University of Nottingham
UK | CHINA | MALAYSIA

COMPUTER NETWORKS

AY2022-2023 Spring Semester

COMP1047 Systems & Architecture

Ying Weng

Computer Networks Part-3. Network Topologies

Physical Topologies

➢ **Physical topologies**

- The mapping of the nodes of a network
- The physical connections between them

❖ For example

- The layout of wiring, cabling the locations of nodes
- The interconnections between the nodes and the cabling or wiring system

Point to Point

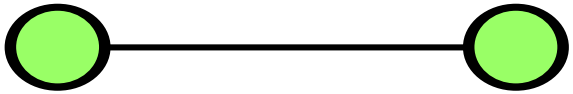
- **[1] Point-to-Point**

- The simplest topology is a permanent link between two endpoints
- Switch point-point topology is the basic model of conventional telephony

❑ The point-to-point topology is divided into two variants

Point to Point

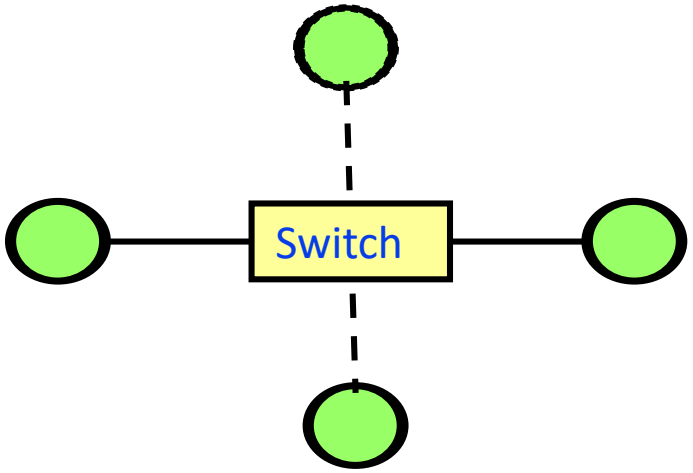
- **[1a] Permanent (dedicated)**
- Easiest to understand
- A point-to-point communication channel to be permanently associated with the two endpoints



Permanent point-to-point network topology

Point to Point

- **[1b] Switched**
- Using circuit switching or packet switching technologies
- A point-to-point circuit can be set up dynamically, and dropped when no longer needed
- This is the basic mode of conventional telephony



Switched point-to-point network topology

Bus

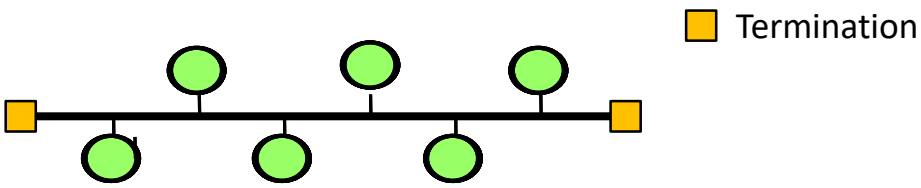
- **[2] *Bus***
- Consists of a single cable, called the bus, that connect all nodes on a network
- Supports only one channel for communication

❑ The bus topology is divided into two variants

Bus

[2a] Linear bus

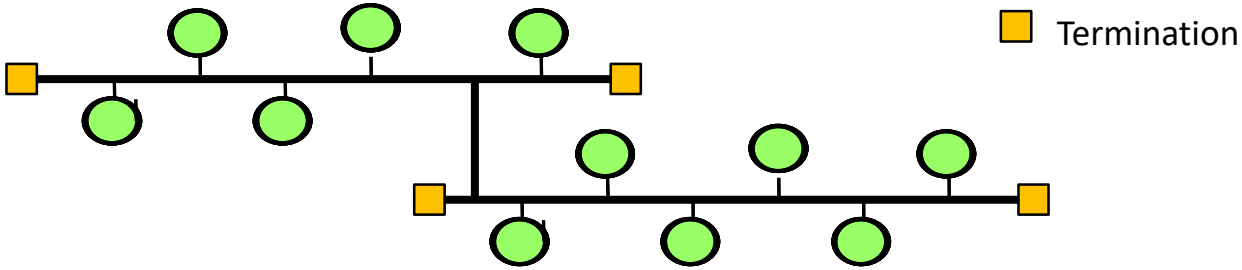
- All of the nodes are connected to a common transmission medium which has **exactly two endpoints** (this is the 'bus', which is also commonly referred to as the backbone or trunk)
- All data are transmitted over this common transmission medium
- All data are able to be received by all nodes in the network virtually simultaneously (disregarding propagation delay)
- An electrical bus would require suitable terminations at each end of the bus to prevent the signal reflecting back along the bus



Linear bus network topology

[2b] Distributed bus

- All of the nodes are connected to a common transmission medium which **has more than two endpoints**
- Is created by **adding branches to the main section** of the transmission medium
- The physical distributed bus topology functions in exactly the same fashion as the physical linear bus topology (i.e., all nodes share a common transmission medium).



