

Computer Networking: A Survey

Abstract- Computer networks have become increasingly ubiquitous. In today's world, a computer network is much more than a collection of interconnected devices. Computer networks are a system of interconnected computers for the purpose of sharing digital information. The computer network enables to analyze, organize and disseminate the information that is essential to profitability. The rise of intranets and internets is the important aspect of computer networking. Intranets and internets are private business networks that are based on internet technology. The businesses are currently implementing intranets at a breakneck pace and for one reason only, an intranet enables a business to collect, manage and disseminate information more quickly and easily than ever before. Many businesses are implementing intranets simply to remain competitive; business that delay is likely to see their competition outdistance them. In this article we are presenting the basic concepts of networking.

Keywords- *Peer-to-peer; Client / Server; Inter-networks; Intra-networks; Communication medium; Internet Protocol; Open Systems Interconnection.*

I. INTRODUCTION

Networking supports communication between two or more programs running on physically distant machines. A computer network is a collection of computers, which are in some way connected such that they can exchange data between themselves and other computers on the network. A network is created when two or more computers are connected to share information and resources. A set of computers exchanging information by common conventions called protocols over communication media. A computer network is simply computers wired together in a way that lets them share data and/or devices such as hard drives, CD-ROMs, fax-modems, printers, etc [2]. A computer network is an interconnected collection of autonomous computers where interconnected means that the computers can exchange information and autonomous means that no computer can start, stop or control another computer connected to the network. Fig 1 gives an example of a network in a school comprising of local area network or LAN connecting computers

with each other, the internet, and various servers [4].

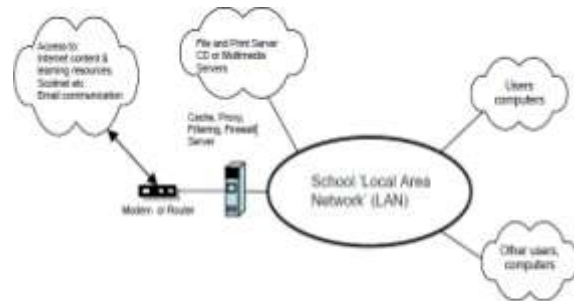


Fig 1: Representation of Network in a school.

II. TYPES OF NETWORK CONFIGURATION

Broadly speaking, there are two types of network configuration, peer-to-peer networks and client/server networks.

A. Peer-to-peer networks

Peer-to-peer networks are more commonly implemented where less than ten computers are involved and where strict security is not necessary. All computers have same status, hence the term „peer“, and they communicate with each other on an equal footing. Files can be shared across the network and all the computers on the network can share devices such as printers or scanners, which are connected to any one computer. Fig 2 represents how the computers are connected in a peer-to-peer networks [4].

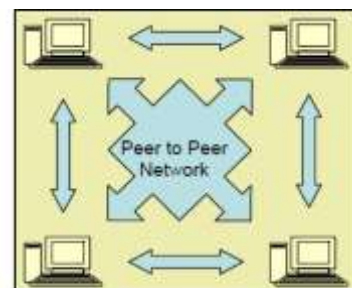


Fig 2: Peer to Peer Networking

B. Client/server networks

Client/server networks are more suitable for larger networks. A central computer, or „server“, acts as the storage location for files and applications shared on the network. Usually the server is higher than an average performance computer. The server also controls the network access of the other computers which are referred to as the „client“ computers. Only the network administrator will have access rights to the server while others cannot. Others can only use the client computers. Fig 3 represents how the computers are connected in a client/server network [4].

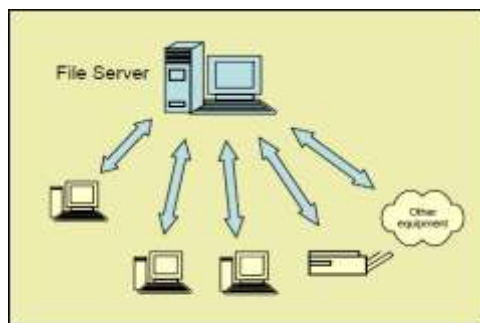


Fig 3: Client - Server Networking

III. COMPONENTS OF A NETWORK

A computer network comprises the following components:

- A minimum of at least two computers.
- Cables that connect the computers each other, although wireless communication is becoming more common.
- A network interface device on each computer (this is called a network interface card or NIC).
- A „switch“ used to switch the data from one point to another. Hubs are outdated.
- Network operating system software [4].

