

A

Seminar report

On

Computer Network

Submitted in partial fulfillment of the requirement for the award of degree
of CSE

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Preface

I have made this report file on the topic **Computer Networks**; I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude towho assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

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Computer Network

A **computer network** is a group of computers that are interconnected by electronic circuits or wireless transmissions of various designs and technologies for the purpose of exchanging data or communicating information between them or their users. Networks may be classified according to a wide variety of characteristics. This article provides a general overview of types and categories and also presents the basic components of a network.

Introduction

A computer network allows sharing of resources and information among devices connected to the network. The Advanced Research Projects Agency (ARPA) funded the design of the Advanced Research Projects Agency Network (ARPANET) for the United States Department of Defense. It was the first operational computer network in the world.^[1] Development of the network began in 1969, based on designs developed during the 1960s. For a history see ARPANET, the first network.

Purpose

Facilitating communications. Using a network, people can communicate efficiently and easily via e-mail, instant messaging, chat rooms, telephony, video telephone calls, and videoconferencing.

Sharing hardware. In a networked environment, each computer on a network can access and use hardware on the network. Suppose several personal computers on a network each require the use of a laser printer. If the personal computers and a laser are connected to a network, the personal computers users each can access the laser printer on the network, as they need it.

Sharing files, data, and information. In a network environment, any authorized computer user can access data and information stored on other computer on the network. The capability of providing access to and storage of data and information on shared storage devices is an important feature of many networks.

Network classification

Connection method

Computer networks can be classified according to the hardware and software technology that is used to interconnect the individual devices in the network, such as optical fiber, Ethernet, Wireless LAN, HomePNA, Power line communication or G.hn.

Ethernet uses physical wiring to connect devices. Frequently deployed devices include hubs, switches, bridges and/or routers. Wireless LAN technology is designed to connect devices without wiring. These devices use radio waves or infrared signals as a transmission medium. ITU-T G.hn technology uses existing home wiring (coaxial cable, phone lines and power lines) to create a high-speed (up to 1 Gigabit/s) local area network.

Advantages of Computer Networks

Following are some of the advantages of computer networks.

- **File Sharing:** The major advantage of a computer network is that it allows file sharing and remote file access. A person sitting at one workstation of a network can easily see the files present on the other workstation, provided he is authorized to do so. It saves the time which is wasted in copying a file from one system to another, by using a storage device. In addition to that, many people can access or update the information stored in a database, making it up-to-date and accurate.
 - **Resource Sharing:** Resource sharing is also an important benefit of a computer network. For example, if there are four people in a family, each having their own computer, they will require four modems (for the Internet connection) and four printers, if they want to use the resources at the same time. A computer network, on the other hand, provides a cheaper alternative by the provision of resource sharing. In this way, all the four computers can be interconnected, using a network, and just one modem and printer can efficiently provide the services to all four members. The facility of shared folders can also be availed by family members.
 - **Increased Storage Capacity:** As there is more than one computer on a network which can easily share files, the issue of storage capacity gets resolved to a great extent. A standalone computer might fall short of storage memory, but when many computers are on a network, memory of different computers can be used in such case. One can also design a storage server on the network in order to have a huge storage capacity.
 - **Increased Cost Efficiency:** There are many softwares available in the market which are costly and take time for installation. Computer networks resolve this issue as the software can be stored or installed on a system or a server and can be used by the different workstations.
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Disadvantages of Computer Networks

Following are some of the major disadvantages of computer networks.

- **Security Issues:** One of the major drawbacks of computer networks is the security issues involved. If a computer is a standalone, physical access becomes necessary for any kind of data theft. However, if a computer is on a network, a computer hacker can get unauthorized access by using different tools. In case of big organizations, various network security softwares are used to prevent the theft of any confidential and classified data.
- **Rapid Spread of Computer Viruses:** If any computer system in a network gets affected by computer virus, there is a possible threat of other systems getting affected too. Viruses get spread on a network easily because of the interconnectivity of workstations. Such spread can be dangerous if the computers have important database which can get corrupted by the virus.
- **Expensive Set Up:** The initial set up cost of a computer network can be high depending on the number of computers to be connected. Costly devices like routers, switches, hubs, etc., can add up to the bills of a person trying to install a computer network. He will also have to buy NICs (Network Interface Cards) for each of the workstations, in case they are not inbuilt.
- **Dependency on the Main File Server:** In case the main File Server of a computer network breaks down, the system becomes useless. In case of big networks, the File Server should be a powerful computer, which often makes it expensive.