Distributed bus network topology

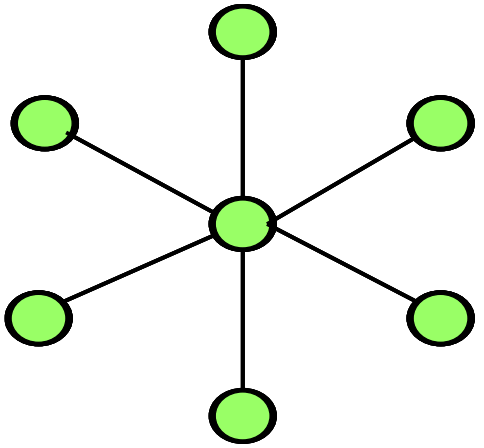
Star

- **[3] Star**
- Every node is connected through **a central device**
- Years ago, the connecting device would have been a hub
- On modern networks, the connecting device is a router or switch.

❑ The star topology is divided into three variants

[3a] Simple Star

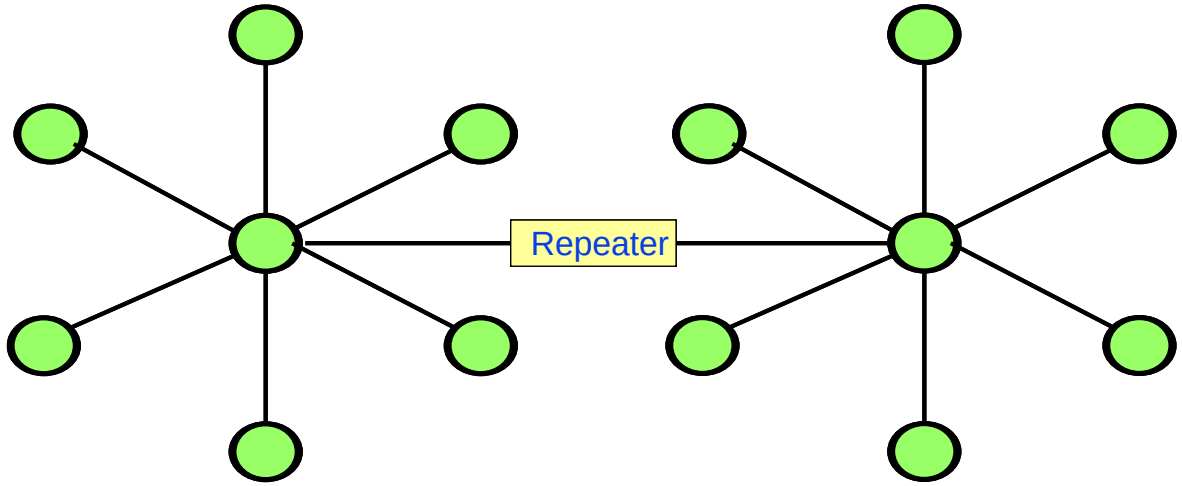
- Each of the nodes is connected to a central node with a point-to-point link in a 'hub' and 'spoke‘ fashion
- The central node is the 'hub‘
- The nodes attached to the central node are the 'spokes‘
- All transmitted data must pass through the 'hub‘ node which will retransmit the data according to a defined protocol
- Without any active device to repeat the signals



