



Introduction to Computer Networking: A Practical Approach

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Abstract

Now a day all the libraries are undergoing the process of computerization. Computer networks are very much essential to the operations of libraries. Network, allow the staff to work for housekeeping operations of library. The staff can share all the network resources from any corner of library. The continuous development of information technology will make library network more essential. If the network in library fails then it affects daily routine of library. In this situation many times librarian depends on the computer professional to solve these problems. To keep in view this difficulty this paper deals with the solution. Using this method one can develop the library network.

Keywords : Computer Networking, Peer-to-peer Network, Client-Server Network, Wireless Network, RJ-45

Introduction

A network is a group of two or more computer systems sharing services and interacting in some manner. This interaction is, accomplished through a shared communication link, with the shared components being data. Put simply a network is a collection of machines have been linked both physically and through software components to facilitate communication and the sharing of information.

A physical pathway known as transmission medium, connects the systems and a set of rules determines how they communicate. These rules are known as protocols. A network protocol is software installed on a machine that determines the agreed-upon set of rules for two or more machine to communicate with each other. One common metaphor used to describe different protocols is to compare them to human languages.

Think of a group of people in the same room who know nothing about each other. In order for them to communicate, this group must determine what language to speak, how to handle identifying each other, whether to make general announcements or have private conversations and so on. Machines using different protocols installed can't communicate with each other.

Networks are widely used by companies or on personal level also. Network for organizations should provide high reliability, cost efficient, and resource sharing.

The purpose of the networking guidelines are as follows:

- to understand the benefits of networking
- to help to know current stage of networking development.
- to plan the next stage of network development.
- to provide practical to create network.

Basic of Networking

A computer network consists of a collection of computers, printers and other equipment that is connected together so that they can communicate with each other. Fig 1 gives an example of a network comprising of a local area network or LAN connecting computers with each other, the internet, and various servers.

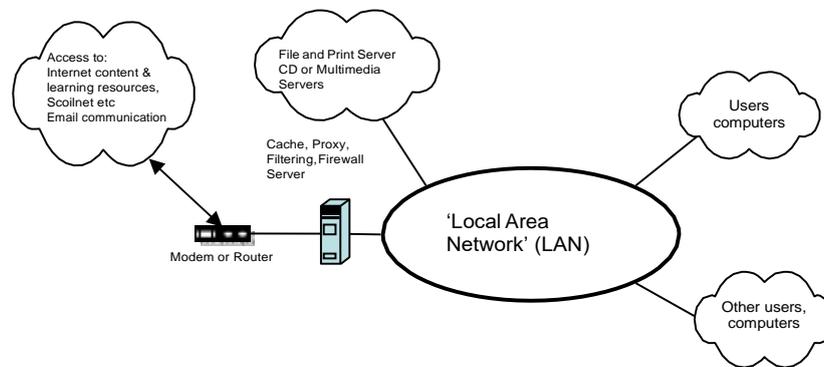


Fig 1: Representation of Network

Broadly speaking, there are two types of network configuration, peer-to-peer networks and client/server 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 the same status, hence the term 'peer', and they communicate with each other on an equal footing. Files, such as word processing or spreadsheet documents, 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.

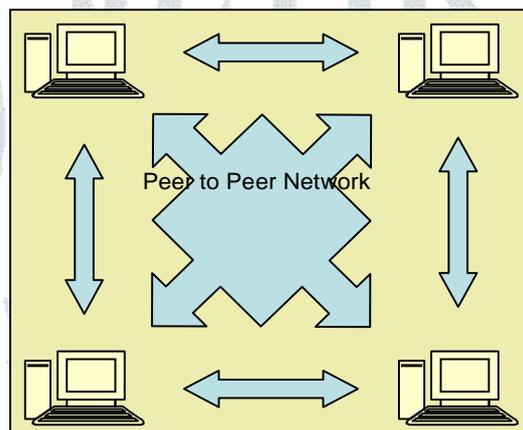


Fig 2: Peer to Peer Networking

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 a higher than average performance computer. The server also controls the network access of the other computers which are referred to as the 'client' computers.

