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The article explains types of network topology, including Bus, Star, Ring, Mesh, and Hybrid, along with their advantages and disadvantages. It also covers networking models, hardware components, and different area networks (LAN, WAN, MAN). By the end of this article, you will be able to: Describe the TCP/IP model and its relationship with the OSI model. Describe the items that exist on a network. Explain the concept of host virtualization. Compare the various types of network models and topologies. Networking Models The Transmission Control Protocol and Internet Protocol (TCP/IP) Model consists of four layers. It is important to remember that the TCP/IP is a two-way model (up and down data flow). Figure 1 TCP/IP Model 1. Network Interface: The Network Interface layer is also known as the Link Layer. It describes how a host accesses the network. For example, copper wire (Ethernet), fiber optics, or radio spectrum (wireless). 2. Internet: The Internet layer determines the routing decisions based on the protocol being used and the information in the data packet. 3. Transport: The Transport layer ensures protocols are followed in host-to-host communications. 4. Application: The Application layer is responsible for the protocol needed for an application to run. It specifies which ports and sockets are needed for the application. A good way to think about the TCP/IP model is a condensed version of the Open Systems Interconnection (OSI) model, where some layers are combined into one. See Figure 2 to review the TCP/IP layers and how they coincide with the four OSI layers: 1) Data Physical Link, 2) Network, 3) Transport, and 4) Application Presentation Session. Figure 2 OSI Data Flow: Representations of TCP/IP and OSI Layers Hardware Components of a Computer Network In the following section, you will learn about the components that comprise a computer network. A is a device connected to a network is a host. A host serves some kind of purpose on the network no matter how unsophisticated. A host can be a number of things: computer workstation, phone (VoIP), printer, server, router, switch (multilayer), hub, bridge, and repeater. A computer workstation can be a Desktop or Laptop computer commonly used for personal use. Their purpose can be business, recreational or both. An organization may have several computer workstations “attached” or running on their network. A VoIP telephone uses an Ethernet connection in order to place and receive calls. This functionality is different from traditional phone systems which use Plain Old telephone service (POTS) lines. Network printers allow for multiple users within an organization to print. This is different from local printers where only the person attached via a serial cable could print at a time. Servers are computational systems with expanded resources needed to provide service to clients (i.e. computer workstations) on a network. They will typically have more memory, hard drive space, and processor cores, as well as advanced software and interface cards. Routers are used to direct data traffic through different network segments and are often located near the network perimeter. Routers are also used to pass data packets through the internet to a given destination. The tall beige router with the green tag is one of the first routers ever developed for ARPANET. Other more modern and Wireless Routers are seen here as well. In data centers or highly connected environments, it is common to see routers in a network rack. The network switch is used to interconnect multiple hosts on a network. A switch has some intelligence built into it. A switch can map the media access control (MAC) addresses of hosts connected to its ports. When data comes into the switch, it can direct that traffic to a specific port where the destined host is located. A bridge joins two separate networks into one. This functionality can be accomplished using a network switch. A network hub is also used to connect host on a network, however, they are not used in highly active environments. Hubs have no intelligence built into them and can often drop packets in a highly active networks. Hubs have one collision domain, meaning no matter how many devices you have connected, only one is allowed to use the media at one time. Hosts connected to a hub may try to send and receive at the same time, which will create a collision and data packets can get “lost” or drop. A wireless repeater is used when a wireless (RF) signal is weak and needs to be amplified. The wireless repeater extends the range of a wireless signal. For example, if a wireless signal has a range of 50 meters and you were 75 meters away, you could use a wireless repeater to connect. Virtualization A virtual switch can shape and control network traffic, and employ protective measures against other virtual machines. Virtual switches are often used within virtualization products like Hyper V and VMware. Offsite hosting is similar to a hosted environment where someone else manages your servers on their network. Whereas, in an onsite environment your organization supplies the network resources, servers, and employees needed to manage the equipment. Organizations may consider using offsite hosting for a lower cost vs. hosting onsite which will have higher costs and overhead expenses. Review the following list of key facts that are important to be aware of. Key Facts - Virtual systems run on top of physical systems or appliances. - Virtual Desktops and Servers can be run using software. (i.e. Citrix, VMware, HyperV, etc.) - A Virtual Switch uses software to emulate the same functions of a physical switch. - The Internet enables the ability to route calls using the Internet (IP addressing) vs. physical wiring - a virtual or hosted PBX. - Network as a Service (NaaS) – entails using a third-party provider for network resources. Offsite cloud technology. Network Models in Computer Networks There are network models and topologies which describe how computational systems communicate and interconnect with each other. The most popular network model is the Client–Server model. The Client–Server model describes when a computer system processes requests from other computer systems and is used for large networks, centralized administration, and security, and provides performance benefits. Figure 3 