Unit 1 : Basics of Network, Network Models and LAN Sharing

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SUBJECT: NETWORK TECHNOLOGY AND ADMINISTRATION

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Topics

- Network concepts - What is network, Use of network
- Network model -peer – to – peer, client – server
- Network Services – File ,Print ,Communication , DB, Security, Application service
- Network Access Methods - CSMA /CD, CSMA /CA ,Token passing, Polling
- Network Topologies Bus, Ring, Star, Mesh ,Tree ,Hybrid
- Communication Methods- Unicasting, Multicasting Broadcasting
- OSI reference model and TCP/IP network model
- File And Print Sharing in LAN. ,mapping of network drive, Disk quota, Encryption, Compression, Net meeting

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Computer Network

- A computer network is a group of computer systems and other computing hardware devices that are linked together through communication channels to facilitate communication and resource-sharing among a wide range of users.
- Networks are commonly categorized based on their characteristics.
- A computer network is a set of computers that are connected together so that they can share information.

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Types of Network

Main types

- Local Area Networks (LAN)
- Wide Area Networks (WAN)
- Metropolitan Area Networks (MAN)

Revised types

- Personal Area Networks (PAN)
- Home Area Networks (HAN)
- Campus Networks
- Enterprise Private Networks
- Backbone Networks (BBN)
- Global Area Networks (GAN)

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Local Area Networks (LAN)

- A LAN connects network devices over a relatively short distance.
- A networked office building, school, or home usually contains a single LAN, though sometimes one building will contain a few small LANs (perhaps one per room), and occasionally a LAN will span a group of nearby buildings.
- In addition to operating in a limited space, LANs are also typically owned, controlled, and managed by a single person or organization.
- They also tend to use certain connectivity technologies, primarily Ethernet.

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MAN(Metropolitan Area Network)

- A network spanning a physical area larger than a LAN but smaller than a WAN, such as a city.
- A MAN is typically owned by an operated by a single entity such as a government body or large corporation.

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WAN(Wide Area Network)

- A WAN spans a large physical distance.
- The Internet is the largest WAN, spanning the Earth.
- A WAN is a geographically-dispersed collection of LANs.
- A network device called a router connects LANs to a WAN.
- In IP networking, the router maintains both a LAN address and a WAN address.

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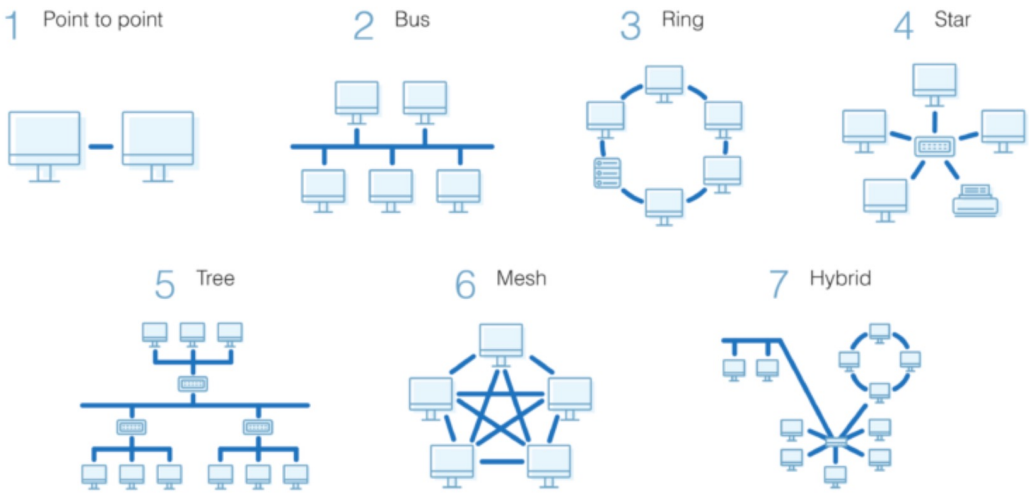
Network Topology

- Network topology refers to how various nodes, devices, and connections on your network are physically or logically arranged in relation to each other
- Bus Topology
- Star Topology
- Ring Topology
- Tree Topology
- Mesh Topology
- Hybrid Topology