Wired technologies

- *Twisted-pair wire* is the most widely used medium for telecommunication. Twisted-pair wires are ordinary telephone wires which consist of two insulated copper wires twisted into pairs and are used for both voice and data transmission. The use of two wires twisted together helps to reduce crosstalk and electromagnetic induction. The transmission speed ranges from 2 million bits per second to 100 million bits per second.
 - *Coaxial cable* is widely used for cable television systems, office buildings, and other worksites for local area networks. The cables consist of copper or aluminum wire wrapped with insulating layer typically of a flexible material with a high dielectric constant, all of which are surrounded by a conductive layer. The layers of insulation help minimize interference and distortion. Transmission speed range from 200 million to more than 500 million bits per second.
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- *Fiber optic cable* consists of one or more filaments of glass fiber wrapped in protective layers. It transmits light which can travel over extended distances without. Fiber-optic cables are not affected by electromagnetic radiation. Transmission speed may reach trillions of bits per second. The transmission speed of fiber optics is hundreds of times faster than for coaxial cables and thousands of times faster than for twisted-pair wire.

Wireless technologies

Terrestrial Microwave – Terrestrial microwaves use Earth-based transmitter and receiver. The equipment look similar to satellite dishes. Terrestrial microwaves use low-gigahertz range, which limits all communications to line-of-sight. Path between relay stations spaced approx. 30 miles apart. Microwave antennas are usually placed on top of buildings, towers, hills, and mountain peaks.

Communications Satellites – The satellites use microwave radio as their telecommunications medium which are not deflected by the Earth's atmosphere. The satellites are stationed in space, typically 22,000 miles above the equator. These Earth-orbiting systems are capable of receiving and relaying voice, data, and TV signals.

Cellular and PCS Systems – Use several radio communications technologies. The systems are divided to different geographic area. Each area has low-power transmitter or radio relay antenna device to relay calls from one area to the next area.

Wireless LANs – Wireless local area network use a high-frequency radio technology similar to digital cellular and a low-frequency radio technology. Wireless LANs use spread spectrum technology to enable communication between multiple devices in a limited area. An example of open-standards wireless radio-wave technology is IEEE 802.11b.

Bluetooth – A short range wireless technology. Operate at approx. 1Mbps with range from 10 to 100 meters. Bluetooth is an open wireless protocol for data exchange over short distances.

The Wireless Web – The wireless web refers to the use of the World Wide Web through equipments like cellular phones, pagers, PDAs, and other portable communications devices. The wireless web service offers anytime/anywhere connection.

Scale

Networks are often classified as local area network (LAN), wide area network (WAN), metropolitan area network (MAN), personal area network (PAN), virtual private network (VPN), campus area network (CAN), storage area network (SAN), and others, depending on their scale, scope and purpose. Usage, trust level, and access right often differ between these types of network. For example, LANs tend to be designed for internal use by an organization's internal systems and employees in individual physical locations (such as a building), while WANs may connect physically separate parts of an organization and may include connections to third parties.

Functional relationship (network architecture)

Computer networks may be classified according to the functional relationships which exist among the elements of the network, e.g., active networking, client-server and peer-to-peer (workgroup) architecture.

Network topology

Computer networks may be classified according to the network topology upon which the network is based, such as bus network, star network, ring network, mesh network, star-bus network, tree or hierarchical topology network. Network topology is the coordination by which devices in the network are arranged in their logical relations to one another, independent of physical arrangement. Even if networked computers are physically placed in a linear arrangement and are connected to a hub, the network has a star topology, rather than a bus topology. In this regard the visual and operational characteristics of a network are distinct. Networks may be classified based on the method of data used to convey the data, these include digital and analog networks.

Types of networks

Common types of computer networks may be identified by their scale.

