connections .
- May use satellite, routers, modem or WAN switches for communications.



The Internet (1)

- Besides using a LAN or WAN for communication within own organization, users also need to communicate with a resource on another network outside the organization.
- Examples of outside communication needs:
 - E-mail a friend in another country.
 - Access news or products on a website.
 - Download a file from a company web-site.
 - Send instant messages with a relative in another city.

The Internet (2)

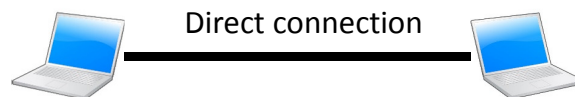
- The most well-known and widely used **publicly-accessible** internetwork is the **Internet**.
- The Internet is created by the interconnection of networks belonging to **Internet Service Providers** (ISPs).
- These ISP networks connect to each other to provide access for millions of users all over the world.

Intranet

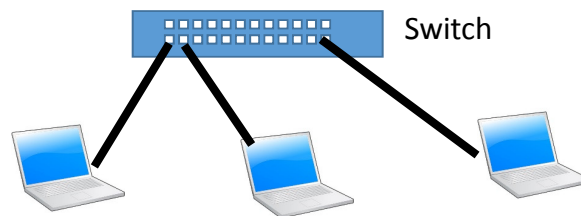
- The term intranet is often used to refer to a private connection of LANs and WANs that belongs to an organization.
- An Intranet is designed to be accessible only by the organization's members, employees, or others with authorization.

Networking Devices

- A minimum network has two hosts.

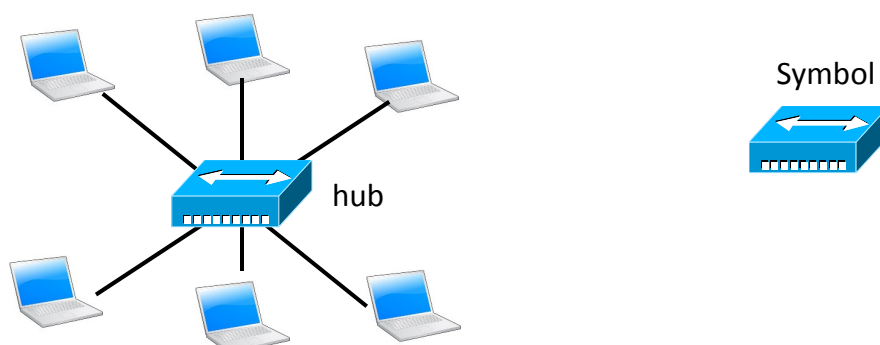


- When there are more than two hosts, we need networking devices to provide the connection.
- Examples of networking devices:
 - Hubs
 - Switches
 - Routers



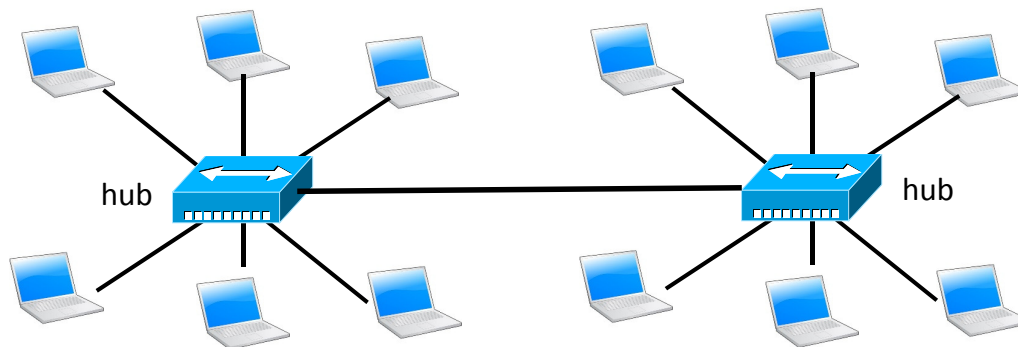
Hubs (1)

- Simple **star topology** network consists of hosts connected to single hub.
- Performance is slow because data is sent to all computers connected to the hub (bandwidth is shared).