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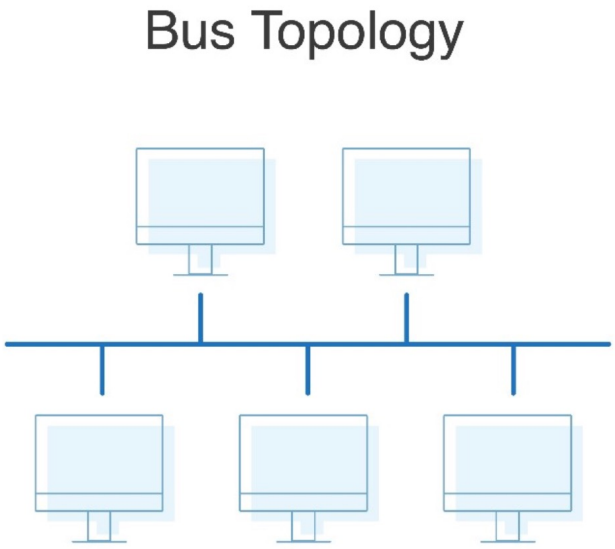
Bus Topology

- A bus topology orients all the devices on a network along a single cable running in a single direction from one end of the network to the other—which is why it's sometimes called a **"line topology" or "backbone topology."**
- Data flow on the network also follows the route of the cable, moving in one direction.



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Advantages/Disadvantages

- Bus topologies are a good, cost-effective choice for smaller networks because the layout is simple, allowing all devices to be connected via a single coaxial or RJ45 cable.
- If needed, more nodes can be easily added to the network by joining additional cables.
- Because bus topologies use a single cable to transmit data, they're somewhat vulnerable. If the cable experiences a failure, the whole network goes down, which can be time-consuming and expensive to restore, which can be less of an issue with smaller networks.
- Bus topologies are best suited for small networks because there's only so much bandwidth, and every additional node will slow transmission speeds.

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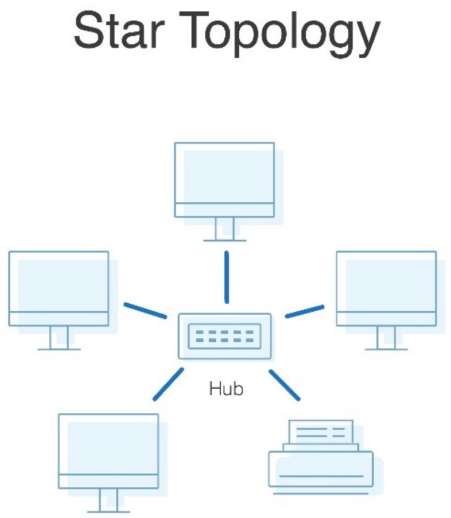
Star

- A star topology, the most common network topology, is laid out so every node in the network is directly connected to one central hub via coaxial, twisted-pair, or fiber-optic cable. Acting as a server, this central node manages data transmission—as information sent from any node on the network has to pass through the central one to reach its destination—and functions as a repeater, which helps prevent data loss.



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Advantages/Disadvantages

- Star topologies are common since they allow you to conveniently manage your entire network from a single location. Because each of the nodes is independently connected to the central hub, should one go down, the rest of the network will continue functioning unaffected, making the star topology a stable and secure network layout.
- Additionally, devices can be added, removed, and modified without taking the entire network offline.
- On the physical side of things, the structure of the star topology uses relatively little cabling to fully connect the network, which allows for both straightforward setup and management over time as the network expands or contracts. The simplicity of the network design makes life easier for administrators, too, because it's easy to identify where errors or performance issues are occurring.
- On the flipside, if the central hub goes down, the rest of the network can't function. But if the central hub is properly managed and kept in good health, administrators shouldn't have too many issues.
- The overall bandwidth and performance of the network are also limited by the central node's configurations and technical specifications, making star topologies expensive to set up and operate.

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Ring

- Ring topology is like a bus topology, but with connected ends.
- The node that receives the message from the previous computer will retransmit to the next node.
- The data flows in one direction, i.e., it is unidirectional.
- The data flows in a single loop continuously known as an endless loop.
- It has no terminated ends, i.e., each node is connected to other node and having no termination point.
- The data in a ring topology flow in a clockwise direction.

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Advantages/Disadvantages

- Since each device is only connected to the ones on either side, when data is transmitted, the packets also travel along the circle, moving through each of the intermediate nodes until they arrive at their destination. If a large network is arranged in a ring topology, repeaters can be used to ensure packets arrive correctly and without data loss.
- Only one station on the network is permitted to send data at a time, which greatly reduces the risk of packet collisions, making ring topologies efficient at transmitting data without errors.
- By and large, ring topologies are cost-effective and inexpensive to install, and the intricate point-to-point connectivity of the nodes makes it relatively easy to identify issues or misconfigurations on the network.
- Even though it's popular, a ring topology is still vulnerable to failure without proper network management. Since the flow of data transmission moves unidirectionally between nodes along each ring, if one node goes down, it can take the entire network with it. That's why it's imperative for each of the nodes to be monitored and kept in good health. Nevertheless, even if you're vigilant and attentive to node performance, your network can still be taken down by a transmission line failure.
- The question of scalability should also be taken into consideration. In a ring topology, all the devices on the network share bandwidth, so the addition of more devices can contribute to overall communication delays. Network administrators need to be mindful of the devices added to the topology to avoid overburdening the network's resources and capacity.
- Additionally, the entire network must be taken offline to reconfigure, add, or remove nodes. And while that's not the end of the world, scheduling downtime for the network can be inconvenient and costly.