IV. Types of network

The network can be divided into geographical areas and fall into these major categories.

- Local Area Network (LANs).
- Wide Area Network (WANs).
- Metropolitan Area Network (MANs).
- Wireless networks.

A. Local Area Network

A LAN is generally confined to a specific location, such as floor, building or some other small

area. By being confined it is possible in most cases to use only one transmission medium (cabling). This technology is less expensive to implement than WAN because you are keeping all of your expenses to a small area, and generally you can obtain higher speed. They are widely used to connect personal computers and workstations in offices and factories to share the resources. Traditional LANs runs at a speed of 10 to 100 mbps have low delay and make very few errors. Never LANs may operate at higher speed up to 100 mbps.

1) Common Physical Topologies

Physical and logical topologies can take several forms. The most common and the most important for understanding the Ethernet and Token Ring topologies are

- Bus topology.
- Ring topology.
- Star topology.
- Mesh topology.
- Cellular topology.

a) Bus topology

A bus physical topology is one in which all devices connect to a common shared cable. A physical bus topology network typically uses one long cable called a backbone computers (workstation and servers) are attached directly to the backbone using Terrestrial microwave-connectors. The backbone is terminated at both ends to remove the signal from the wire after it has passed all devices. The bus topology is the first used topology to connect the computers in a network. This is the oldest form of topologies. This is a failure model. Most bus topologies allow electric or electro-magnetic signals to travel in both directions. A LAN with BUS topology is represented in Fig 4.

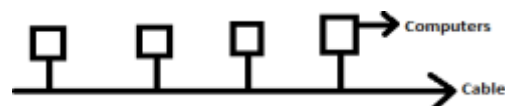


Fig: 4 LAN with BUS topology

b) Ring topology

Ring topologies are wired in a circle. Each node is connected to its neighbors or either side, passes around the ring in one direction only. Each device incorporates a receiver and a transmitter and serves as a repeater that passes the signal to the next device in the ring. Because the signal is regenerated at each device,

signal degeneration is low. After some period of time the RING topology came into existence. To avoid the disadvantages of BUS topology, the RING topology is invented. But this is also a failure model. Ring topologies are ideally suited for token passing access methods. The token gets passed around the ring, and only the node that holds the token can transmit data. Ring topologies are quite rare. A LAN with RING topology is represented in Fig 5.

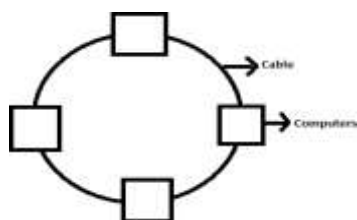


Fig: 5 LAN with RING topology

c) *Star topology*

Star topologies use a central device with drop cables extending in all directions. Each networked device is connected via a point-to-point link to the central device called a hub or multiport repeater or switch. Additionally, star topologies can be nested within other stars to form tree or hierarchical network topologies. In star topology, electrical or electromagnetic signals travel from the networked device, up its drop cable, to the switch, from there the signal is sent to other network. To avoid the disadvantages of BUS topology and RING topology, the STAR topology is invented. This is not a failure model. But it is a standard model and now-a-days this topology is commonly used everywhere. A LAN with STAR topology is represented in Fig 6.

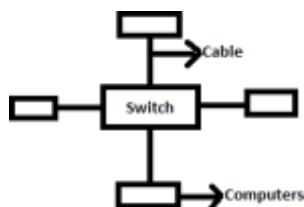


Fig: 6 LAN with STAR topology

d) *Mesh topology*

A mesh network has a point-to-point connection between every device in the network. Because each

device requires an interface for every other device on the network, mesh topologies are not usually considered practical. However, mesh networks are extremely fault tolerant and each link provides guaranteed capacity.

e) *Cellular topology*

A cellular topology combines wireless point-to-point and multipoint strategies to divide a geographic area into cells. Each cell represents the portion of the total network area in which a specific connection operates. Devices within the cell communicate with a central station or switch. Switches are interconnected to route data across the network and to provide the complete network infrastructure. For example, devices may roam from cell to cell while maintaining connection to the network.