Simple star network topology

○ [3b] Extended Star

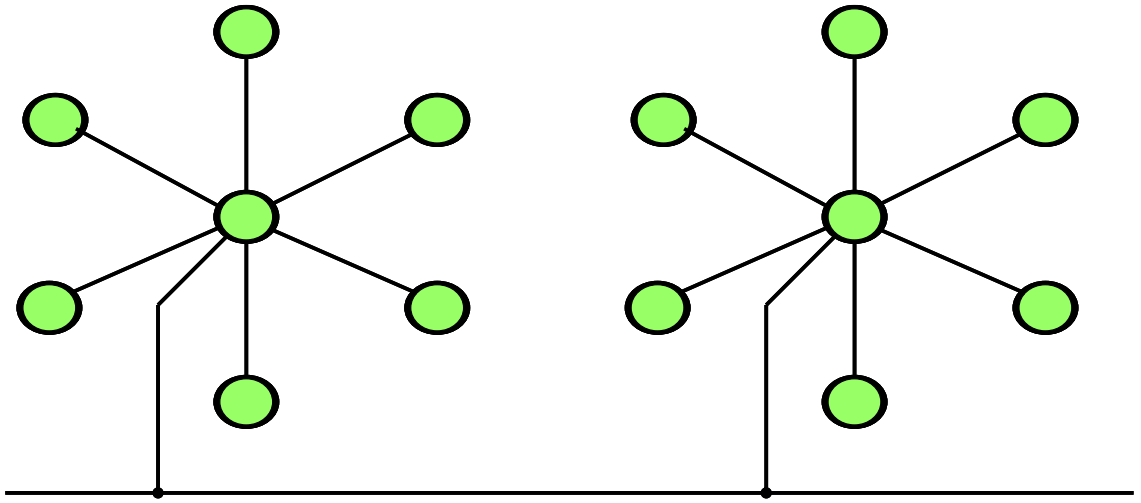
- Has one or more repeaters between the central node (the 'hub' of the star) and the peripheral or 'spoke' nodes,
- Repeater is used to extend the maximum transmission of the simple star network



Extended star network topology

- **[3c] Distributed Star**

- Connects multiple star networks with a daisy chain in a linear fashion
- Has no hierarchy and no central connection from which a set of stacked hubs emerge



Distributed star network topology

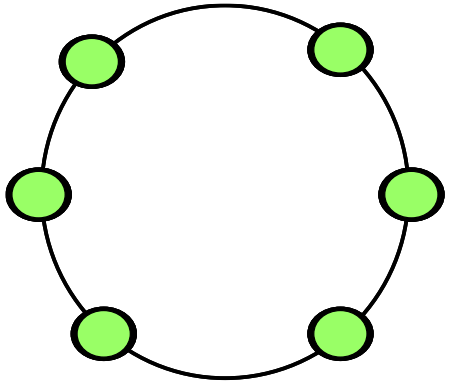
Ring

- **[4] Ring**
- Every node is connected to the two nearest nodes so that the entire network forms a circle

❑ The ring topology is divided into two variants

○ [4a] Simple Ring

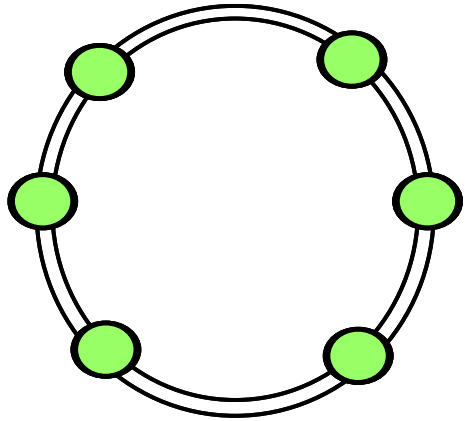
- Each node of the network is connected to two other nodes in the network
- The first and last nodes being connected to each other, forming a ring
- All transmitted data travel from one node to the next node in a circular manner
- The data generally flow in a single direction only



Single ring network topology

[4b] Dual Ring

- This is similar to the simple ring however each node connects to two other nodes with two connections to form a double ring
- The dual ring has twice the capacity of the single ring as data can travel in both directions simultaneously
- The dual ring provides protection in the case of a link failure between two nodes as the data can be rerouted the opposite way round the ring



Dual ring network topology

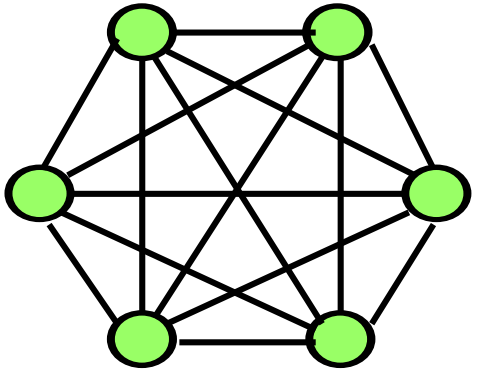
Mesh

- **[5] Mesh**
- Nodes in the network are connected to other nodes in the network with a point-to-point link