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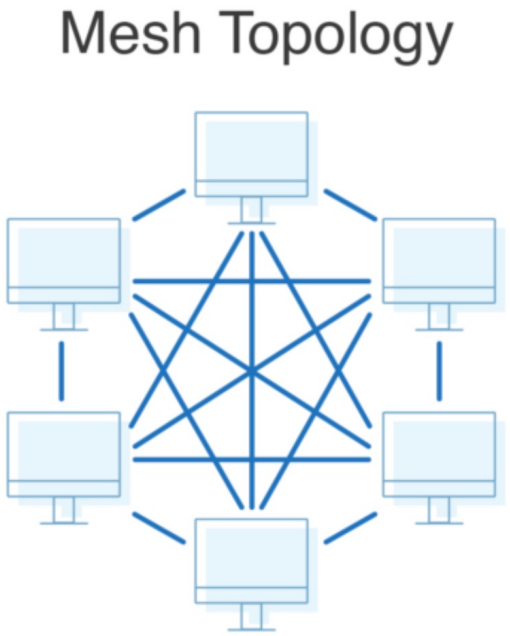
Mesh

- A mesh topology is an intricate and elaborate structure of point-to-point connections where the nodes are interconnected. Mesh networks can be full or partial mesh. Partial mesh topologies are mostly interconnected, with a few nodes with only two or three connections, while full-mesh topologies are surprise! fully interconnected.



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Advantages/Disadvantages

- Mesh topologies are reliable and stable, and the complex degree of interconnectivity between nodes makes the network resistant to failure. For instance, no single device going down can bring the network offline.
- Mesh topologies are incredibly labour-intensive. Each interconnection between nodes requires a cable and configuration once deployed, so it can also be time-consuming to set up. As with other topology structures, the cost of cabling adds up fast, and to say mesh networks require a lot of cabling is an understatement.

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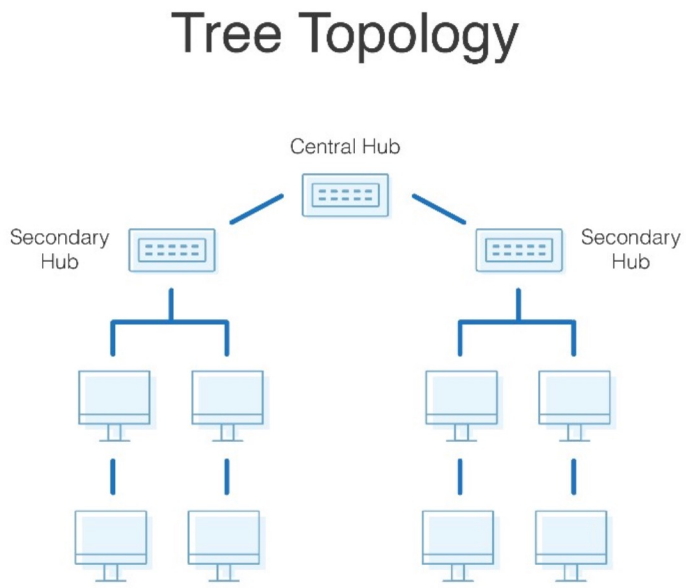
Tree

- The tree topology structure gets its name from how the central node functions as a sort of trunk for the network, with nodes extending outward in a branch-like fashion. However, where each node in a star topology is directly connected to the central hub, a tree topology has a parent-child hierarchy to how the nodes are connected. Those connected to the central hub are connected linearly to other nodes, so two connected nodes only share one mutual connection. Because the tree topology structure is both extremely flexible and scalable, it's often used for wide area networks to support many spread-out devices.



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Advantages/Disadvantages

- Combining elements of the star and bus topologies allows for the easy addition of nodes and network expansion. Troubleshooting errors on the network is also a straightforward process, as each of the branches can be individually assessed for performance issues.
- As with the star topology, the entire network depends on the health of the root node in a tree topology structure. Should the central hub fail, the various node branches will become disconnected, though connectivity within—but not between—branch systems will remain.
- Because of the hierarchical complexity and linear structure of the network layout, adding more nodes to a tree topology can quickly make proper management an unwieldy, not to mention costly, experience. Tree topologies are expensive because of the sheer amount of cabling required to connect each device to the next within the hierarchical layout.