Client-Server Model Diagram in Computer Networking The other well-known network model is the Peer-to-Peer model. The Peer-to-Peer model describes when each computer system on the network can request or processes request from other computers. The benefits this model provides for large networks are performance, security, and centralized administration. A Peer-to-Peer model is easy to set up, used for small networks, and decentralizes administration. Figure 4 Peer-to-Peer Model Diagram in Computer Networking Network Topology Types with Diagrams Network topologies can be viewed as a “MAP” of the network. It shows how the nodes interconnect. The Institute of Electrical and Electronic Engineers (IEEE) sets the standards for computer network technology. There are five network topologies identified below: Bus, Token Ring, Star, Mesh, and Hybrid. Bus Topology in Computer Network Bus topology is one of the simplest forms of network architecture, where all devices are connected to a single communication line called the “bus” or backbone. The bus serves as a shared transmission medium, allowing devices to send and receive data sequentially. When a device transmits data, the signal propagates along the bus and is received by all connected devices. However, only the intended recipient processes the data, while others ignore it. A terminator is attached to both ends of the bus to prevent signal reflection, which could cause data interference. Bus topology typically uses coaxial or fiber-optic cables for data transmission. Protocols like Carrier Sense Multiple Access with Collision Detection (CSMA/CD) are often used to manage data collisions. Figure 5 Bus Topology Diagram in Computer Network: Black lines indicate endpoints. Token Ring Topology in Computer Network Token ring topology organizes network devices in a logical circular structure, where data flows unidirectionally between them. A special data packet called a “token” circulates through the ring. A device must acquire the token to transmit data, ensuring orderly communication and preventing data collisions. Each device in the ring acts as a repeater, regenerating and passing the token and data to the next device. The logical circular connection can be implemented physically in a ring or using centralized hardware like a Multi-Station Access Unit (MSAU). Figure 6 Token Ring Topology Diagram in Computer Network Star Topology in Computer Network In star topology, all devices are connected to a central hub, switch, or router using dedicated communication lines. The central hub acts as the mediator, receiving data from one device and forwarding it to the intended recipient. Devices in this topology do not communicate directly, ensuring structured data transfer. The central device plays a crucial role in managing data traffic and isolating faults. Star topology is widely used in modern Local Area Networks (LANs) and wireless networks due to its efficiency and reliability. Figure 7 Star Topology Diagram in Computer Network Mesh Topology in Computer Network Mesh topology creates a network where devices (nodes) are interconnected, forming multiple communication paths. It can be categorized into: Full Mesh: Every node is directly connected to all other nodes. Partial Mesh: Some nodes are interconnected, while others are not directly linked. This topology provides high redundancy and reliability. If one connection fails, data can take alternative routes to reach its destination. Mesh networks are common in mission-critical applications, such as military communication systems and financial infrastructures. Figure 8-1 Mesh Topology Diagram in Computer Network Hybrid Topology in Computer Network Hybrid topology combines two or more topologies, leveraging their strengths to meet specific network requirements. For example, a hybrid network may integrate star and bus topologies, using a central hub to connect star-configured subnets to a bus backbone. This topology is highly versatile and can be customized for various use cases, making it ideal for large, dynamic environments like corporate offices or university campuses. Figure 8-2 Hybrid Topology (Star-Bus topology) Diagram in Computer Network Network Topology Advantages and Disadvantages Topology Advantages Disadvantages Bus Topology – Cost-effective and easy to set up. – Difficult to troubleshoot. – Ideal for small networks. – Performance decreases with more devices. Token Ring – Prevents data collisions using token-based access. – Slower than other topologies in high-demand networks. – Deterministic performance. – Failure of one device can affect the entire network. Star Topology – Easy to add/remove devices. – Failure of the central hub disrupts communication. – Centralized management and fault isolation. – Requires more cabling compared to bus topology. Mesh Topology – High redundancy and fault tolerance. – Expensive due to extensive cabling. – Ideal for mission-critical systems. – Complex installation and maintenance. Hybrid Topology – Combines the strengths of multiple topologies. – Complex to design and manage. – Scalable and flexible. – Cost can increase depending on the design and components used. Area Networks Types in Computer Network Computer networks are classified based on their geographical coverage and functional scope, allowing them to cater to different needs and environments. Below, we provide a detailed explanation of the main types of area networks: LAN, WLAN, CAN, MAN, and WAN, highlighting their technical characteristics, advantages, and typical applications. Local Area Network (LAN) A Local Area Network (LAN) is a computer network that connects devices within a limited geographical area, such as a home, office, school, or campus. LANs are designed to facilitate high-speed communication and resource sharing among devices like computers, printers, and servers. Typically, LANs use Ethernet cables or wireless connectivity for data transmission. They often employ star or bus topologies, with switches and routers serving as the backbone of the network infrastructure. Ethernet-based LANs (IEEE 802.3) support wired connections, while wireless LANs operate on Wi-Fi standards (IEEE 802.11). Transmission speeds in LANs can range from 100 Mbps to 10 Gbps, ensuring efficient handling of local data traffic. Due to their confined scope, LANs are relatively easy to set up and maintain, making them