

Alexandria University
Institute of Graduate Studies and Research
Department of Information Technology
M.Sc. program in Information Technology
2020



Assignment (1) of
Comparison of network topology types
in
Communication Systems and Computer Networks
1404703

Supervisor
Prof. Shawkat K. Guirguis

Name: Israa Faisal Jassam
ID: 1404-3-160

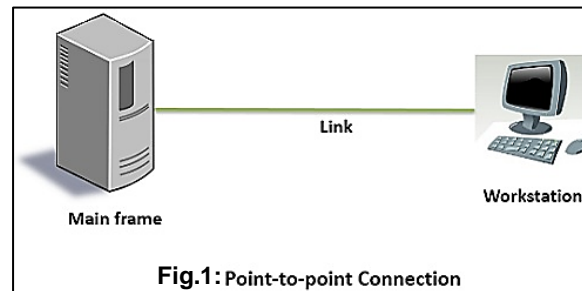
1. Introduction

1.1 Network topologies:

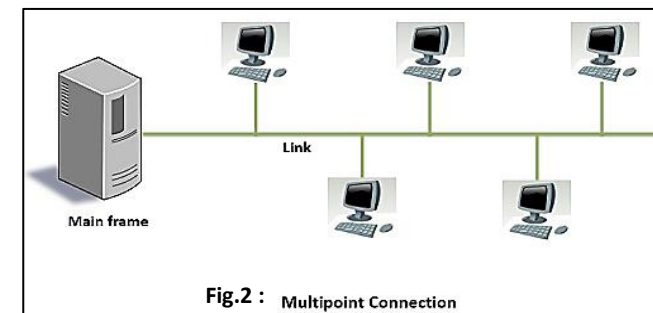
It is the schematic description of a network arrangement, connecting various nodes (sender and receiver) through lines of connection. There are two types of network topologies: physical and logical. Physical topology confirms the physical layout of the connected devices and nodes, while the logical topology focuses on the pattern of data transfer between network nodes.

1.1.1 Physical topology: refers to the interconnected structure of a local area network (LAN). The method employed to connect the physical devices on the network with the cables, and the type of cabling used, all constitute the physical topology. Physical topology is further divided into two sections, Point-to-point connections and Multipoint connections.

- **point-to-point connection:** a communication link is established between two devices with one wire. A simple example of point-to-point connection is talking over telephone between two persons where anyone else is not allowed to use the phone on either side (Fig.1).



- **multipoint connection:** is a connection established between more than two devices. In multipoint connection, a single link is shared by multiple devices. So, it can be said that the channel capacity is shared temporarily by every device connecting to the link. If devices are using the link turn by turn, then it is said to be time shared line configuration. Example of a multipoint connection is communication between a group of computers in a network (Fig.2).



1.1.2 The logical topology:

Describes how data moves from node to node. It is the way that the signals act on the network media, or the way that the data passes through the network from one device to the next without regard to the physical interconnection of the devices.

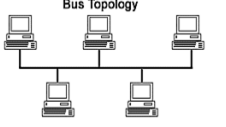
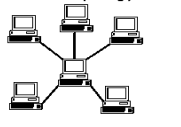
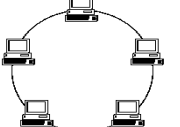
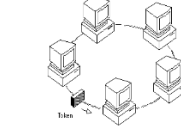

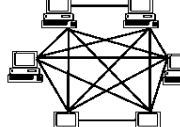
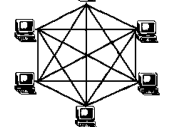
1.1.3 Considerations When Choosing a Topology:

- Money. (A linear bus network may be the least expensive way to install a network; you do not have to purchase concentrators or hub) .
- Length of cable, Number and location of users. (The linear bus network uses shorter lengths of cable) .
- Future growth or Expandability. (With a star topology, expanding a network is by adding concentrators).
- Cable or Wireless type. (The most common cable in schools is unshielded twisted pair, which is most often used with star topologies).

1.2 Types and Comparisons Between the Topologies:

There are several types of topology, and we will explain the comparison between the most famous seven types, which are Bus, Star, Ring, Token-ring, Tree, Mesh, and Fully in table (1-1).

