Networking Overview

Networks are systems of interconnected computers and the communication equipment used to connect them. They may range in size from a small personal area network to a global area network that links devices together worldwide. Networks provide services that allow users to share or access information or systems remotely. They are built using a reference model to design and define groups of functionality.

Click the links below to learn more.

Common Types of Networks:

Personal area networks (PANs)—Generally, a PAN is a microcomputer network used for communications among computer devices (including telephones, tablets, printers, cameras, scanners, etc.) being used by an individual person.

Local area networks (LANs)—LANs are computer networks that cover a limited area, such as a home, office or campus.

Storage area networks (SANs)—SANs are a variation of LANs and are dedicated to connecting storage devices to servers and other computing devices.

Wide area networks (WANs)—WANs are computer networks that cover a broad area, such as a city, region, nation or an international link.

Metropolitan Area Networks (MANs)—MANs are WANs that are limited to a city or region; usually, MANs are characterized by higher data transfer rates than WANs.

Network Services

Network services are functional features made possible by appropriate OS applications.

Network file system

Allows users to share files, printers and other resources in a network.

Email services

Provides the ability, via a terminal or PC connected to a communication network, to send an unstructured message to another individual or group of people.

Print services

Provides the ability, typically through a print server on a network, to manage and execute print request services from other devices on the network.

Remote access services

Provides remote access capabilities where a computing device appears, as if directly attached to the remote host.

Network Reference Models

A network reference model is used by an enterprise to build intercomputer and network communication processes. These include the open systems interconnect (OSI) model and Transmission Control Protocol/Internet Protocol (TCP/IP)

OSI Model

The open systems interconnect (OSI) model is used for the design of a network and defines groups of functionality required to network computers into layers. Each layer implements a standard protocol to implement its functionality.

There are seven layers in the OSI model, each containing specialized tasks or functions. Each layer is self-contained and relatively independent of the other layers in terms of its particular function. This enables solutions offered by one layer to be updated without adversely affecting the other layers.

7- Application

The application layer provides a standard interface for applications that must communicate with devices on the network such as print files on a network-connected printer, send an email or store data on a file server.

In addition, the application layer may communicate the computer's available resources to the rest of the network. The application layer should not be confused with application software. Application software uses the application layer interface to access network-connected resources.

6- Presentation

The presentation layer transforms data to provide a standard interface for the application layer and provides common communication services, such as encryption, text compression and reformatting such as, conversion of Extended Binary-coded for Decimal Interchange Code [EBCDIC] to ASCII code).

The presentation layer converts the outgoing data into a format acceptable by the network standard and then passes the data to the session layer. Similarly, the presentation layer converts data received from the session layer into a format acceptable to the application layer.

5- Session

The session layer controls the dialogs (sessions) between computers. It establishes, manages and terminates the connections between the local and remote application layers. All conversations, data exchanges and dialogs between the application layers are managed by the session layer.

4- Transport

The transport layer provides reliable and transparent transfer of data between end points, end-to-end error recovery and flow control. The transport layer ensures that all of the data sent to it by the session layer are successfully received by the remote system's transport layer.

The transport layer is responsible for acknowledging every data packet received from the remote transport layer, ensuring that an acknowledgement is received from the remote transport layer for every packet sent. If an acknowledgement is not received for a packet, then that packet will be resent.

3- Network

The network layer creates a virtual circuit between the transport layer on the local device and the transport layer on the remote device. This is the layer of the stack that understands IP addresses and is responsible for routing and forwarding. This layer prepares the packets for the data link layer.

2- Data Link

The data link layer provides for the reliable transfer of data across a physical link. It receives packets of data from the network layer, encapsulates them into frames and sends them as a bit stream to the physical layer. These frames consist of the original data and control fields necessary to provide for synchronization, error detection and flow control.

1- Physical

The physical layer provides the hardware that transmits and receives the bit stream as electrical, optical or radio signals over an appropriate medium or carrier. This layer defines the cables, connectors, cards and physical aspects of the hardware required to physically connect a device to the network.

TCP/IP Model

The most common way a user accesses a resource on the Internet is through the TCP/IP Internet World Wide Web (WWW) application service. TCP/IP provides the basis for the Internet; a set of communication protocols that encompass media access, packet transport, session communication, file transfer, electronic mail (e-mail), terminal emulation, remote file access and network management. The TCP/IP suite includes both network-oriented protocols and application support protocols.

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- Application
- Transport
- Network
- Data link
- Physical

There is no direct match between the TCP/IP standards and the layers of the OSI framework.

Network Topologies

Network topologies (configurations) define how networks are organized and linked together from a physical standpoint.

Bus

All devices (nodes) are linked along one communication line where transmissions are received by all attached nodes. This architecture is reliable in very small networks, as well as easy to use and understand. This configuration requires the least amount of cable to connect the computers together and, therefore, is less expensive than other cabling arrangements. It is also easy to extend, and two cables can be easily joined with a connector to make a longer cable for more computers to join the network. A repeater can also be used to extend a bus configuration.

Star

A type of local area network (LAN) architecture that utilizes a central controller to which all nodes are directly connected. With star topology, all transmissions from one station to another pass through the central controller which is responsible for managing and controlling all communication. The central controller often acts as a switching device.

Ring

A type of local area network (LAN) architecture in which the cable forms a loop, with stations attached at intervals around the loop. In ring topology, signals transmitted around the ring take the form of messages. Each station receives the messages and each station determines, on the basis of an address, whether to accept or process a given message. However, after receiving a message, each station acts as a repeater, retransmitting the message at its original signal strength. Figure 4.11 illustrates these commonly used physical topologies.

Mesh

A network topology in which devices are connected with many redundant interconnections between network nodes (primarily used for backbone networks).

Ad Hoc

Ad hoc networks are designed to dynamically connect remote devices, such as mobile phones, laptops and tablets. These networks are termed ad hoc because of their shifting network topologies.

Multipoint Wireless

Networks that can have many devices attached and each communicates with a wireless bridge.

Devices

Computer networks employ various types of hardware for access, range and security.

Bridge

Data link layer device developed in the early 1980s to connect local area networks (LANs) or create two separate LAN or wide area network (WAN) network segments from a single segment to reduce collision domains (i.e., network segments with multiple hosts). A bridge acts as a store-and-forward device in moving frames toward their destination. This is achieved by analyzing the media access control (MAC) header of a data packet, which represents the hardware address of an NIC (network interface card).

Hub

A common connection point for devices in a network, hubs are used to connect segments of a local area network (LAN). A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

Switch

Typically associated as a data link layer device, switches enable local area network (LAN) segments to be created and interconnected, which has the added benefit of reducing collision domains in Ethernet-based networks.

Router

A networking device that can send (route) data packets from one local area network (LAN) or wide area network (WAN) to another, based on addressing at the network layer (Layer 3) in the open systems interconnection (OSI) model. Networks connected by routers can use different or similar networking protocols. Routers usually are capable of filtering packets based on parameters, such as source addresses, destination addresses, protocol and network applications (ports).