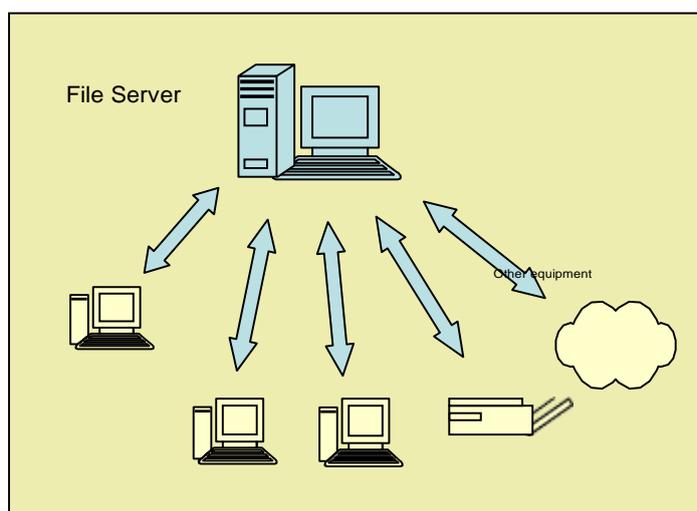


Fig 3: Client - Server Networking

Table 1 provides a summary comparison between Peer-to-Peer and Client/Server Networks.

Peer-to-Peer Networks vs Client/Server Networks	
Peer-to-Peer Networks	Client/Server Networks
<ul style="list-style-type: none"> • Easy to set up 	<ul style="list-style-type: none"> • More difficult to set up
<ul style="list-style-type: none"> • Less expensive to install 	<ul style="list-style-type: none"> • More expensive to install
<ul style="list-style-type: none"> • Can be implemented on a wide range of operating systems 	<ul style="list-style-type: none"> • A variety of operating systems can be supported on the client computers, but the server needs to run an operating system that supports networking
<ul style="list-style-type: none"> • More time consuming to maintain the software being used (as computers must be managed individually) 	<ul style="list-style-type: none"> • Less time consuming to maintain the software being used (as most of the maintenance is managed from the server)
<ul style="list-style-type: none"> • Very low levels of security supported or none at all. These can be very cumbersome to set up, depending on the operating system being used 	<ul style="list-style-type: none"> • High levels of security are supported, all of which are controlled from the server. Such measures prevent the deletion of essential system files or the changing of settings
<ul style="list-style-type: none"> • Ideal for networks with less than 10 computers 	<ul style="list-style-type: none"> • No limit to the number of computers that can be supported by the network
<ul style="list-style-type: none"> • Does not require a server 	<ul style="list-style-type: none"> • Requires a server running a server operating system
<ul style="list-style-type: none"> • Demands a moderate level of skill to administer the network 	<ul style="list-style-type: none"> • Demands that the network administrator has a high level of IT skills with a good working knowledge of a server operating system

Table 1: Peer-to-Peer Networks vs Client/Server Networks

Components of a Network

A computer network comprises the following components:

- A minimum of at least 2 computers
- Cables that connect the computers to 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 and are little used for new installations.
- Network operating system software

Structured Cabling

The two most popular types of structured network cabling are **twisted-pair** (also known as **10BaseT**) and **thin coax** (also known as **10Base2**). 10BaseT cabling looks like ordinary telephone wire, except that it has 8 wires inside instead of 4. Thin coax looks like the copper coaxial cabling that's often used to connect a Video Recorder to a TV.

10BaseT Cabling

When 10BaseT cabling is used, a strand of cabling is inserted between each computer and a hub. If you have 5 computers, you'll need 5 cables. Each cable cannot exceed 325 feet in length. Because the cables from all of the PCs converge at a common point, a 10BaseT network forms a star configuration.

Fig 4a shows a Cat5e cable, with a standard connector, known as an RJ-45 connector. Fig 4b shows a standard Cat5e Wall Outlet socket which the cables are connected to. Fig 4c shows a standard Cat5e Patch Panel Wall Outlet socket which is used to terminate the cables from various points in the school bank to a central point. Fig 4d shows a wall mounted cabinet used to house and protect patch panel cables and connectors.