Personal area network

A personal area network (PAN) is a computer network used for communication among computer devices close to one person. Some examples of devices that are used in a PAN are personal computers, printers, fax machines, telephones, PDAs, scanners, and even video game consoles. A PAN may include wired and

wireless connections between devices. The reach of a PAN typically extends to about 30 feet (approximately 9 meters).^[citation needed]

Local area network

A local area network (LAN) is a network that connects computers and devices in a limited geographical area such as home, school, computer laboratory, office building, or closely positioned group of buildings. Each computer or device on the network is a node. Current wired LANs are most likely to be based on Ethernet technology, although new standards like ITU-T G.hn also provide a way to create a wired LAN using existing home wires (coaxial cables, phone lines and power lines)^[2].

For example, a library may have a wired or wireless LAN for users to interconnect local devices (e.g., printers and servers) and to connect to the internet. On a wired LAN, PCs in the library are typically connected by category 5 (Cat5) cable, running the IEEE 802.3 protocol through a system of interconnected devices and eventually connect to the Internet. The cables to the servers are typically on Cat 5e enhanced cable, which will support IEEE 802.3 at 1 Gbit/s. A wireless LAN may exist using a different IEEE protocol, 802.11b, 802.11g or possibly 802.11n. The staff computers (bright green in the figure) can get to the color printer, checkout records, and the academic network *and* the Internet. All user computers can get to the Internet and the card catalog. Each workgroup can get to its local printer. Note that the printers are not accessible from outside their workgroup.

The defining characteristics of LANs, in contrast to WANs (Wide Area Networks), include their higher data transfer rates, smaller geographic range, and no need for leased telecommunication lines. Current Ethernet or other IEEE 802.3 LAN technologies operate at speeds up to 10 Gbit/s. This is the data transfer rate. IEEE has projects investigating the standardization of 40 and 100 Gbit/s.^[3]

Home area network

A home area network (HAN) or home network is a residential local area network. It is used for communication between digital devices typically deployed in the home, usually a small number of personal computers and accessories, such as printers and mobile computing devices. An important function is the sharing of Internet access, often a broadband service through a CATV or Digital Subscriber Line (DSL) provider.

Campus area network

A campus area network (CAN) is a computer network made up of an interconnection of local area networks (LANs) within a limited geographical area. It can be considered one form of a metropolitan area network, specific to an academic setting.

In the case of a university campus-based campus area network, the network is likely to link a variety of campus buildings including; academic departments, the university library and student residence halls. A campus area network is larger than a local area network but smaller than a wide area network (WAN) (in some cases).

The main aim of a campus area network is to facilitate students accessing internet and university resources. This is a network that connects two or more LANs but that is limited to a specific and contiguous geographical area such as a college campus, industrial complex, office building, or a military base. A CAN may be considered a type of MAN (metropolitan area network), but is generally limited to a smaller area than a typical MAN. This term is most often used to discuss the implementation of networks for a contiguous area. This should not be confused with a Controller Area Network. 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.

Metropolitan area network

A metropolitan area network (MAN) is a network that connects two or more local area networks or campus area networks together but does not extend beyond the boundaries of the immediate town/city. Routers, switches and hubs are connected to create a metropolitan area network.

Wide area network

A wide area network (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances, using a communications channel that combines many types of media such as telephone lines, cables, and air waves. A WAN often uses transmission facilities provided by common carriers, such as telephone companies. WAN technologies generally function at the lower three layers of the OSI reference model: the physical layer, the data link layer, and the network layer.

Global area network

A global area network (GAN) is a model for supporting mobile communications across an arbitrary number of wireless LANs, satellite coverage areas, etc. The key challenge in mobile communications is handing off the user communications from one local coverage area to the next. In IEEE Project 802, this involves a succession of terrestrial WIRELESS local area networks (WLAN).^[4]

Virtual private network

A Virtual Private Network (VPN) is a computer network in which some of the links between nodes are carried by open connections or virtual circuits in some larger network (e.g., the Internet) instead of by physical wires. The data link layer protocols of the virtual network are said to be tunneled through the larger network when this is the case. One common application is secure communications through the public Internet, but a VPN need not have explicit security features, such as authentication or content encryption. VPNs, for example, can be used to separate the traffic of different user communities over an underlying network with strong security features.

A **Virtual Private Network (VPN)** is a network that provides the mobile user with a secure connection to the company network server, as if the user had a private line. VPNs help to ensure that transmitted data is

A VPN allows computer users to appear to be editing from an IP address location other than the one which connects the actual computer to the Internet.