cost-effective and highly reliable for small-scale networking. Figure 9 LAN – Local Area Network (i.e. Office Building) Wireless Local Area Network (WLAN) A Wireless Local Area Network (WLAN) is an extension of LAN that uses wireless communication technology instead of cables for device connectivity. WLANs rely on radio frequency (RF) signals to establish communication between devices and access points, providing flexibility and mobility for users. Operating under the IEEE 802.11 standards, WLANs are commonly deployed in homes, offices, and public spaces like cafes and airports. They enable users to connect multiple devices, including laptops, smartphones, and IoT devices, without the need for physical cabling. WLANs generally cover a radius of up to 150 feet indoors and more in outdoor environments. However, wireless communication is prone to interference and may have lower data transmission speeds compared to wired LANs. Security protocols like WPA2 or WPA3 are crucial to protect WLANs from unauthorized access and data breaches. Figure 10 WLAN – Wireless Area Network (i.e. Wireless LAN) Campus Area Network (CAN) A Campus Area Network (CAN) spans a larger geographical area than a LAN, such as a university, corporate campus, or industrial park. It connects multiple buildings or departments within a campus-like environment, forming a unified network that supports high-speed communication and data sharing. CANs typically use a combination of fiber optics and Ethernet cables for robust and reliable connectivity. They often integrate multiple LANs into a cohesive structure, with a central backbone for managing traffic. The primary purpose of a CAN is to facilitate seamless communication and resource sharing between various facilities, such as labs, libraries, and administrative offices. CANs are cost-effective compared to Wide Area Networks (WANs) because they cover a limited area and are managed internally. However, they require specialized planning and management to ensure smooth operation across the network. Figure 11 CAN – Campus Area Network (i.e. University Campus) Metropolitan Area Network (MAN) A Metropolitan Area Network (MAN) is a network that spans a city or a large metropolitan area. MANs are designed to interconnect multiple LANs within a city, providing high-speed communication and resource sharing over a broader geographic area. They often use fiber-optic cables and technologies like Multiprotocol Label Switching (MPLS) or Asynchronous Transfer Mode (ATM) for efficient data transmission. Typical applications of MANs include connecting government institutions, universities, and large enterprises across different locations within the same city. With data speeds ranging from 10 Mbps to several Gbps, MANs are ideal for supporting applications that require significant bandwidth, such as video conferencing and cloud computing. Despite their extensive coverage, MANs are limited to city-scale operations and are more complex to manage than LANs. Figure 12 MAN – Metropolitan Area Network (i.e. City limits) Wide Area Network (WAN) A Wide Area Network (WAN) is the largest type of computer network, covering vast geographical areas such as countries, continents, or even the entire globe. WANs connect multiple smaller networks, including LANs and MANs, to enable long-distance communication and data transfer. The internet is the most prominent example of a WAN. These networks rely on technologies like satellite links, leased lines, and public telecommunications infrastructure to maintain connectivity. Protocols such as Frame Relay, MPLS, and IPsec are commonly used to manage WAN traffic. WANs are essential for organizations with distributed offices and global operations, allowing seamless data sharing and collaboration. However, WANs are expensive to set up and maintain due to their reliance on external service providers and advanced infrastructure. Additionally, they may experience higher latency compared to local networks. Figure 13 WAN – Wide Area Network (i.e. New York to Chicago) Network Topology Key Takeaways This article introduced the physical and virtual network components. The information covered various objects which will help when discussing different types of network models and topologies. The TCP/IP model along with two common network models were described, the Client–server and Peer-to-Peer network models. The article explained the models and relating them to physical systems helped one see how each host, and workstation, makes up a network. Different types of network topologies were also discussed to provide an idea of the various ways a network can be constructed and the scope or range they have. A topology is a relationship exist between the links and linking devices (nodes) to each other which is represented by a geometric representation. Star and Ring topology are the types of network topologies. The crucial difference between star and ring topology is that the star topology is suitable for a primary-secondary type of connection whereas ring topology is more convenient for the peer-to-peer connection. The link is shared equally in the peer-to-peer connection. Inversely, in a primary-secondary relationship one device is used to control traffic and other devices must transmit the signal through it. Content: Star Topology Vs Ring Topology Comparison Chart Definition Key Differences Conclusion Comparison Chart Basis for comparisonStar TopologyRing Topology Architecture structure Peripheral nodes are linked to the central device known as a hub. Every node has two branches connected to a node either side of it. Amount of cabling required Larger Less as compared to star topology Point of failure Hub Every node in the ring Data traversal All data passes through the central network connection. Data moves in only one direction around the ring till it arrives the destination. Network expansion A new cable is plugged in from the new node to the hub. In order to add a new node, a connection must be broken which turns down the network. Fault isolation Easy Difficult Troubleshooting The other nodes are affected only in the case of a hub failure.When a node goes down the information continues to transfer till the damaged node. Cost High Low Definition of Star Topology Star Topology is the network architecture in which each device has a dedicated point-to-point link only to the central controller