Table (1-1) Comparison of Topology Types

Point	Bus	Star	Ring	Token-ring	Tree	Mesh	Fully	
Topology								
Architecture	is a topology for a Local Area Network (LAN) in which all the nodes are connected to a single cable. The cable to which the nodes connect is called a "backbone". If the backbone is broken, the entire segment fails.	is a topology for a Local Area Network (LAN) in which all nodes are individually connected to a central connection point, like a hub or a switch. A star takes more cable than e.g. a bus, but the benefit is that if a cable fails, only one node will be brought down.	A ring topology is a network configuration where device connections create a circular data path. Each networked device is connected to two others, like points on a circle. Together, devices in a ring topology are referred to as a ring network.	a communication protocol in a local area network (LAN) where all stations are connected in a ring topology and pass one or more tokens for channel acquisition. A token is a special frame of 3 bytes that circulates along the ring of stations. A station can send data frames only if it holds a token. The tokens are released on successful receipt of the data frame.	in Tree Topology, all the computer is connected to the central hub, in the computer networking, tree topology is known as combination of a star network topology and a bus topology. In tree topology, all the computers are connected like the branches of a tree.	a network setup, all the computers are connected to each other in a network. It is very difficult to establish the connections of the mesh topology. In a Mesh topology every computer has a point-to-point connection to the other computer. In order to connect n nodes, mesh topology require $n(n-1)/2$ communication links.	all the computers connected to every other computer. Full Mesh is a network in which devices are organized in a mesh topology. A full mesh topology provides a great deal of redundancy, but because it can be prohibitively expensive to implement, it is usually reserved for network backbones.	
Delay	*Rank	3	9	4	6	3	7	9
	Reason	Slow response time because of one computer transmit at a time	Good response time, depends on delay of hub	Data has to make a lot of stops	When the token become empty, the computer can send, this helps to reduces chances of collision then reduce delay.	Slowly because of more traffic.	Manages high amounts of traffic, because multiple devices can transmit data simultaneously.	Manages high amounts of traffic, because multiple devices can transmit data simultaneously.

Point		Bus	Star	Ring	Token-ring	Tree	Mesh	Fully
Complexity	Rank	9	7	3	3	7	4	3
	Reason	Easy to connect or remove nodes in a network without affecting any other node	average complexity each device connects to central device with only one link only	Complexity because of simple to data to devices	all devices connected with each other's	More complex because of tree is combination a star network topology and a bus topology	Installation is complex in mesh topology, as each node is connected to more than one node.	Installation is very complex in mesh topology, as each node is connected to every others node.
Security	Rank	2	7	3	4	4	4	9
	Reason	Any computer that is connected to bus topology network will be able to see all the data transmissions on all the other computers	Security depends on central device security	data travels from one device to the next until they reach their destination	data travels from one device to the next until they reach their destination	The data pass over more than one node	The data pass over more than one node	It provides high privacy and security, due to point-to-point links
Congestion control	Rank	4	6	7	7	8	7	9
	Reason	signal send source from broadcast and travels to all work stations connected to bus cable. Although the message broadcasted but only one computer at a time can transmit a packet on a bus topology	compared Bus topology it gives far much better performance, signals don't necessarily get transmitted to all the workstations.	All the traffic flows in only one direction, this reduces chances of collision.	specially-formatted frame, called a token, travels around the ring, stopping at each host. The destination host takes the data out of the frame. No data collisions.	It is ideal when the workstations are located in groups, with each group occupying a relatively small physical region. An example is a university campus in which each building has its own star network, and all the central computers are linked in a campus-wide system.	separate cable to connect every other device on the providing straight communication sending messages, check connected into two devices. A message is sent sender to receiver because individual and separate	Data can be transmitted from different devices simultaneously. This topology can withstand high traffic
Routing methodology	Rank	2	6	7	7	5	6	6
	Reason	when device sends broadcast message onto the cable that all other devices see the message only the intended recipient accepts the message	communicate across the network by passing data send through the hub	All computer is connected to two others, like points on a circle	Very organized	All the computer is connected to the central hub, in the computer networking, tree topology is known as combination of a star network topology and a bus topology	It has multiple links, so if one route is blocked then other can be accessed for data communication	It has multiple links, so if one route is blocked then other can be accessed for data communication