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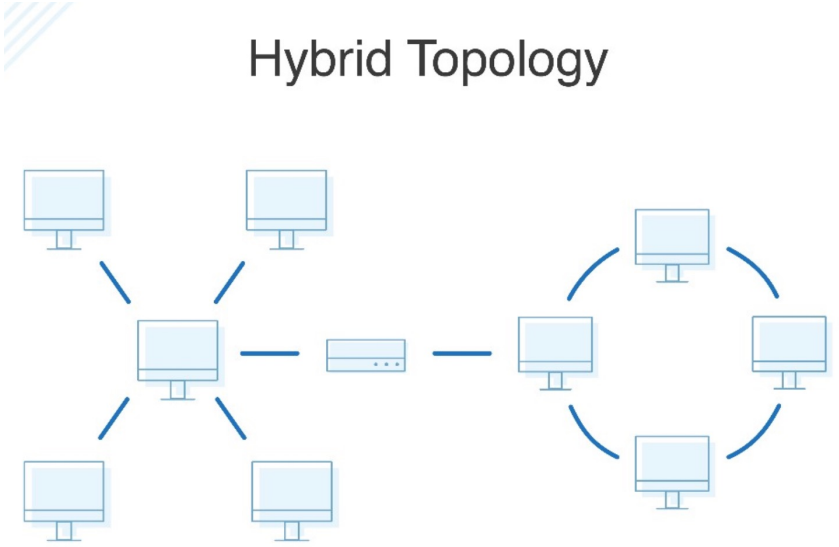
Hybrid

- Hybrid topologies combine two or more different topology structures—the tree topology is a good example, integrating the bus and star layouts. Hybrid structures are most commonly found in larger companies where individual departments have personalized network topologies adapted to suit their needs and network usage.



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Advantages/Disadvantages

- The main advantage of hybrid structures is the degree of flexibility they provide, as there are few limitations on the network structure itself that a hybrid setup can't accommodate.
- However, each type of network topology comes with its own disadvantages, and as a network grows in complexity, so too does the experience and know-how required on the part of the admins to keep everything functioning optimally. There's also the monetary cost to consider when creating a hybrid network topology.

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Communication Methods

- **Unicast**: This type of information transfer is useful when there is a participation of single sender and single recipient. So, in short, you can term it as a one-to-one transmission. For example, a device having IP address 10.1.2.0 in a network wants to send the traffic stream(data packets) to the device with IP address 20.12.4.2 in the other network, then unicast comes into the picture. This is the most common form of data transfer over the networks.
- **Multicast**: In multicasting, one/more senders and one/more recipients participate in data transfer traffic. In this method traffic recline between the boundaries of unicast (one-to-one) and broadcast (one-to-all). Multicast lets server's direct single copies of data streams that are then simulated and routed to hosts that request it. IP multicast requires support of some other protocols like IGMP (Internet Group Management Protocol), Multicast routing for its working. Also in Classful IP addressing Class D is reserved for multicast groups.

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- **Broadcast:** Broadcast is the term used to describe communication where a piece of information is sent from one point to all other points. In this case there is just one sender, but the information is sent to all connected receivers.

File Service

- Network File Service (NFS) A set of protocols that run over an Ethernet network and offer support for file transfer and access, and for paging. The system was originally developed by Sun to allow the use of workstations without disks: it provides the ability for one workstation, without disks, to use another workstation, with disks, to supply both a file store and paging support. The system is now offered by other suppliers and has become a de facto standard for work of this kind.

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Print Services

- A print server allows printers to be shared by everyone on the network. Printer sharing is not as important as file sharing, but it is a useful network service.
- **The advantages of printer sharing are**: Fewer printers are needed, and less money is spent on printers and supplies. Reduced maintenance. There are fewer machines to maintain, and fewer people spending time fiddling with printers. Access to special printers. Very high-quality color printers and very high-speed printers are expensive and needed only occasionally. Sharing these printers makes the best use of expensive resources.

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Database Services

- Database servers are the most common type of application servers. Because database services enable applications to be designed in separate client and server components, such applications frequently are called client/server databases. With a client/server database, the client and server applications are designed to take advantage of the specialized capabilities of client and database systems.
- The client application manages data input from the user, generation of screen displays, some of the reporting, and data- retrieval requests sent to the database server.
- The database server manages the database files; adds, deletes, and modifies records in the database; queries the database and generates the results required by the client; and transmits results back to the client. The database server can service requests for multiple clients at the same time
- Provides database security and Optimize the performance of database operations
- Determine optimum locations for storing data without requiring clients to know where the data is located
- Service large numbers of clients by reducing the amount of time any one client spends accessing the database and Distribute data across multiple database servers

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Network Access Methods

- Network access refers to the different methods that computers use to place data on the network.