Hubs (2)

- To increase number of available nodes, can cascade hubs; also known as daisy-chaining (connecting a port on one hub to a port on another hub).



Switches (1)

- Switches send data only to the intended recipient, not all computers connected to it.
 - Bandwidth is not shared.
 - Improves network performance.
- Switches connect multiple segments of a LAN together, thus reduces total LAN traffic.
- Switches allow different speeds (e.g. 100 Mbps, 1 Gbps) on different ports.



A Cisco switch:

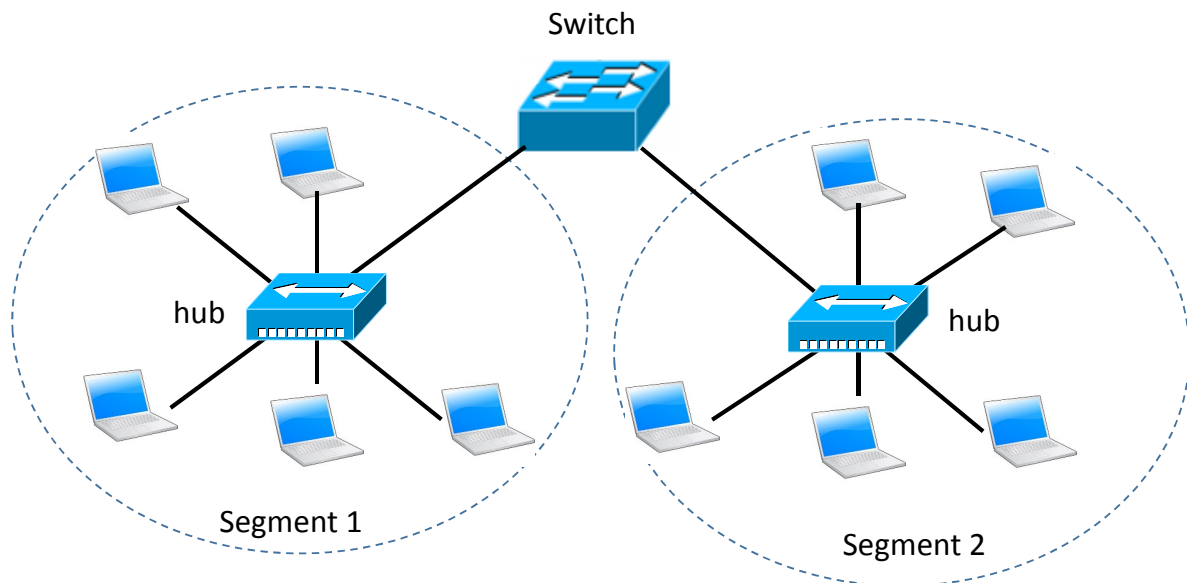
Catalyst 2924
(24 ports)

Symbol



Switches (2)

- Example: A Local Area Network (LAN) comprising of two segments connected by a switch.



Routers (1)

- Used to route messages among sub-networks on a computer network.
- Find the best path for data packets from the source to the destination network.
- Also used to connect computer network to the Internet.