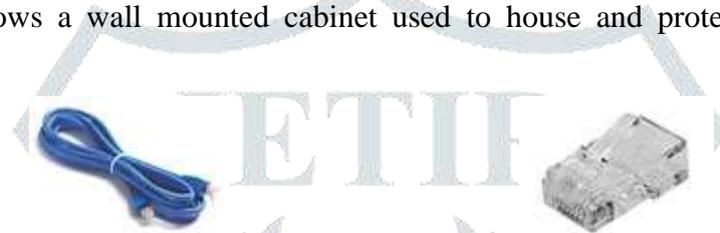


Fig 4a: Cat5e Cable and a close up of RJ-45 connector



Fig 4b: Cat5e Wall Outlets



Fig 4c: Cat5e Patch Panel



Fig4d: Wall Mounted Cabinet

10BaseT cabling is available in different grades or categories. Some grades, or "cats", are required for Fast Ethernet networks, while others are perfectly acceptable for standard 10Mbps networks and less expensive, too. All new networks use a minimum of standard unshielded twisted-pair (UTP) Category 5e 10BaseT cabling because it offers a performance advantage over lower grades.

Network Interface Card (NIC)

A NIC (pronounced 'nick') is also known as a network card. It connects the computer to the cabling, which in turn links all of the computers on the network together. Each computer on a network must have a network card. Most modern network cards are 10/100 NICs and can operate at either 10Mbps or 100Mbps.



Fig 5: Network Interface Cards (NICs)

Hub and Switch

A hub is a device used to connect a PC to the network. The function of a hub is to direct information around the network, facilitating communication between all connected devices. However in new installations switches should be used instead of hubs as they are more effective and provide better performance. A switch, which is often termed a 'smart hub'.

Switches and hubs are technologies or 'boxes' to which computers, printers, and other networking devices are connected. Switches are the more recent technology and the accepted way of building today's networks. With switching, each connection gets "dedicated bandwidth" and can operate at full speed. In contrast, a hub shares bandwidth across multiple connections such that activity from one PC or server can slow down the effective speed of other connections on the hub.

Now more affordable than ever, Dual-speed 10/100 autosensing switches are recommended for all networks.



Fig 6a: An 8 port Hub



Fig 6b: 2 Examples of 24 port Switches

Wireless Networks

The term 'wireless network' refers to two or more computers communicating using standard network rules or protocols, but without the use of cabling to connect the computers together. Instead, the computers use wireless radio signals to send information from one to the other. A wireless local area network (WLAN) consists of two key components: an access point (also called a base station) and a wireless card. Information can be transmitted between these two components as long as they are fairly close together (up to 100 metres indoors or 350 metres outdoors).



Fig 7a: Wireless Access point or Wireless Basestation

When the term 'wireless network' is used today, it usually refers to a wireless local area network or WLAN. A WLAN can be installed as the sole network. However, it can also be used to extend an existing wired network to areas where wiring would be too difficult or too expensive to implement, or to areas located away from the main network or main building. Wireless networks can be configured to provide the same network functionality as wired networks, ranging from simple peer-to-peer configurations to large-scale networks accommodating hundreds of users.



Fig 7b: Desktop PC Wireless LAN card



Fig 7c: Laptop PC Wireless LAN card

Networking Software

- Peer-to-Peer Software:
- Built into operating systems that support networking
 - Windows XP, Vista, Windows 7
 - Mac OS , Linux
- Home Network Server ("server" in the name yet still used on P2P; for media files)
- Client/Server Software (central services and security)

- Network operating system (NOS) software
 - Windows XP Professional,(Vista Ultimate?)
 - Windows Server 2008
 - SUSE Linux Enterprise

Common network cable types

Coaxial Cable

Coaxial cabling has a single copper conductor at its center. A plastic layer provides insulation between the center conductor and a braided metal shield (See fig. 8). The metal shield helps to block any outside interference from fluorescent lights, motors, and other computers.



Fig. 8 Coaxial cable

Although coaxial cabling is difficult to install, it is highly resistant to signal interference. In addition, it can support greater cable lengths between network devices than twisted pair cable. The two types of coaxial cabling are thick coaxial and thin coaxial.

Thin coaxial cable is also referred to as thinnet. 10Base2 refers to the specifications for thin coaxial cable carrying Ethernet signals. The 2 refers to the approximate maximum segment length being 200 meters. In actual fact the maximum segment length is 185 meters. Thin coaxial cable has been popular in school networks, especially linear bus networks.

