UNIT 1 BUILDING A SIMPLE NETWORK

Structure **Page No.**

1.0 INTRODUCTION

Computer Networks forms the basis of the present day's communication. It comprises of the technology that makes the world to work. While structuring the network, one need to have sound knowledge of both software and hardware components associated with computer networking. Hardware settings involves structuring of cables, electrical connectivity, fixing access points etc, whereas the software setting helps the network administrator to make the hardware component work properly.

In this unit you will learn about the ways and means, required to build a simple network i.e. a network that can be used for your day to day working viz. sharing of files, configuring a network device, configuring a network in wired/wireless mode and so on. *We will sum up this unit with a simple case discussed in section 1.5 of this unit, the case relates to "Designing & Development of small networks", through this case you will be able to understand the practical utility and benefit of this unit*.
In a wired computer network the structured cabling forms the backbone of the network. This unit starts with the discussion over structured cabling, which is later extended to the depth of computer networks, suitable for your level.

1.1 OBJECTIVES

After going through this unit you will be able to:

- Identify the prominent problems associated with networking;
- Propose basic network solution for the identified network problems;
- Perform basic hardware structuring, required for network layout and ;
- Perform software settings, required to make a workable network.

1.2 STRUCTURE CABLING

The term structured cabling is related the cabling and connectivity products used to integrate voice, data, video etc. over LAN(Local Area Network).The cables and connectivity products are desired to be used in a systematic way, such that the organized cabling system can be easily understood by installers, network administrators, and any other technician that deals with cabling. To maintain the

world wide code of conduct for structured cabling, standards are laid by industry viz. The EIA/TIA (Electronic Industries Association / Telecommunication Industry Association) and ISO/IEC (International Standards Organization/ International Electrotechnical Commission) have created industry standards for cabling. These standards results the standardized cabling architectures, which allows a single delivery method to be designed for support and services in the workspace.

However, to ensure the efficient and effective structured cabling design, three rules are advised to be followed :

1. **Look for a complete connectivity**: Connectivity includes all the systems that are designed to connect, route, manage, and identify cables in structured cabling systems.

2. **Plan for future growth :** The number of cables installed should also meet future requirements. Category 5e, Category 6, and fiber-optic solutions should be considered to ensure that the future needs will be met.

3. **Freedom of choice in vendors**. Even though a closed and proprietary system may be less expensive initially, this could end up being much more costly over the long term. A non-standard system from a single vendor may make it more difficult to make moves, adds, or changes at a later time.

Before applying the rules to ensure reasonably good cabling mechanism, we need to do some home work, related to the length of cables required (Number of Bundles), secondly type of cable required viz. shielded or unshielded (UTP-Unshielded Twisted Pair cable). Further, we need to choose the cable as per the distance i.e. for ~ 100m length of network coverage cat5e option of cable is fine but for ~150m length of network coverage cat6 is to be opted, after that length we need to use repeaters. Now, we need to understand where to use sheathed cable and where to use unsheathed cable. The Shielded cable is thick and more protected to physical damages, thus it is generally used in the situations where physical endurance is more required viz. dragging the cable through some pipe or so. Further, you need to understand the components involved in entire cabling process, viz. The connectors, patch cords, cable and its types. So, we start with the understanding of related components viz connectors, patch cords etc. in a sequential manner.

The Structured cabling of an Ethernet systems, leads to increase the flexibility and cost-effectiveness of transmitting voice, data, and multimedia over integrated networks. Ethernet patch cords are fast, and they are becoming a familiar part of our everyday experience. These ubiquitous cables have played a central role in the development of generic and structured cabling systems, and today are used for connecting virtually all networking components, without regard to a particular application or industry. In all of these ways, patch cords are the Ether of the Ethernet. These Ethernet patch cords are clubbed with RJ45 (RJ-Registered Jack) connectors, these are the connectors which holds 8P8C ("8 position, 8 conductor") configuration. Refer to figure-1 to map RJ45 with the 8P8C configuration

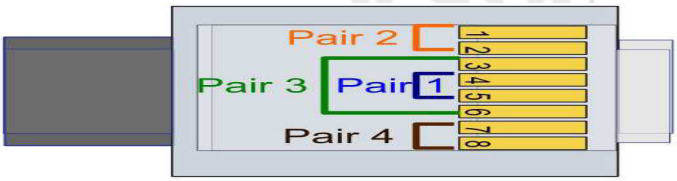


Figure 1: 8P8C connector plug commonly referred as RJ 45

In Ethernet networks, these RJ-45 plugs and jacks form a modular, gendered connector system that helps in making dynamic alterations in network components in a fast and easy way. The male plugs and female jacks are held together by a spring-loaded tab—called a hook—that keeps them securely in place while in use, but allows them to be easily unplugged when changes are made to a network system or work area.