- CSMA/CD (Carrier Sense Multiple Access/Collision Detection)
- CSMA/CA (Carrier Sense Multiple Access/Collision Avoidance)
- Token Passing

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CSMA/CD (Carrier Sense Multiple Access/Collision Detection)

- In CSMA/CD, every host has equal access to the wire and can place data on the wire when the wire is free from traffic.
- When a host want to place data on the wire, it will "sense" the wire to find whether there is a signal already on the wire.
- If there is traffic already in the medium, the host will wait and if there is no traffic, it will place the data in the medium.
- if two systems place data on the medium at the same instance, they will collide with each other, destroying the data.
- If the data is destroyed during transmission, the data will need to be retransmitted. After collision, each host will wait for a small interval of time and again the data will be retransmitted, to avoid collision again.

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CSMA/CA (Carrier Sense Multiple Access/Collision Avoidance)

- In CSMA/CA, before a host sends real data on the wire it will "sense" the wire to check if the wire is free.
- If the wire is free, it will send a piece of "dummy" data on the wire to see whether it collides with any other data.
- If it does not collide, the host will assume that the real data also will not collide.

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Token Passing

- In CSMA/CD and CSMA/CA the chances of collisions are there.
- As the number of hosts in the network increases, the chances of collisions also will become more.
- In token passing, when a host want to transmit data, it should hold the token, which is an empty packet.
- The token is circling the network in a very high speed.
- If any workstation wants to send data, it should wait for the token.
- When the token has reached the workstation, the workstation can take the token from the network, fill it with data, mark the token as being used and place the token back to the network.

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Polling

- The message which is sent by the primary station consists of the address of the station which is selected for granting access.
- The point to remember is that all the nodes receive the message but the addressed one responds and sends data in return, but if the station has no data to transmit then it sends a message called **Poll Reject or NAK** (negative acknowledgment).
- But this method has some drawbacks like the high overhead of the polling messages and high dependence on the reliability of the primary station.

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OSI Model

- The Open Systems Interconnection (OSI) model is a conceptual model created by the International Organization for Standardization which enables diverse communication systems to communicate using standard protocols. In plain English, the OSI provides a standard for different computer systems to be able to communicate with each other.
- The OSI model can be seen as a universal language for computer networking. It's based on the concept of splitting up a communication system into seven abstract layers, each one stacked upon the last.

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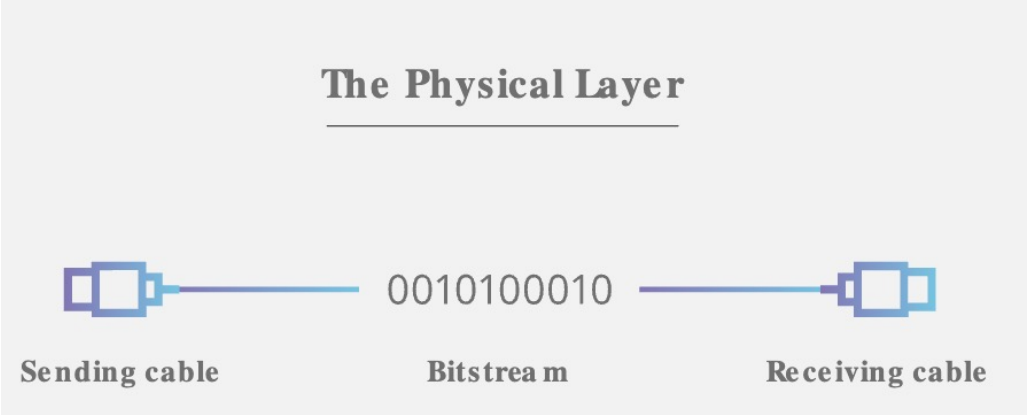
1. The Physical Layer

- This layer includes the physical equipment involved in the data transfer, such as the cables and switches. This is also the layer where the data gets converted into a bit stream, which is a string of 1s and 0s. The physical layer of both devices must also agree on a signal convention so that the 1s can be distinguished from the 0s on both devices.