Thick coaxial cable is also referred to as thicknet. 10Base5 refers to the specifications for thick coaxial cable carrying Ethernet signals. The 5 refers to the maximum segment length being 500 meters. Thick coaxial cable has an extra protective plastic cover that helps keep moisture away from the center conductor. This makes thick coaxial a great choice when running longer lengths in a linear bus network. One disadvantage of thick coaxial is that it does not bend easily and is difficult to install.

Unshielded Twisted Pair

Twisted pair cabling comes in two varieties: shielded and unshielded. Unshielded twisted pair (UTP) is the most popular and is generally the best option for networks (See fig. 8).

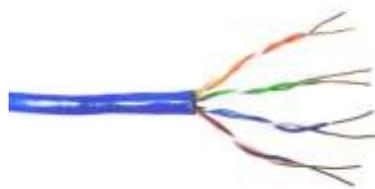


Fig.8 Unshielded twisted pair

The quality of UTP may vary from telephone-grade wire to extremely high-speed cable. The cable has four pairs of wires inside the jacket. Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and other electrical devices.

Fiber Optic Cable

Fiber optic cabling consists of a center glass core surrounded by several layers of protective materials (See fig. 9). It transmits light rather than electronic signals eliminating the problem of electrical interference. This makes it ideal for certain environments that contain a large amount of electrical interference. It has also made it the standard for connecting networks between buildings, due to its immunity to the effects of moisture and lighting.

Fiber optic cable has the ability to transmit signals over much longer distances than coaxial and twisted pair. It also has the capability to carry information at vastly greater speeds. This capacity broadens communication possibilities to include services such as video conferencing and interactive services. The cost of fiber optic cabling is comparable to copper cabling; however, it is more difficult to install and modify. 10BaseF refers to the specifications for fiber optic cable carrying Ethernet signals.

The center core of fiber cables is made from glass or plastic fibers (see fig 9). A plastic coating then cushions the fiber center, and kevlar fibers help to strengthen the cables and prevent breakage. The outer insulating jacket made of teflon or PVC.



Fig. 9 Fiber optic cable

How the connections are made by using twisted pair cable :

Here is the step by step procedure to explain how the connections using twisted pair cable are made.

For making the connections we should have the following material :

- Cat5e cable
- RJ45 connectors
- Cable stripper
- Scissors
- Crimping tool

Steps for making the connections :

Step – 1 Strip cable end :

Take the Cat 5 or Cat 6 cable and strip 1 – 1½” of insulating sheath. This should be done very carefully because there is a chances to cut inner wire inside the shield. So avoid cutting into conductor insulation.

Step – 2 Untwist wire ends :

After cutting outer layer 1 – 1½” inch four pairs of twisted cable will be look. Untwist the wire and separate the pairs. This four pairs having different colours. These colours are (1) Orange White & Orange (2) Green White & Green (3) Blue White & Blue (4) Brown White & Brown

Step – 3 Arrange the wires :

Now clear the twist in the wire and arrange them straight. There are two methods of arranging the wire.

- 1) TIA/EIA 568A: GW-G OW-BL BLW-O BrW-Br
- 2) TIA/EIA 568B: OW-O GW-BL BLW-G BrW-Br

The TIA/EIA 568B method for arranging the wire is very popular and adopted by standard companies like D-Link, CISCO etc.

Step – 4 Trim wires to size :

Trim all the wires evenly by the scissor. Leave about 1/2" wires exposed.

Step – 5 Attach connector :

Maintain wire order as we arrange them according to step-3. Keep the wires arrangement left-to-right. Take the RJ45 connector insert the wire into it with RJ45 tab facing downward.

Step – 6 Check the wires :

Check the wires that it reaches to end. Check the sheath well inside the connector.

Step – 7 Crimping :

Take the crimping tool. Insert the RJ45 connector into the 8P socket of the crimping tool and crimp the connector.

Step – 8 Test :

The cable connection tester is available in the market to check whether the connections are made correctly or not. Test the cable using this tester.

By applying above step it is very easy to make the cable connections. Now your computer is ready to connect to another computer by using hub.

Conclusion :

This is the very popular methods of networking. By this method one can create the computer network at their workplace. This is very easy and cheapest way of computer networking. Now-a-days networking through the fiber optic cables is very popular but the costing is very high. It is suggested that the twisted pair cable is to be prefer for the internal network i.e. in the computer lab which is commonly known as Intranet.

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