The patch cords used in most Ethernet systems are constructed using UTP(Unshielded Twisted-Pair) cable. UTP cable consists of eight insulated copper-core conductors grouped into four pairs, with each pair twisted together along the cable's length. The conductor pairs and individual conductors in UTP cables are represented by a color code that assigns a primary color—blue, orange, green, or brown—to each of the 4 twisted pairs. The insulation of a conductor within a pair is either a solid primary color, or white striped with that primary color. In this way, all conductors are identified as members of a specific twisted pair, and as individual members within that pair. The conductor pairs are numbered 1 to 4 as shown in Figure -2 below, where Pair 1 corresponding to the blue pair, Pair 2 to the orange pair, Pair 3 to the green pair, and Pair 4 to the brown pair. The individual conductors in UTP cables can be solid copper-core wires with a well-defined thickness, or bundles of fine copper wire strands. Even though the solid-conductor cables are less expensive and easier to terminate, patch cords are almost always made from stranded cables. This is because the stranding of the conductors increases the cable's flexibility and durability.

Figure 2: UTP Cable Cross Section **Figure 3: CAT-5E UTP Cable**

You might be thinking , what's the use of twisting the cable, why not we use the straight strands of the cable. To answer your question you need to understand a lot of Physics associated with it, but in short, The twisted conductor pairs in UTP cables form a balanced circuit. This is because the voltages of each member in a given pair has the same amplitude (the same voltage magnitude), but their voltages are opposite in phase (one voltage is positive, and the other is negative). The uniform twisting of each of these balanced pairs reduces electromagnetic interference (EMI) and radio frequency interference (RFI) originating from other conducting pairs inside the cable, or from equipment in the cable's environment. The conductor pairs inside a twisted-pair cable influence one another through a type of EMI called crosstalk. Crosstalk occurs when the electromagnetic field generated by one pair is large enough (the pair's signal is strong enough) to cross over to the location of a neighboring pair.

You are required to go through the following key points given in the form of notes, below. These key points will let you to understand various aspects related to the various questions which might be boggling in your mind like "How the number of turns in the UTP, relates to its performance ? " Or " What is the relevance of shielding the Cable?" Or " What are the various IEEE and EIA/TIA cabling Standards, how they differ ?" Or " When to use which type of cable?" Or " What is the difference between CAT 5/CAT 5e/Cat6 cables, when to use which cable?". in the discussion below we try to answer all these questions.

NOTE:

1. **How the number of turns in the UTP, relates to its performance ?**

   The greater the number of conductor twists, the better a cable's immunity to EMI and RFI. This immunity gets even better when the number of twists per unit length (the twist rate) is varied among the four pairs. For example, manufacturers of higher-grade cables employ variations in the twist rates of individual conductor pairs, using a different twist rate for each of the four pairs in order to minimize the crosstalk between them.

2. **What is the relevance of shielding the Cable?**

   Wrapping each conductor pair with a foil shielding further reduces the crosstalk among pairs, and wrapping all four of the twisted-pairs in a foil or braided metallic shield reduces a cables susceptibility to EMI and RFI in noisy cable environments. Thus, STP (Shielded Twisted Pair) cables employ both types of shielding, giving them the highest immunity to all interference types. FTP (Foil Twisted Pair) and ScTP (Screened Twisted Pair) cables employ only the outer foil or braided-conductor shielding, giving them enhanced immunity against external EMI and RFI, but no more protection against crosstalk than an equally-constructed UTP cable.

3. **What are the various IEEE cabling Standards, how they differ?**

   10Base-T and 100Base-T are the IEEE (Institute of Electrical and Electronics Engineers) standards defining the electrical and physical characteristics of twisted-pair cabling for use in 10 Mbps (Megabits per second) and 100Mbps Ethernet connections. The "T" stands for Twisted pair, and these two Ethernet connections use wire pairs 2 and 3 to transmit and receive information, corresponding to the orange and green twisted pair conductors shown in Figure 2. Nowadays we use the Gigabit Ethernet (or 1000Base-T), where all four conductor pairs shown in Figure 2 above, are used to transmit and receive information simultaneously.

4. **What are the various EIA/TIA cabling Standards, how they differ?**

   568A and 568B are EIA/TIA(Electronics Industry Association/Telecommunications Industry Association) wiring standards specifying two different RJ-45 pin assignments for the orange and green conductor pairs in Category-type twisted-pair cables. The wiring for two different conductor/pin configurations is shown in Figure 4, and the same are tabulated in Table-1below. You should observe that, the Ethernet patch cords with connectors wired using the same standard on both ends, are referred as *"Straight Through Cable"* and those with different standards are referred as *"Crossover cable"*. In Brief, to create a straight-through cable, you'll have to use either T-568A or T-568B on both ends of the cable. To create a cross-over cable, you'll wire T-568A on one end and T-568B on the other end of the cable. The general structuring of Straight Through and Cross Over Cable is shown in Figure 5 below.