❑ The mesh topology is divided into two variants

[5a] Fully connected mesh

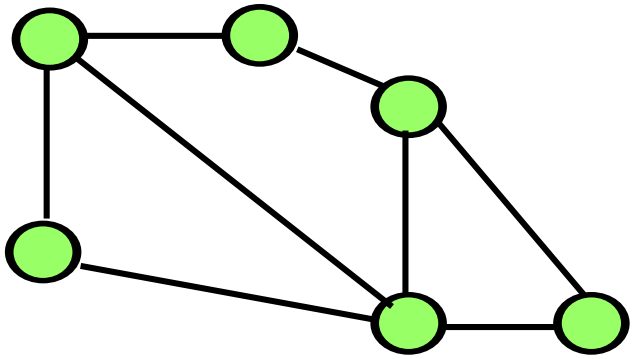
- Each node in the network is connected to each of the other nodes in the network with a point-to-point link
- This makes it possible for data to be simultaneously transmitted from any single node to all of the other nodes
- This is generally too expensive for large networks



Fully connected mesh network topology

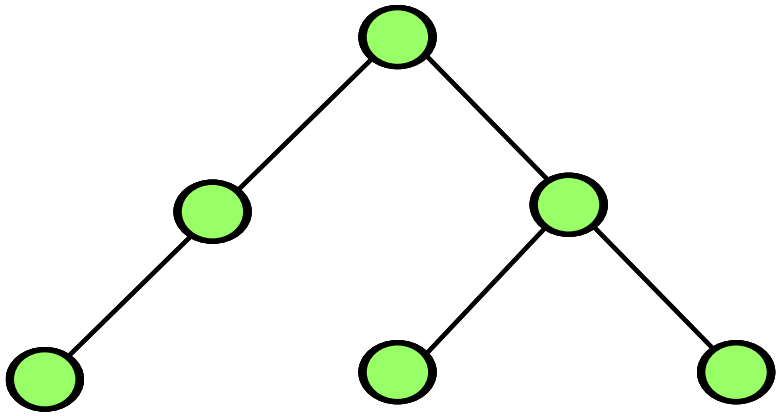
- **[5b] Partially connected mesh**

- Some of the nodes of the network are connected to more than one other node in the network with a point-to-point link
- This makes it possible to take advantage of some of the redundancy that is provided by a physical fully connected mesh topology
- Without the expense and complexity required for a connection between every node in the network



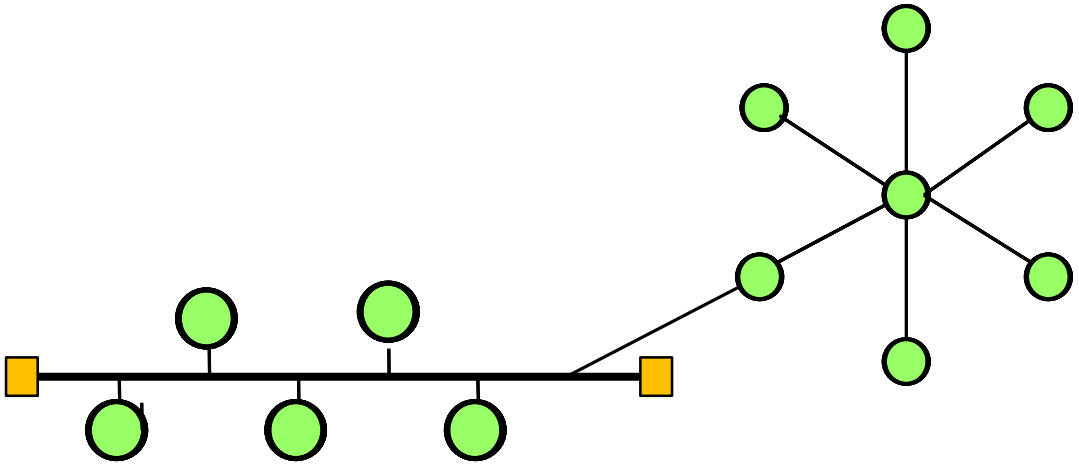
Partially connected mesh network topology

- **[6] Tree (or Hierarchical Network)**
  - A central 'root' node (the top level of the hierarchy) is connected to one or more other nodes that are one level lower in the hierarchy (level 2).
  - Each of the second level nodes are connected to one or more nodes that are one level lower in the hierarchy (level 3) .
  - The network can consist of multiple levels or layers.
  - Each node in the network has a specific fixed number of nodes connected to it at the next lower level in the hierarchy, the number, being referred to as the **'branching factor'**.