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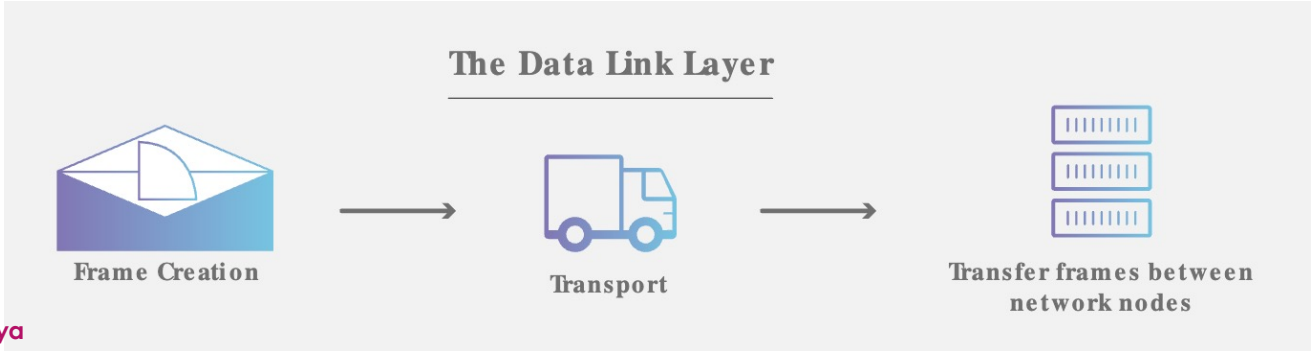
2. The Data Link Layer

- The data link layer is very similar to the network layer, except the data link layer facilitates data transfer between two devices on the SAME network. The data link layer takes packets from the network layer and breaks them into smaller pieces called frames. Like the network layer, the data link layer is also responsible for flow control and error control in intra-network communication (The transport layer only does flow control and error control for inter-network communications).



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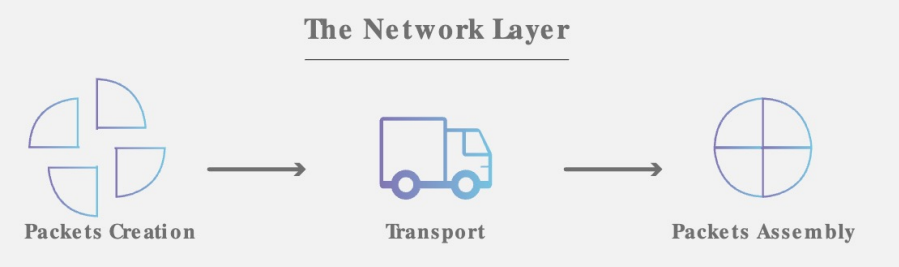
3. The Network Layer

- The network layer is responsible for facilitating data transfer between two different networks. If the two devices communicating are on the same network, then the network layer is unnecessary. The network layer breaks up segments from the transport layer into smaller units, called packets, on the sender's device, and reassembling these packets on the receiving device. The network layer also finds the best physical path for the data to reach its destination; this is known as routing.



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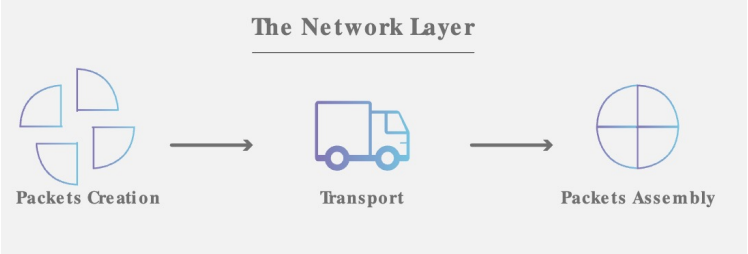
4. The Transport Layer

- Layer 4 is responsible for end-to-end communication between the two devices. This includes taking data from the session layer and breaking it up into chunks called segments before sending it to layer 3. The transport layer on the receiving device is responsible for reassembling the segments into data the session layer can consume.
- The transport layer is also responsible for flow control and error control. Flow control determines an optimal speed of transmission to ensure that a sender with a fast connection doesn't overwhelm a receiver with a slow connection. The transport layer performs error control on the receiving end by ensuring that the data received is complete, and requesting a retransmission if it isn't.



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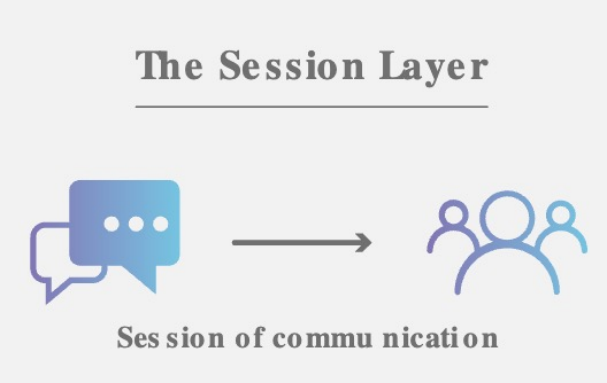
5. The Session Layer

- This is the layer responsible for opening and closing communication between the two devices. The time between when the communication is opened and closed is known as the session. The session layer ensures that the session stays open long enough to transfer all the data being exchanged, and then promptly closes the session in order to avoid wasting resources.