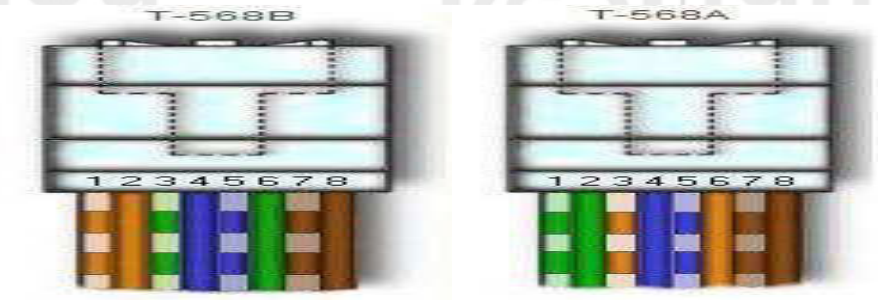


Figure 4: 568A and 568B are EIA/TIA wiring standards -specifying different RJ-45 pin assignments

Table 1: Wiring Diagram for EIA/TIA Standards 568a and 568b

Pair #	Wire	Pin #
1-White/Blue	White/Blue	5
	Blue/White	4
2-White/Green	White/Green	1
	Green/White	2
3-White/Orange	White/Orange	3
	Orange/White	6
4-White/Brown	White/Brown	7
	Brown/White	8
568-A Wiring Diagram		

Pair #	Wire	Pin #
1-White/Blue	White/Blue	5
	Blue/White	4
2-Wht./Orange	White/Orange	1
	Orange White	2
3-White/Green	White/Green	3
	Green/White	6
4-White/Brown	White/Brown	7
	Brown/White	8
568-B Wiring Diagram		

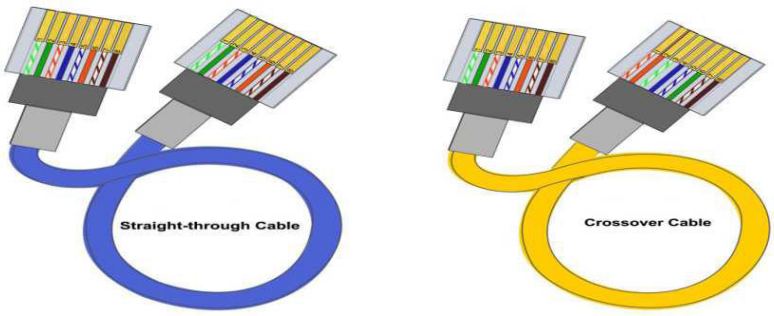


Figure 5: Straight-Through Cable and Cross Over Cable

5. **When to use which type of cable?**

The straight-through cables are used when connecting Data Terminating Equipment (DTE) to Data Communications Equipment (DCE), such as computers and routers to modems (gateways) or hubs (Ethernet Switches). The cross-over cables are used when connecting DTE to DTE, or DCE to DCE equipment; such as computer to computer, computer to router; or gateway to hub connections. The DTE equipment terminates the signal, while DCE equipment do not. To simplify, we tabulated the generalized situations, where you might be expected to use the respective cables. i.e. Crossover cable or Straight Through Cable:

Computer to Computer	–	Crossover
Switch to Switch	–	Crossover
Computer to Modem	–	Straight Through
Computer to Switch	–	Straight Through
Switch To Router	–	Both (if problems, go with Crossover)

6. **What is the difference between CAT 5/ 5e / 6 cables, when to use which cable?**

Making the choice between types of Ethernet cables available for networking and connecting their computers to the Internet viz. Cat 5, Cat 5e, and Cat 6 cables can be confusing. To distinguish between the various types of cables, you have to understand the nomenclature, the term *Cat* being short for "Category", whereas the numbers and letters to follow are all used to indicate performance. These performance designations make it easier to choose the right type for various purposes such as networking computers together or using peripherals including hubs and routers. All three types of cables, Cat 5, Cat 5e,

and Cat 6, are comprised of four pairs of UTP (unshielded twisted pair), but the amount of transmissions the cable will be able to support is up to its category rating.

The Original Cat 5 Cable : An old standard in the industry, Cat 5 cable is able to perform up to 100MHz and is still widely used for a variety of applications, although most new installations will use Cat 5e or higher. Able to support 10/100 Ethernet and fast Ethernet, Cat 5 cable is upwardly compatible with the Cat 5e version.

The Improved Cat 5e Cable : With improved durability over Cat 5, the protective outer covering of Cat 5e cable is thicker and therefore more suitable and reliable for more situations than its earlier counterpart. There are several other differences between this version and its predecessor including its backwards compatibility, as it will work along with either 10BaseT or 100Base T networking hubs and cards. There is also less cross talk or electronic interference with Cat 5e as opposed to Cat 5 cable thanks to improved signal capabilities. In terms of bandwidth, Cat 5e supports gigabit Ethernet connections of up to 350MHz, more than trebling the 100MHz of a Cat 5 cable.