known as a hub. There is no direct link exists among the devices. It is dissimilar to mesh topology which allows direct traffic between the devices. In Star topology, the controller plays an important role and act as a mediator. When a device wants to send data to another, it first sends data to the controller which then relays the data to other connected devices. Star topology needs only one link and I/O port to connect a device to another. That is the reason it is easy to install and reconfigure. The addition, deletion, replacement of the devices involves only one connection that is between that device and the hub. The cabling requirements are less in the star topology, but it is greater when we compare it with other topologies such as tree, ring and bus. This topology is robust where even if the link fails, only that link is influenced and the other links remain active. It also makes fault identification and isolation easier. Hub observes link problems and bypasses faulty links. Definition of Ring Topology The Ring Topology connects each device with dedicated point-to-point line configuration to other two adjacent devices, and the first device connects to the last device. It passes a signal in only one direction from one device to other until it reaches the device sent the signal. A repeater is installed in each device in the ring. If a device receives a signal meant for another device, the device regenerates the bits and boosts the signal by using a repeater that is installed on each device and transfers them along. When the signal reaches the destination, the receiver sends back an acknowledgement to the sender. Ring topology is easy to install and configure as each device is linked to its immediate neighbour. The addition, deletion and repositioning of a device just require changing only two connections. The only limitations are the traffic and media considerations, i.e., the maximum length of the ring and the number of devices. The fault isolation in a ring can be simplified by using an alarm which alerts the network operator to the problem and its location. A signal is circulated continuously, if any device does not receive a signal within a specified time it can issue an alarm. Though, unidirectional nature of traffic can be disadvantageous for the network where even a single faulty cable can disable the entire network. This limitation can be overcome by employing a switch or a dual ring that is able to closing off the break. Key Differences Between Star and Ring Topology In the star topology, each device is connected to a central node which sends the information received from one device to the other and act as a mediator. On the other hand, in the ring topology, each device has two nodes connected to either side of it, and the last node is connected to the first one. The star topology requires more cable than ring topology. Hub in the star topology is considered as a point of failure because the failure of any device would not affect the whole network, but if hub goes down, no data is transmitted across it. In contrast, each node in the ring topology is considered to be a point of failure as the failure of any device could significantly affect whole ring network. In a star topology, all the data travels through the central hub. As against, in the ring topology, the data passes through each node unidirectionally until it reaches the destination. To add new nodes to the ring network, a cable is used to connect the new device to the hub without influencing the rest of the network. On the contrary, the addition of new devices is done by breaking a connection which results in temporary unserviceable network till the new device is activated. Fault isolation is easier in star topology while it is quite difficult in the ring topology. Troubleshooting in the ring topology is simple, as the information continues to transfer through the rest of ring until reaching the point of failure. Conversely, in the star topology, the other devices are affected only when the connecting device goes down (Hub). Star topology is expensive than the ring because it requires central connecting device usually hub. Conclusion The star topology is used to connect primary-secondary type of connection whereas ring topology is used for peer-to-peer connections. «Network Hardware Devices | Router, Hub, ... A Network topology defines the structure and layout of a network. There are different types of network topologies, each with its unique structure, advantages and disadvantages. In this article, we have explained seven types of network topologies, along with their corresponding diagrams. Understanding the structure of various network topologies is essential for designing an effective network infrastructure.If you are interested in learning the deployment and implementation of different network topologies, check out our networking courses.What is a Network Topology?Network topology refers to the layout and interconnection of devices within a network. It describes how network components like computers, servers, and other devices are connected and communicate with each other.It is crucial for optimizing network performance and reliability. It defines the arrangement of nodes and connections, which directly impacts data flow efficiency. A well-structured network topology reduces congestion and latency, ensuring smooth data transmission. It also supports scalability, enabling easy integration of new devices without disrupting operations. CCNA Certification Training CourseLearn from industry experts and prepare for CCNA.Explore course Types of Network TopologyThere are seven types of network topologies in networking:1. Point-to-Point2. Bus3. Star4. Ring5. Mesh6. Tree7. HybridNow let's discuss these topologies one by one. 1. Point-to-Point TopologyPoint-to-point topology is the simplest network configuration, connecting two nodes directly through a dedicated communication link. This setup resembles a direct line between two endpoints, allowing for efficient and fast data transfer.Think of a telephone call between two people. In a point-to-point topology, like that call, two connected devices communicate directly without interference, sharing the entire bandwidth for high performance and low latency.Advantages:● High bandwidth and fast communication speeds.