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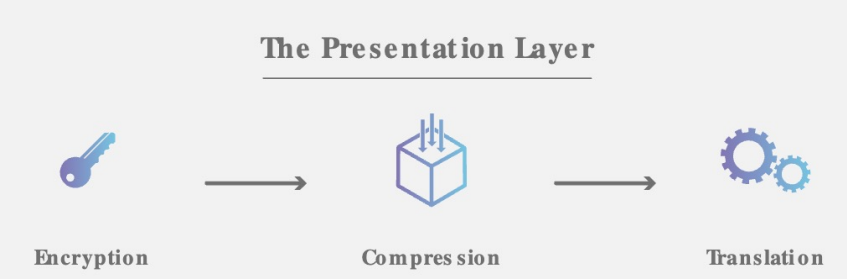
6. The Presentation Layer

- This layer is primarily responsible for preparing data so that it can be used by the application layer; in other words, layer 6 makes the data presentable for applications to consume. The presentation layer is responsible for translation, encryption, and compression of data.
- Two communicating devices communicating may be using different encoding methods, so layer 6 is responsible for translating incoming data into a syntax that the application layer of the receiving device can understand.
- If the devices are communicating over an encrypted connection, layer 6 is responsible for adding the encryption on the sender's end as well as decoding the encryption on the receiver's end so that it can present the application layer with unencrypted, readable data.



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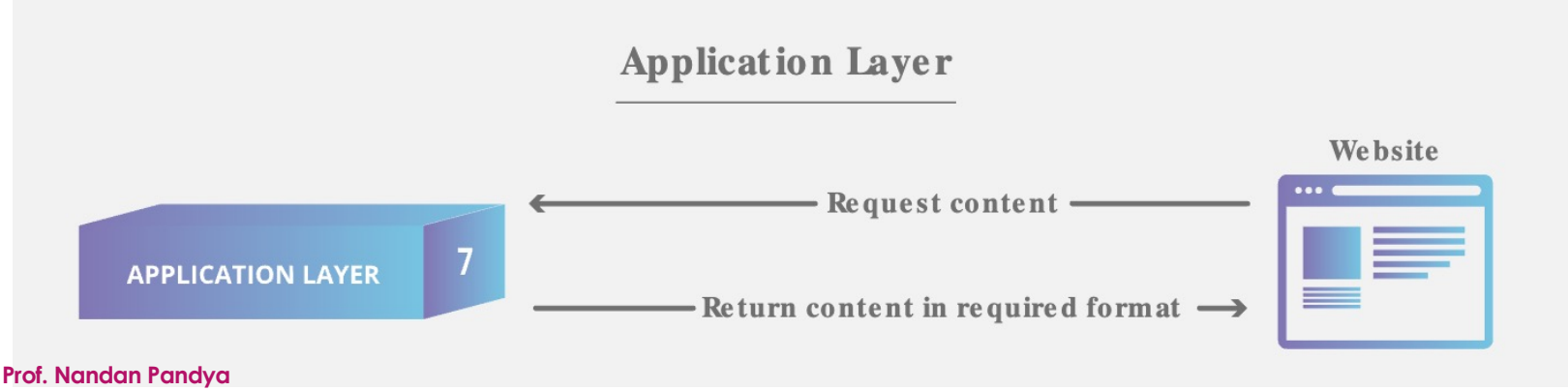
7. The Application Layer

- This is the only layer that directly interacts with data from the user.
- Software applications like web browsers and email clients rely on the application layer to initiate communications.