Internet work

An Internetwork is the connection of two or more distinct computer networks via a common routing technology. The result is called an internetwork (often shortened to internet). Two or more networks connect using devices that operate at the [Network Layer] (Layer 3) of the OSI Basic Reference Model, such as a router. Any interconnection among or between public, private, commercial, industrial, or governmental networks may also be defined as an internetwork.

Internet

The Internet is a global system of interconnected governmental, academic, public, and private computer networks. It is based on the networking technologies of the Internet Protocol Suite. It is the successor of the Advanced Research Projects Agency Network (ARPANET) developed by DARPA of the U.S. Department of Defense. The Internet is also the communications backbone underlying the World Wide

Web (WWW). The 'Internet' is most commonly spelled with a capital 'I' as a proper noun, for historical reasons and to distinguish it from other generic internetworks.

Participants in the Internet use a diverse array of methods of several hundred documented, and often standardized, protocols compatible with the Internet Protocol Suite and an addressing system (IP Addresses) administered by the Internet Assigned Numbers Authority and address registries. Service providers and large enterprises exchange information about the reachability of their address spaces through the Border Gateway Protocol (BGP), forming a redundant worldwide mesh of transmission paths.

Intranets and extranets

Intranets and extranets are parts or extensions of a computer network, usually a local area network.

An intranet is a set of networks, using the Internet Protocol and IP-based tools such as web browsers and file transfer applications, that is under the control of a single administrative entity. That administrative entity closes the intranet to all but specific, authorized users. Most commonly, an intranet is the internal network of an organization. A large intranet will typically have at least one web server to provide users with organizational information.

Basic hardware components

All networks are made up of basic hardware building blocks to interconnect network nodes, such as Network Interface Cards (NICs), Bridges, Hubs, Switches, and Routers. In addition, some method of connecting these building blocks is required, usually in the form of galvanic cable (most commonly Category 5 cable). Less common are microwave links (as in IEEE 802.12) or optical cable ("optical fiber"). An Ethernet card may also be required.

Network interface cards

A network card, network adapter, or NIC (network interface card) is a piece of computer hardware designed to allow computers to communicate over a computer network. It provides physical access to a networking medium and often provides a low-level addressing system through the use of MAC addresses.

Repeaters

A repeater is an electronic device that receives a signal, cleans it from unnecessary noise, regenerates it and retransmits it at a higher power level, or to the other side of an obstruction, so that the signal can cover longer distances without degradation. In most twisted pair Ethernet configurations, repeaters are required for cable which runs longer than 100 meters.

Hubs

A network hub contains multiple ports. When a packet arrives at one port, it is copied unmodified to all ports of the hub for transmission. The destination address in the frame is not changed to a broadcast address.^[5]

Bridges

A network bridge connects multiple network segments at the data link layer (layer 2) of the OSI model. Bridges do not promiscuously copy traffic to all ports, as hubs do, but learn which MAC addresses are reachable through specific ports. Once the bridge associates a port and an address, it will send traffic for that address only to that port. Bridges do send broadcasts to all ports except the one on which the broadcast was received.

Bridges come in three basic types:

- Local bridges: Directly connect local area networks (LANs)
- Remote bridges: Can be used to create a wide area network (WAN) link between LANs. Remote bridges, where the connecting link is slower than the end networks, largely have been replaced with routers.
- Wireless bridges: Can be used to join LANs or connect remote stations to LANs

Switches

A network switch is a device that forwards and filters OSI layer 2 datagrams (chunk of data communication) between ports (connected cables) based on the MAC addresses in the packets.^[6] This is distinct from a hub in that it only forwards the frames to the ports involved in the communication rather

than all ports connected. A switch breaks the collision domain but represents itself a broadcast domain. Switches make forwarding decisions of frames on the basis of MAC addresses. A switch normally has numerous ports, facilitating a star topology for devices, and cascading additional switches.^[7] Some switches are capable of routing based on Layer 3 addressing or additional logical levels; these are called multi-layer switches. The term *switch* is used loosely in marketing to encompass devices including routers and bridges, as well as devices that may distribute traffic on load or by application content (e.g., a Web URL identifier).

Routers

A router is a networking device that forwards packets between networks using information in protocol headers and forwarding tables to determine the best next router for each packet. Routers work at the Network Layer (layer 3) of the OSI model and the Internet Layer of TCP/IP.

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