Tree network topology.

- **[7] Hybrid**
  - Hybrid networks use a combination of any two or more topologies in such a way that the resulting network does not exhibit one of the standard topologies
  - Two common examples for hybrid network topology: star bus and star ring
  - An example of star bus network topology is shown below



Star bus network topology

Hybrid

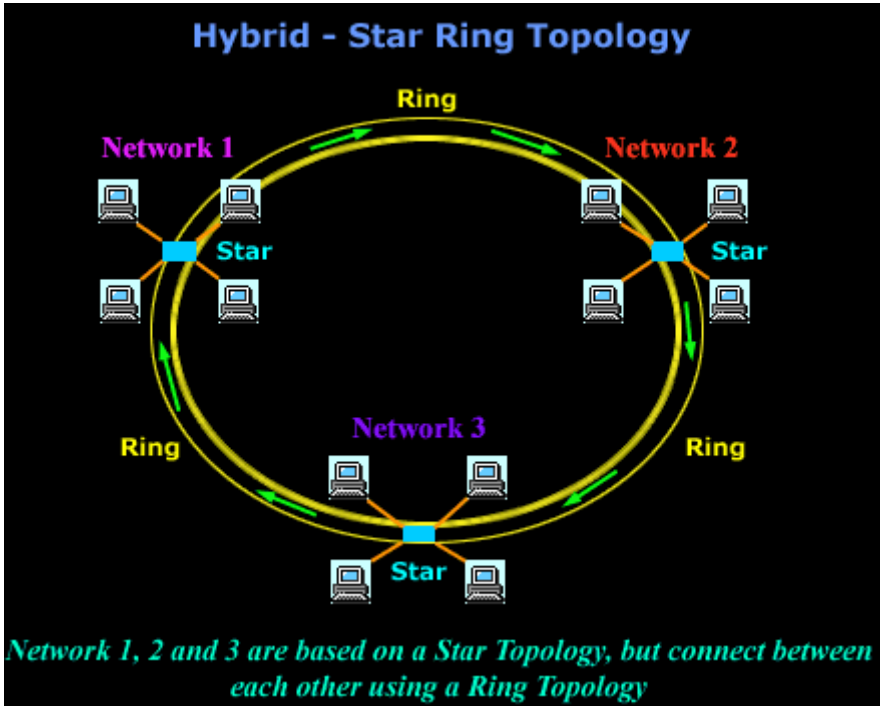
- A star ring network consists of two or more star topologies connected using a multi-station access unit (MU) as a centralized hub

Question: Can you give an example of star ring network topology?

Solution

- A star ring network consists of two or more star topologies connected using a multi-station access unit (MU) as a centralized hub

Question: Can you give an example of star ring network topology?



Physical Topologies

- A summary of the advantages and disadvantages of the most common topologies.
- As a comparison with wireless networking is also included.

➢ Bus topology:

Advantages	Disadvantages
Cheap and easy to implement.	Network disruption when computers are added or removed.
Require less cable.	A break in the cable will prevent all systems from accessing the network.
Does not use any specialized network to troubleshoot.	Difficult to troubleshoot.

Physical Topologies

- **Ring topology:**

Advantages	Disadvantages
Cable faults are easily located, making troubleshooting easier.	Expansion to the network can cause network disruption.
Ring networks are moderately easy to Install.	A single break in the cable can disrupt the entire network.

Physical Topologies

- **Star topology:**

Advantages	Disadvantages
Easily expanded without disruption.	Requires more cable.
Cable failure affects only a single User.	A break in the cable of central node will prevent all systems from accessing the network.
Easy to troubleshoot and isolate problems.	More difficult to implement.

Physical Topologies

- **Mesh topology:**

Advantages	Disadvantages
Provides redundant paths between Devices.	Requires more cable than the other LAN topologies.
The network can be expanded without disruption to current users.	Complicated implementation.

Physical Topologies

- **Wireless networking:**

Advantages	Disadvantages
Allows for wireless remote access.	Potential security issues associated with wireless transmissions.
Network can be expanded without disruption to current users.	Limited speed in comparison to other network topologies.


Thank you