A Cisco 2900-series router

Front view



Rear view

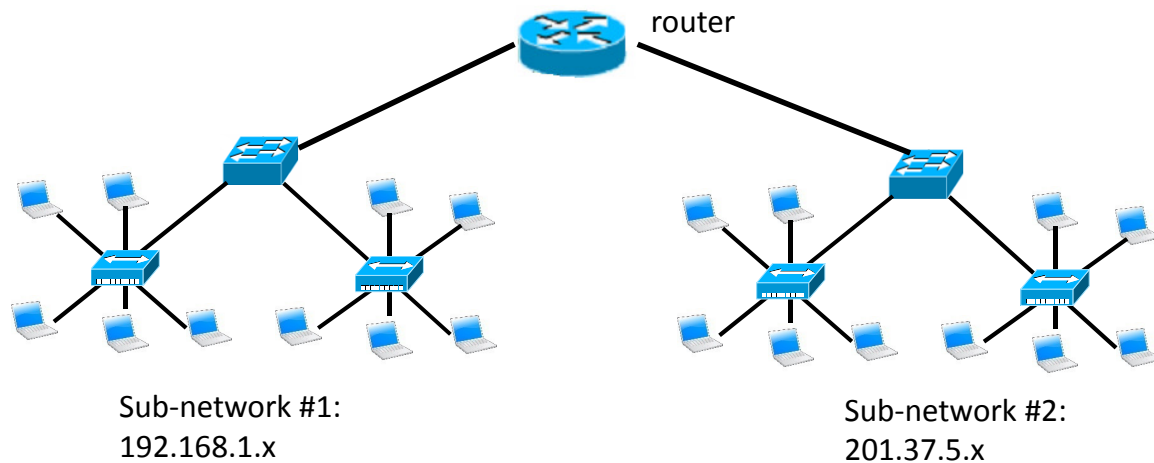


Symbol



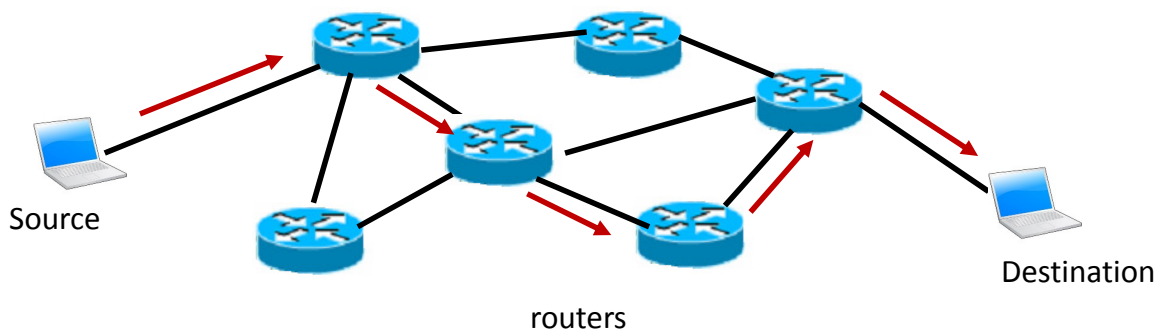
Routers (2)

- Example of a router routing messages among sub-networks on a computer network:



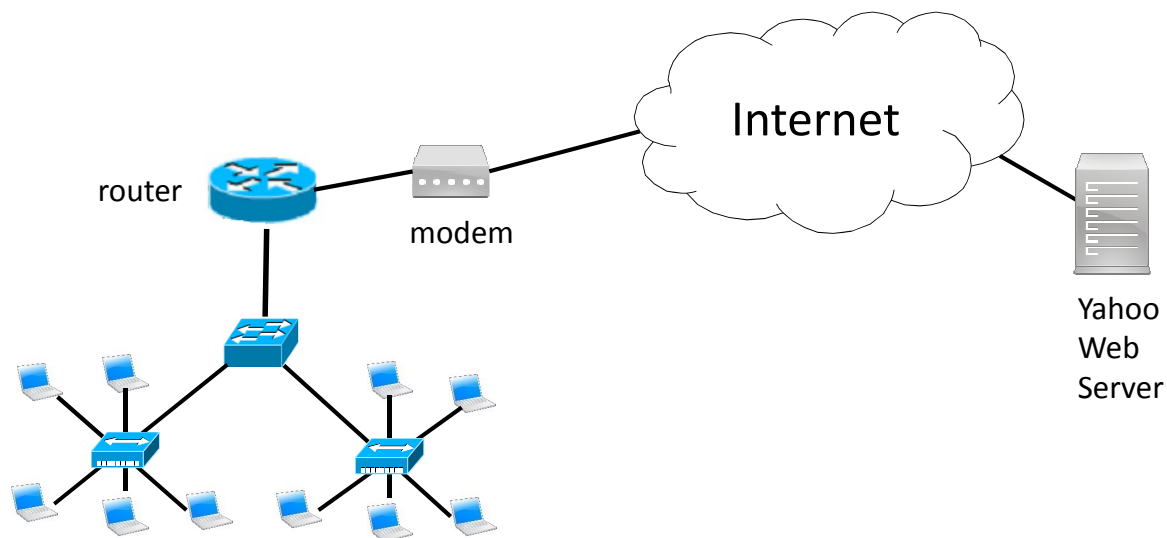
Routers (3)