● Easy to maintain and troubleshoot since only two nodes are involved.Disadvantages:● Limited to two devices; expanding the network requires additional links.● If the connection fails, communication between the two nodes is disrupted.Interested in building a career networking? Contact our learner advisors to know more about training courses. 2. Bus TopologyImagine a long cable, resembling a bus route, with devices connected along its length. This is the essence of a bus topology. In a bus network, all devices share the same communication channel. Data travels along the cable, and each device checks if the data is intended for it. If so, it accepts the data; otherwise, it ignores it.Think of a school bus with seats for students. In a bus topology, devices like computers and printers are arranged in a line along a single cable, which serves as their communication pathway, similar to the bus route.Read more about Bus TopologyAdvantages:● Simple to set up and cost-effective.● Well-suited for small networks with few devices.Disadvantages:● Limited scalability; adding more devices can degrade performance.● A single cable break can disrupt the entire network.3. Star TopologyIn a star topology, each device is connected directly to a central hub or switch. All communication between devices must go through this central point. It's like a hub-and-spoke model, with the hub being the focal point for data transmission.Advantages:● Easy to install, manage, and troubleshoot.● Isolates issues to individual connections; a failure in one device doesn't affect others.Disadvantages:● Dependence on the central hub; if it fails, the entire network goes down.● More cabling is required, making it costlier than bus topology.4. Ring TopologyIn a ring topology, each device is connected to exactly two other devices, forming a closed loop or ring. Data circulates around the ring in one direction. When a device receives data, it processes it and passes it along to the next device until it reaches its destination.Advantages:● Even data distribution, as each device has an equal opportunity to transmit.● Simple and predictable data path.Disadvantages:● A break in the ring can disrupt the entire network.● Adding or removing devices can be complex.5. Mesh TopologyMesh topology is like a web of connections, where each device is connected to every other device. This creates redundancy and multiple paths for data to travel. Mesh networks can be either full mesh (every device is connected to every other) or partial mesh (some devices have fewer connections).Advantages:● High redundancy; network remains operational even if some connections fail.● Scalable and adaptable; can handle a large number of devices.Disadvantages:● Expensive due to the numerous cables and ports required.● Complex to set up and maintain.6. Tree TopologyA tree topology combines characteristics of star and bus topologies, arranging nodes in a hierarchical structure that resembles a tree. In this layout, multiple star networks are connected to a central bus, allowing for a scalable and organized network design.Think of a family tree, where each branch represents different family members connected to a common ancestor. Similarly, in a tree topology, the central node acts as the trunk, with branches extending to various sub-nodes.Advantages: ● Scalable and easy to expand by adding new nodes without disrupting the entire network.● Facilitates better management and organization of devices.Disadvantages:● If the central trunk fails, it can disrupt the entire network.● More complex to configure and maintain compared to simpler topologies.7. Hybrid TopologyA hybrid topology combines two or more different topologies into a single network. This is often done to harness the strengths of one topology while mitigating its weaknesses. For example, a network might use a star topology for its core infrastructure and a bus topology for a smaller, isolated segment.Advantages:● Flexibility to tailor the network to specific needs.● Enhanced fault tolerance by combining different topologies.Disadvantages:● Complexity increases with the number of topologies integrated.● requires careful planning to ensure smooth operation.Where is Network Topology Used?Let's look at the uses of different topology types to get an understanding of where to use a specific type of topology:Topology TypeCommon UsesBus TopologySmall networks, simple LANs, where cost-effectiveness is key.Ring TopologyApplications requiring data integrity, such as token-based networks (e.g., FDDI).Mesh TopologyHigh availability environments like mobile ad hoc networks and air traffic control systems.Star TopologyModern Ethernet LANs, office networks, and Wi-Fi setups for easier management.Tree TopologyLarge organizations needing a structured layout with easy expansion.Hybrid TopologyComplex enterprise networks and backbone infrastructures.Point-to-PointDedicated connections, like leased lines or direct links between devices. What is the Best Type of Network Topology?The best type of topology depends on the factors you care about the most. Here are some factors, and the best type of network topology for it.1. For low costs: Bus and Star2. For high reliability: Mesh and Hybrid3. For high scalability: Tree and Mesh4. For high performance: Mesh and Star CCNA Certification Training CourseLearn from industry experts and prepare for CCNA.Explore course Types of Network ArchitecturesNetwork architecture is the overall design and structure of a network, including its hardware, software, protocols, and layers. It is different from the network topology, as a topology only defines the layout and connections of devices, network architecture defines the broader design and structure of the network.Some common network architectures include 3-tier (core, distribution, access), 2-tier (collapsed core), spine-leaf, SOHO, and cloud architectures. 