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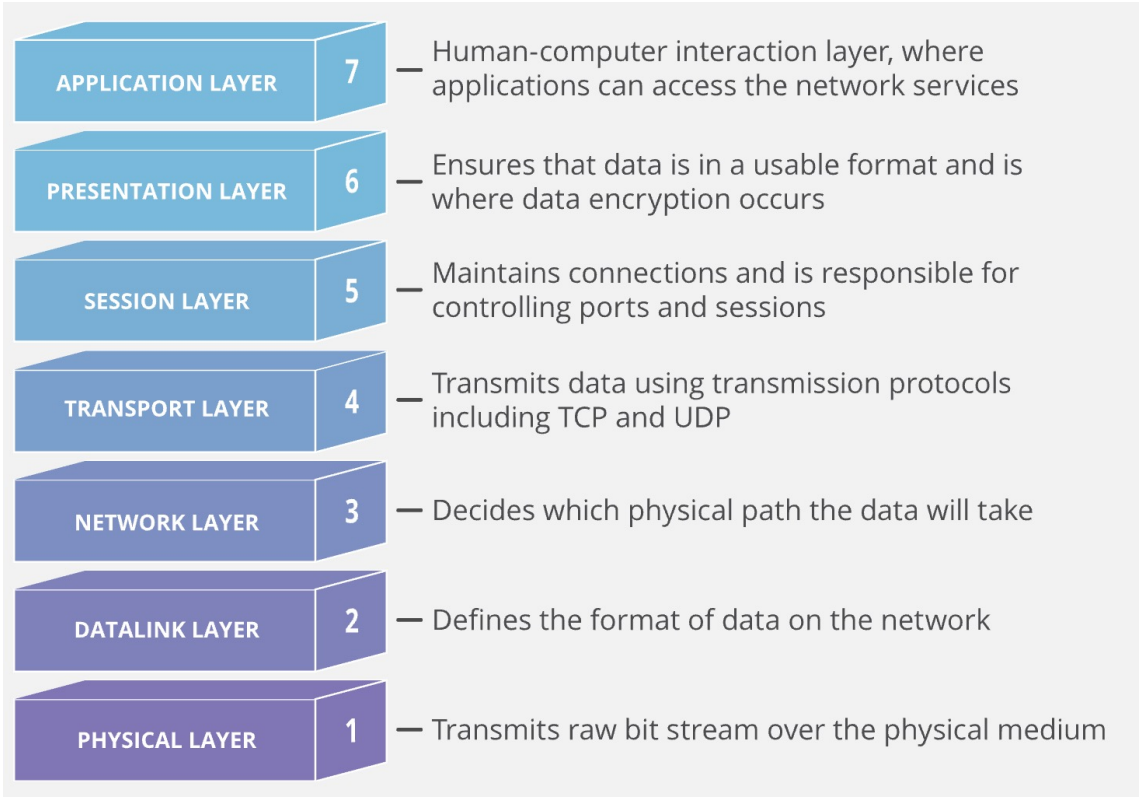

All

People

Seem

To

Need

Data

Processing

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TCP/IP

- TCP/IP model, it was designed and developed by Department of Defence (DoD) in 1960s and is based on standard protocols. It stands for Transmission Control Protocol/Internet Protocol.
- The **TCP/IP model** is a concise version of the OSI model. It contains four layers, unlike seven layers in the OSI model.

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Application	• To allow access to network resources
Transport	• To provide reliable process to process message delivery and error delivery
Internet	• To move packets from source to destination • To provide internetworking
Network Interface	Responsible for the transmission for the between two device on the same network.

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Application Layer

- Application layer interacts with an application program, which is the highest level of OSI model. The application layer is the OSI layer, which is closest to the end-user. It means the OSI application layer allows users to interact with other software application.
- Application layer interacts with software applications to implement a communicating component
- Application-layer helps you to identify communication partners, determining resource availability, and synchronizing communication.
- It allows users to log on to a remote host
- This layer provides various e-mail services
- This application offers distributed database sources and access for global information about various objects and services.

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Transport Layer

- Transport layer builds on the network layer in order to provide data transport from a process on a source system machine to a process on a destination system. It is hosted using single or multiple networks, and also maintains the quality of service functions.
- It determines how much data should be sent where and at what rate. This layer builds on the message which are received from the application layer. It helps ensure that data units are delivered error-free and in sequence.
- Transport layer helps you to control the reliability of a link through flow control, error control, and segmentation or de-segmentation.
- The transport layer also offers an acknowledgment of the successful data transmission and sends the next data in case no errors occurred. TCP is the best-known example of the transport layer.

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Internet Layer

- An internet layer is a second layer of TCP/IP layers of the TCP/IP model.
- It is also known as a network layer.
- The main work of this layer is to send the packets from any network, and any computer should reach the destination irrespective of the route they take.
- The Internet layer offers the functional and procedural method for transferring variable length data sequences from one node to another with the help of various networks.
- Message delivery at the network layer does not give any guaranteed to be reliable network layer protocol.

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Network Interface Layer

- This layer is also called a network access layer. It helps you to defines details of how data should be sent using the network.
- It also includes how bits should optically be signaled by hardware devices which directly interfaces with a network medium, like coaxial, optical, coaxial, fiber, or twisted-pair cables.
- A network layer is a combination of the data link and physical layer of OSI.
- This layer defines how the data should be sent physically through the network. This layer is responsible for the transmission of the data between two devices on the same network.

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Practical Topics

- File And Print Sharing in LAN
- Mapping of network drive
- Disk Quota
- Encryption
- Compression
- Net meeting

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