- Example of routers finding the best path for data packets from the source to the destination network:



Routers (4)

- Example of using router to connect computer network to the Internet:



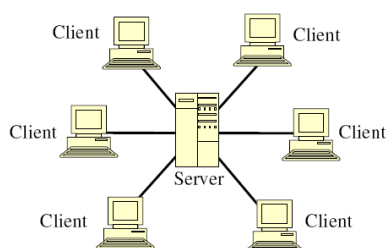
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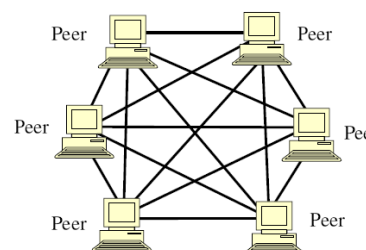
Models of Distributed Computing

- Two models:
 - Client-server model
 - Peer-to-peer model

Client-server Model



Peer-to-peer Model



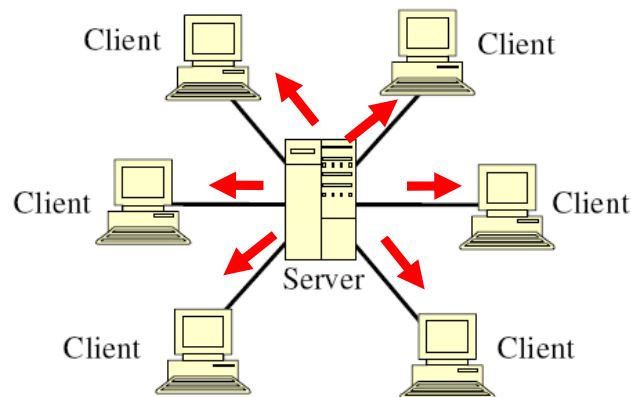
The lines connecting the computers represent flow of information, not physical wirings.

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Client-server Model (1)

- In Client-server model, a number of client computers request for resources (e.g. data, video stream, ...etc) from the central server.
- Example:
 - Server: A web server that hosts the web-site for SP.
 - Clients: Student laptops that are browsing the web-page of SEEE.

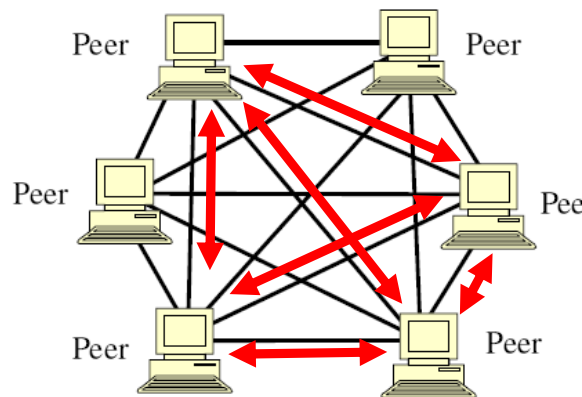


Client-server Model (2)

- Dedicated computer running Server OS.
- Centralized management and control.
- Centralized servers provide data, services and applications to client computers.
- Scalable – can support a large network up to thousands of users.
- High level of security based on access permissions.

Peer-to-peer Model (1)

- In Peer-to-Peer model, each node is a **client as well as a server**.
- All peers provide resource to other nodes.



Peer-to-peer Model (2)

- Meant for small networks < 15 users.
- Low cost.
- All computers in network are considered equal.
- No centralization - user files are not stored in a central location.
- No need for network administrator. Users manage their own resources.

Comparison between Client-server model and Peer-to-peer model

Client-server model

- Advantages:
 - Centralized control & management.
 - More efficient file management.
 - Better security.
 - Excellent logging facilities.
- Disadvantages:
 - If server goes down, resources are unavailable.
 - More difficult to configure & manage.
 - Requires additional hardware & software.

Peer-to-peer model

- Advantages:
 - Simple to setup.
 - Minimal additional hardware/software required.
 - Printers & files can be easily shared .
- Disadvantages:
 - Lack of centralized control.
 - Inconsistent availability.
 - Uneven performance.
 - Poor security.

Questions & Answers