1. Two-tier Network TopologyTwo-tier network topology is a flat or collapsed core design. It consists of two layers i.e., the access layer and the core layer. In organizations where the network is smaller, scalability and complexity are not much concern generally adopt this type of architecture. Here is the topology of the two-tier network topology for your reference.Scenario: In a small office network, a two-tier topology may consist of access switches connecting end-user devices (such as computers and printers) in the access layer. These access switches are then connected to a core switch or router, which provides connectivity to other networks or the internet.2. Three-tier Network TopologyThree-tier network topology is a 3-layer architecture in which the network is divided into. ✓ Access layer✓ Distribution layer✓ Core layerIt provides better scalability, flexibility, and network segmentation compared to a two-tier design. Here is the three-tier network topology diagram for your reference. Scenario: In an enterprise network, a three-tier topology may consist of access switches in the access layer connecting end-user devices. These access switches are then connected to distribution switches in the distribution layer, which provide connectivity between access switches and aggregate traffic. The distribution switches are further connected to core switches in the core layer, which handle high-speed backbone connections and connect to other networks.3. Spine-Leaf Network TopologyThe Spine-leaf network topology, also referred to as leaf-spine or Clos architecture, is a highly scalable and high-performance design frequently employed in large data centers or cloud environments. It facilitates low-latency and non-blocking communication among devices, ensuring efficient and rapid data transmission. Here is the spine and leaf network topology for your reference.Scenario: In a data center, a spine-leaf topology may consist of leaf switches in the access layer connecting servers or storage devices. These leaf switches are then connected to spine switches in the spine layer, which provide connectivity between leaf switches and facilitate east-west traffic. This design ensures that any device in the network can reach any other device with minimal latency.4. WAN Network TopologyWAN (Wide Area Network) topology refers to the network architecture used to interconnect geographically dispersed locations or branch offices. Here is the WAN topology in which branch offices, regional offices, remote offices, and data centers are connected. There can be thousands of branches which are connected to the WAN infrastructure. Scenario: In a multi-site organization, a WAN topology may involve multiple branch offices connected to a central headquarters. Each branch office typically has its own local area network (LAN) connected to a router, which establishes a connection to the WAN. The WAN network can be implemented using technologies such as leased lines, MPLS (Multi-Protocol Label Switching), VPN (Virtual Private Network), or SD-WAN (Software-Defined Wide Area Network).5. Small Office/Home Office (SOHO) Network TopologySOHO network topology is generally used in a small office or a home office. Here is the typical SOHO network topology for your reference.Scenario: In a home office setup, a SOHO topology may involve a single router or gateway device that connects to the internet service provider (ISP). The end-user devices such as laptops, phones, etc. can be connected to the router via wireless or desktop, and servers can also be connected to the router through wired.6. On-premises and Cloud Network TopologyWhen network architectural designs use both On-premises and cloud networks for deploying network resources. On-premises means deploying network devices infrastructure locally and integrated with cloud services to fulfill all the needs of an organization. Scenario: In a hybrid cloud environment, on-premises network resources such as servers, storage, and switches are interconnected with cloud resources through dedicated connections or secure VPN tunnels. The on-premises network is just like an extension of the cloud network which utilizes the data exchange between the two environments.Summing Up!!Now you can understand that network topologies are essential for designing efficient and resilient communication networks. You already saw each topology has its own set of characteristics, making it suitable for different scenarios. Whether you opt for a simple bus network, a robust star configuration, a circular ring, an intricate mesh, or a hybrid approach, the choice should align with your network's goals, budget, and scalability requirements.The correct topology should be chosen based on the network's size, scalability, and fault tolerance needs. Therefore, each topology has a place in the development of effective and trustworthy communication infrastructures. Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Network topologies describe the methods in which all the elements of a network are mapped. The topology term refers to both the physical and logical layout of a network. Types of Networking Topologies Two main types of network topologies in computer networks are 1) Physical topology 2) Logical topology Physical topology This type of network is an actual layout of the computer cables and other network devices Logical topology Logical topology gives insight’s about network’s physical design. Different types of Physical Topologies are: P2P Topology Bus Topology Ring Topology Star Topology Tree Topology Mesh Topology Hybrid Topology Network Topology Diagram Let’s learn each topology in detail: Point to Point (P2P) Point-to-point topology is the easiest of all the network topologies. In this method, the network consists of a direct link between two computers. P2P Topology Diagram Advantages This is faster and highly reliable than other types of connections since there is a direct connection. No need for a network operating system Does not need an expensive server as individual workstations are used to access the files No need for any dedicated network technicians because each user sets their permissions Disadvantages The biggest drawback is that it only be used for small areas where computers are in close proximity. You can’t back up files and folders centrally There is no security besides the permissions. Users often do not require to log onto their workstations. Bus Topology Bus Topology Diagram Bus topology uses a single cable which connects all the included nodes. The main cable acts as a spine for the entire network. One of the computers in the network acts as the computer server. When it has two endpoints, it is known as a linear bus topology. Advantages Here are pros/benefits of using a bus topology: Cost of the cable is very less as compared to other topology, so it is widely used to build small networks. Famous for LAN network because they are inexpensive and