Point		Bus	Star	Ring	Token-ring	Tree	Mesh	Fully
Reliability	Rank	2	6	3	3	5	7	9
	Reason	If the common cable fails, then the whole system will crash down	If hub fails, then the whole system will crash down.	If the cable fails or any computer shuts down, then the whole system will crash down.	If the cable fails or any computer shuts down, then the whole system will crash down.	In case of any node failure, other hierarchical networks are not affected.	allows a routing-based network to operate in case a node when a connection becomes Finally, the network becomes as there is often more than between a destination in source itself.	A failure of one device does not cause a break in the network or transmission of data.
Cost	Rank	9	5	3	3	5	4	3
	Reason	Cost of the cable is less as compared to another topology	Star topology requires more wires & hub, compared to the ring and bus topology.	High cost because of costly connection device.	High cost because of costly connection device.	Large cabling is required as compared to star and bus topology.	The length of cable used long, the cost to implement is higher than other network topologies	The length of cable used very long, The cost to implement is higher than other network topologies
Advantages		<ul style="list-style-type: none"> • It works well when you have a small network. • It's the easiest network topology for connecting computers or peripherals in a linear fashion. • It requires less cable length than a star topology. 	<ul style="list-style-type: none"> • Centralized management of the network, through the use of the central computer, hub, or switch. • Easy to add another computer to the network. • If one computer on the network fails, the rest of the network continues to function normally. 	<ul style="list-style-type: none"> • All data flows in one direction, reducing the chance of packet collisions. • A network server is not needed to control network connectivity between each workstation. • Data can transfer between workstations at high speeds. • Additional workstations can be added without impacting performance of the network. 	<ul style="list-style-type: none"> • No collisions. • No terminators required. • Data packets travel at great speed. • Easier to fault find. 	<ul style="list-style-type: none"> • It is a combination of bus and star topology • It provides high scalability, as leaf nodes can add more nodes in the hierarchical chain. • Other nodes in a network are not affected, if one of their nodes get damaged • It provides easy maintenance and fault identification. • Supported by several hardware and software vendors. • Point-to-point wiring for individual segments. 	<ul style="list-style-type: none"> • The failure of a single node in the network can cause the entire network to fail. • The transmission speed drops with an increase in the number of nodes. • Fault tolerance. • Guaranteed communication channel capacity. • Easy to troubleshoot. 	<ul style="list-style-type: none"> • A fault is one terminal on the network will not affect the rest, as the data has multiple redundancy paths, depending on the size of the network, that are open to it. • Data transmitted via different cables reducing network clogging-keeping data transfer rates at an acceptable level.

Point	Bus	Star	Ring	Token-ring	Tree	Mesh	Fully
Disadvantages	<ul style="list-style-type: none"> • It can be difficult to identify the problems if the whole network goes down. • It can be hard to troubleshoot individual device issues. • Bus topology is not great for large networks. • Terminators are required for both ends of the main cable. • Additional devices slow the network down. • If a main cable is damaged, the network fails or splits into two. 	<ul style="list-style-type: none"> • May have a higher cost to implement, especially when using a switch or router as the central network device. • The central network device determines the performance and number of nodes the network can handle. • If the central computer, hub, or switch fails, the entire network goes down and all computers are disconnected from the network. 	<ul style="list-style-type: none"> • All data being transferred over the network must pass through each workstation on the network, which can make it slower than a star topology. • The entire network will be impacted if one workstation shuts down. • The hardware needed to connect each workstation to the network is more expensive than Ethernet cards and hubs/switches. 	<ul style="list-style-type: none"> • Requires more cable than the bus. • Not common as the bus. • A break in the ring will bring it down. • Less device available. 	<ul style="list-style-type: none"> • Large cabling is required as compared to star and bus topology. • On the failure of a hub, the entire network fails. • Tree network is very difficult to build Architecture than other network topologies. • 	<ul style="list-style-type: none"> • A lot of cabling is required. Thus, the costs are high. • Owing to its complexity, the administration of a mesh network is difficult. • Difficulty of installation and reconfiguration. • Cost of maintaining redundant link. 	<ul style="list-style-type: none"> • A large amount of cabling is required. • Complicated implementation
Total of Rank	31	46	30	33	37	38	48

* **Note:** the number **9** means **excellent**, **8** means **very good**, **7** means **good** and so on.

1.3 Conclusion:

According to the comparison points above, the best topology is Fully connected topology, since every device is connected to every other device, thus maximizing speed and security. These, however, are quite expensive to install Star topology. next best is Star, and then Mesh, Tree, Token, Ring, finally Bus topology which is pretty old, but not too expensive..., which is basically a connection of start.

1.4 References:

1. Computer Networks, Fifth Edition, By ANDREW S. TANENBAUM and DAVID J. WETHERAL, Prentice Hall, 2011.
2. https://link.springer.com/referenceworkentry/10.1007/1-4020-0613-6_12282
3. <https://computernetworktopology.com/category/type-of-network-topology/>
4. <https://www.computerhope.com/jargon/m/mesh.htm>
5. https://www.ibm.com/support/knowledgecenter/en/SSGU8G_14.1.0/com.ibm.erep.doc/ids_erp_101.htm
6. <https://www.geeksforgeeks.org/types-of-network-topology/>
7. <https://hmhub.me/star-topology/>
8. <http://www.pearsonitcertification.com/articles/article.aspx?p=101697>
9. <https://www.studytonight.com/computer-networks/network-topology-types>
10. <https://www.kullabs.com/classes/subjects/units/lessons/notes/note-detail/6969>
11. <http://webpage.pace.edu/ms16182p/networking/ring.html>
12. <https://techdifferences.com/difference-between-point-to-point-and-multipoint-connection.html>