B. Wide Area Network

A wide area network spans a large geographical area, often a country or continent. It multiplies multiple connected LANs that can be separated by any geographical distance. In most WANs the network contains numerous cables or telephone lines, each one connection a pair of routers. If two routers that do not share a cable nevertheless wish to communicate, they must do it indirectly. On personal computers we are using modem to communicate indirectly with other computer. WAN connecting two different networks is represented in Fig 7.

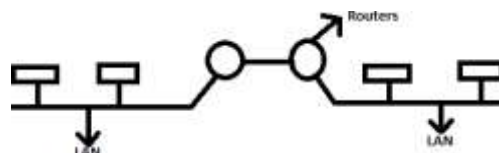


Fig: 7 WAN connecting two different networks

C. Metropolitan Area Network

Metropolitan Area Network is basically a bigger version of LAN and normally uses same technology. It might cover a group of nearby corporate offices or a city and might be either private or public. On the other hand, MAN is network running throughout a metropolitan area such as a backbone for a phone service carrier. A MAN just has one or two cables and does not contain switching elements.

D. Wireless Networks

Mobile computers such as notebook computers, laptops are the fastest growing segment of computer industry. Users want to connect this machine to their

office LANs to see the data when they are out from the office, since the wired connection is not possible we have to use wireless networks.

For e.g. on aircraft single router will maintain a radio link with some other router on ground, changing routers as it flies along this configuration is just a traditional LAN, except that its connection to the outside world happens to be a radio link instead of a wired line.

V. COMMUNICATION LINKS

Various types and forms of communication medium are

- Fiber-optic cable.
- Twisted-pair copper wire.
- Coaxial cable.
- Wireless local-area links. (e.g. 802.11, Bluetooth)
- Satellite channel [3].

VI. INTERNET PROTOCOL (IP)

To solve the scaling problem with Ethernet, and to allow support for other types of LANs and point-to-point links as well, the Internet Protocol was developed. To support universal connectivity, IP provides a global mechanism for addressing and routing, so that packets can actually be delivered from any host to any other host. IP addresses (for the most common version 4, which we denote IPv4) are 4 bytes (32 bits), [6] and are part of the IP header that generally follows the Ethernet header. The Ethernet header only stays with a packet for one hop; the IP header stays with the packet for its entire journey across the Internet. An essential feature of IPv4 addresses is that they can be divided into a “network” part and a “host” part [5]. There are different types of classes in IPv4 and their ranges are shown in Table 1.

Table: 1 Range and types of classes

Class	Address Range
Class A	0 to 126
Class B	128 to 191
Class C	192 to 223
Class D	224 to 239
Class E	240 to 254

Range 127 is reserved for the loopback or localhost, for example, 127.0.0.1 is the common loopback address. Range 255.255.255.255 broadcasts to all hosts on the local network [9].

VII. OPEN SYSTEMS INTERCONNECTION (OSI) MODEL

In 1977 the International Organization for Standardization, or ISO, founded the Open Systems Interconnection model, or OSI, a process for creation of new network standards. OSI represented an attempt at the creation of networking standards independent of any individual government. The OSI model is today perhaps best known for its seven-layer networking model. Those seven layers of the OSI model and their purpose are stated in Table 2. OSI has its own version of IP and TCP. The IP equivalent is CLNP, the Connection Less Network Protocol, although OSI also defines a connection oriented protocol CMNS. The TCP equivalent is TP4.

Table: 2 Layers of OSI model and their purpose

Layer	Purpose
Physical	Network Interface Card, wire and so on.
Data Link	Error checking, manages link control, communication with cards.
Network	Addressing, traffic, switching.
Transport	Handles network transmission
Session	Establishes rules for communication, determines synchronization.
Presentation	Translator between application and others, redirector, encryption, compression.
Application	Interface to network services.

CONCLUSION

Computer communication, it seems, will become a much more useful networking tool when large numbers of people with similar interests acquire access to the technology. Though it can expedite the formation of new interpersonal networks by overcoming the space and time barriers faced by traditional networking techniques, it still requires a great deal of concentrated effort and resources to get the people to use it. This problem should become increasingly minimized over the coming years as the technological innovations become more diffused throughout society [8].

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