easy to install. It is widely used when a network installation is small, simple, or temporary. It is one of the passive topologies. So computers on the bus only listen for data being sent, that are not responsible for moving the data from one computer to others. Disadvantages Here are the cons/drawbacks of bus topology: In case if the common cable fails, then the entire system will crash down. When network traffic is heavy, it develops collisions in the network. Whenever network traffic is heavy, or nodes are too many, the performance time of the network significantly decreases. Cables are always of a limited length. Ring Topology Diagram In a ring network, every device has exactly two neighboring devices for communication purpose. It is called a ring topology as its formation is like a ring. In this topology, every computer is connected to another computer. Here, the last node is combined with a first one. This topology uses token to pass the information from one computer to another. In this topology, all the messages travel through a ring in the same direction. Advantages Here are pros/benefits of ring topology: Easy to install and reconfigure. Adding or deleting a device in-ring topology needs you to move only two connections. The troubleshooting process is difficult in a ring topology. Failure of one computer can disturb the whole network. Offers equal access to all the computers of the networks Faster error checking and acknowledgment. Disadvantages Here are drawbacks/cons of ring topology: Unidirectional traffic. Break in a single ring can risk the breaking of the entire network Modern days high-speed LANs made this topology less popular. In the ring, topology signals are circulating at all times, which develops unwanted power consumption. It is very difficult to troubleshoot the ring network. Adding or removing the computers can disturb the network activity. Star Topology Star Topology Diagram In the star topology, all the computers connect with the help of a hub. This cable is called a central node, and all other nodes are connected using this central node. It is most popular on LAN networks as they are inexpensive and easy to install. Advantages Here are pros/benefits of start topology: Easy to troubleshoot, set up, and modify. Only those nodes are affected, that has failed. Other nodes still work. Fast performance with few nodes and very low network traffic. In Star topology, addition, deletion, and moving of the devices are easy. Disadvantages Here are cons/drawbacks of using Star: If the hub or concentrator fails, attached nodes are disabled. Cost of installation of star topology is costly. Heavy network traffic can sometimes slow the bus considerably. Performance depends on the hub’s capacity A damaged cable or lack of proper termination may bring the network down. Mesh Topology The mesh topology has a unique network design in which each computer on the network connects to every other. It is develops a P2P (point-to-point) connection between all the devices of the network. It offers a high level of redundancy, so even if one network cable fails, still data has an alternative path to reach its destination. Types of Mesh Topology Partial Mesh Topology: In this type of topology, most of the devices are connected almost similarly as full topology. The only difference is that few devices are connected with just two or three devices. Partially Connected Mesh Topology Full Mesh Topology: In this topology, every nodes or device are directly connected with each other. Fully Connected Mesh Topology Advantages Here, are pros/benefits of Mesh topology The network can be expanded without disrupting current users. Need extra capable compared with other LAN topologies. No traffic problem as nodes has dedicated links. Dedicated links help you to eliminate the traffic problem. A mesh topology is robust. It has multiple links, so if any single route is blocked, then other routes should be used for data communication. P2P links make the fault identification isolation process easy. It helps you to avoid the chances of network failure by connecting all the systems to a central node. Every system has its privacy and security. Disadvantages Installation is complex because every node is connected to every node. It is expensive due to the use of more cables. No proper utilization of systems. Complicated implementation. It requires more space for dedicated links. Because of the amount of cabling and the number of input-outputs, it is expensive to implement. It requires a large space to run the cables. Tree Topology Tree Topology Tree topologies have a root node, and all other nodes are connected which form a hierarchy. So it is also known as hierarchical topology. This topology integrates various star topologies together in a single bus, so it is known as a Star Bus topology. Tree topology is a very common network which is similar to a bus and star topology. Advantages Here are pros/benefits of tree topology: Failure of one node never affects the rest of the network. Node expansion is fast and easy. Detection of error is an easy process It is easy to manage and maintain Disadvantages Here are cons/drawback of tree topology: It is heavily cabled topology If more nodes are added, then its maintenance is difficult If the hub or concentrator fails, attached nodes are also disabled. Hybrid Topology Hybrid Topology Hybrid topology combines two or more topologies. You can see in the above architecture in such a manner that the resulting network does not exhibit one of the standard topologies. For example, as you can see in the above image that in an office in one department, Star and P2P topology is used. A hybrid topology is always produced when two different basic network topologies are connected. Advantages Here, are advantages/pros using Hybrid topology: Offers the easiest method for error detecting and troubleshooting Highly effective and flexible networking topology It is scalable so you can increase your network size Disadvantages The design of hybrid topology is complex It is one of the costliest processes How to select a Network Topology? Here are some important considerations for selecting the best topology to create a network in your organization: Bus topology is surely least expensive to install a network. If you want to use a shorter cable or you planning to expand the network is future, then star topology is the best choice for you. Fully mesh topology is theoretically an ideal choice as every device is connected to every other device. If you want to use twisted pair cable for networking, then you should build star topologies. Summary Topology What it is Image P2P The network consists of a direct link between two computers Bus Uses a single cable which connects all the included nodes Ring Every device has exactly two neighboring devices for communication purpose Star All the computers connect with the help of a hub. Mesh The mesh topology has a unique network design in which each computer on the network connects to every other. Tree Tree topologies have a root node, and all other nodes are connected which forming a hierarchy. Hybrid Topology Hybrid topology combines two or more topologies Read More When designing a computer network, selecting the right topology is crucial for ensuring efficient performance and easy maintenance. Star and Ring topologies are two common types, each with distinct characteristics. Star topology connects all devices to a central hub, making it easy to manage and troubleshoot, While Ring topology connects devices in a circular pattern, offering equal access to network resources but with more vulnerability to failure. Understanding the differences between these topologies helps in choosing the best solution for specific networking requirements.What is Star Topology?In Star topology, the nodes are connected to the central hub or router in which the information is travel from the central hub or router to all the nodes. There are n links in Star topology if there are n nodes. The nodes are connected completely via a dedicated link in which the information is travel from node to node. A new cable is added to the central hub to add a new node in the star topology. Advantages of Star Topology Easy to Install and Manage: The configuration and administration of Star topology are rather simple and that makes it fold suited for small to medium scale networks. Failure Isolation: If one cable or device fails it does not affect the entire network and in the process only the device is isolated from the network. Scalability: This aspect of convenience is given as new devices can be integrated directly to the main controller. Disadvantages of Star Topology Single Point of Failure: This actually has a heart; the middle piece is important and in case it is removed, the network collapses. High Cabling Cost: Every device has to be connected to the hub by its singular cable which is a little expensive if the network is large. What is Ring Topology? In a Ring topology, every node is connected to its left and right side nodes in which the information is travel from node to node in a ring manner in one direction. There are also n links in ring topology like star topology if there are n nodes present. In-ring topology, to add a new node the entire connection must be broken down. Advantages of Ring Topology Equal Access to Resources: In this case, data flow in circles; all the devices have an equal connection to resources, minimizing the chances of accessing a congested network. Better Performance with More Devices: The more devices are connected, the device throughput does not deteriorate making it favorable for large scale networks. Disadvantages of Ring Topology Difficult to Troubleshoot: Troubleshooting can be hard as at least one device is usually faulty and affects the whole network. Less Robust: Communication networks are vulnerable to one or multiple failures of the connected devices, or a single connection in case of having no a redundant dual-ring configuration. Why Star Topology is Better than Ring Topology?Star topology is considered superior to Ring topology because of the problem of installation, maintenance and fault containment of the later. Star topology networking allows it that if one device or cable fails the rest of the networking does not cease. This is different from Ring topology in which a single fault poses a prospects of breaking down the entire network. Also, Star topology is easier to add another device; thus, it can be more expandable than the other types of networks.Star topologyRing TopologyIn star topology, the nodes are connected to the central hub or router.In ring topology, every node is connected to its left and right side nodes.In star topology, the only hub is the failure point.In-ring topology, every node are failure point.The cost of star topology is high.The cost of ring topology is low.In star topology, the information is travel from the central hub or router to all the nodes.In-ring topology, the information is travel from nodes to nodes in a ring manner in one direction.The cables are required in star topology more than the ring topology.The cables are required in ring topology less than the star topology.There are n links in Star topology if there are n nodes.There are also n links in a ring topology if there are n nodes present.A new cable is added to the central hub to add a new node.Whereas to add a new node in a ring topology, the connection must be broken.In Star topology, the addition and removal of new nodes are moderately difficult.In-ring topology, the addition, and removal of new nodes are difficult.Star topology is used for local Area NetworkRing topology is used for Wide Area NetworkStar topology access rate is fast. The ring topology access rate is slow.Star topology transmission speed is fast.Ring topology transmission speed is slow.Applications-High-speed LANs.Usually employed in small size networks, and more.Applications-Used in SONET rings (Synchronous Optical Networks).Deployed in LAN and MAN and more.Conclusion Where we compare Star and Ring topology, then it is very clear that the Star topology is much reliable and flexible than the Ring topology because of the reason that the location of error in star topology is easily identified and fixed. As for the advantages, ring topology which gives stable performance in definite conditions is more sensitive to the complete network breakdown if it is happened with any one equipment or connection. For this reason, for most of the modern day networking requirements, Star topology is normally preferred, particularly for networks that are expected to grow, require high levels of reliability and that can easily be managed.

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