Remember that Cat 5e cable is not rated for outdoor use, although many people do without incident. If you must use this cable outside, add a conduit such as one made from PVC to keep moisture away. The safe operating temperature for Cat 5e cable is anywhere from 10 degrees Celsius to 60 degrees Celsius.

Also, with this particular category cable, 100 meters is the maximum length you will be able to use the cable without the benefit of either a network bridge, hub, or amplification to strengthen the signal.

*The Cat 6 Cable :*Certified and designed specifically for gigabit use, Cat 6 cable reduces cross talk even more than its predecessors by improving upon the original Cat 5 version with wires featuring extra twists. The use of Cat 6 cable does not guarantee that the network will be a full gigabit network, for this to be achieved each and every one of the components must be gigabit certified. Unless your network meets this criteria, opt for Cat 5e which will provide high quality speeds while saving money in the process.

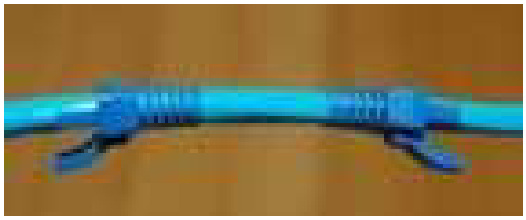
For quick reference, here are the ratings of the various category cables: Cat 5 up to 100MHz ; Cat 5e up to 350MHz; Cat 6 up to 550MHz

1.2.1 Assembling Patch Cable

By learning the theoretical aspects of structured cabling, you might be exhausted. So, let's apply our learnt skills in a practical manner, just follow the instructions given below and you will be able to produce your own patch cable assembly.

Steps to assemble Patch Cable:

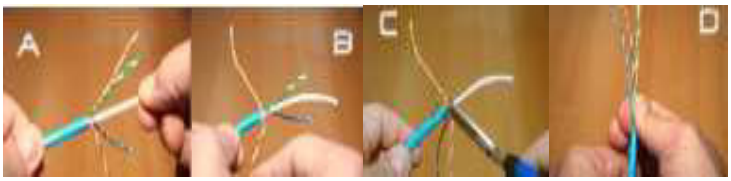
1. Cut the cable to the length that you will need.



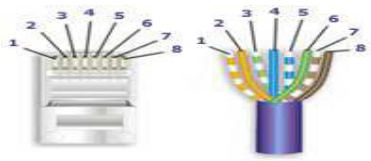
2. Skin the cable about 1.5” down.

3. Remove all of the twists in the cables pairs. Un-twist each pair, and straighten each wire between the fingers.

4. Cat 6 cable has a center spine that needs to be removed. Pull on the spine and fold the pairs back. Then cut the spine as close to the cables end as possible. The process is shown in steps A,B,C,D to be executed sequentially

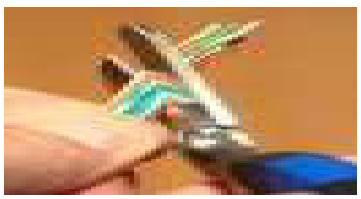


5. Place the wires in the order of one of the two diagrams shown in Figure 4 above, i.e. for EIA/TIA - 568B or 568A. Here we have chosen the 568B diagram which is by far the most popular. If you are unsure, go with the 568B wiring.

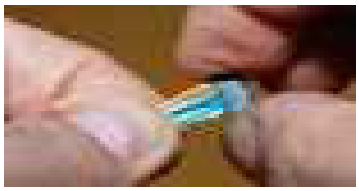


6. Bring all of the wires together, until they touch. Hold the grouped (and sorted) wires together tightly, between the thumb, and the forefinger. At this point, recheck the wiring sequence with the diagram.

7. Cut the wires on a very sharp angle to make it easier to install the load-bar(in the next step).

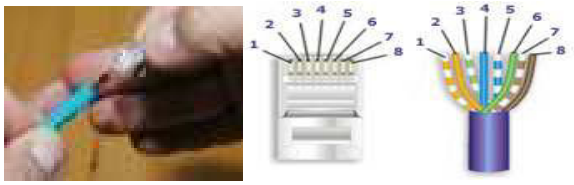


8. Insert the loadbar on the wires one wire at a time.
This is why we recommended cutting the wires on an angle.



9. Check the wiring sequence one more time. Than slide the load bar down all the way and make a straight cut about 0.25 past the loadbar. A perfectly straight cut is essential here.

10. Insert the connector onto the loadbar assembly.
Hold the plug with the copper connectors up and the locking clip facing down.
In this configuration, the Brown Pair of wires should be to the right side



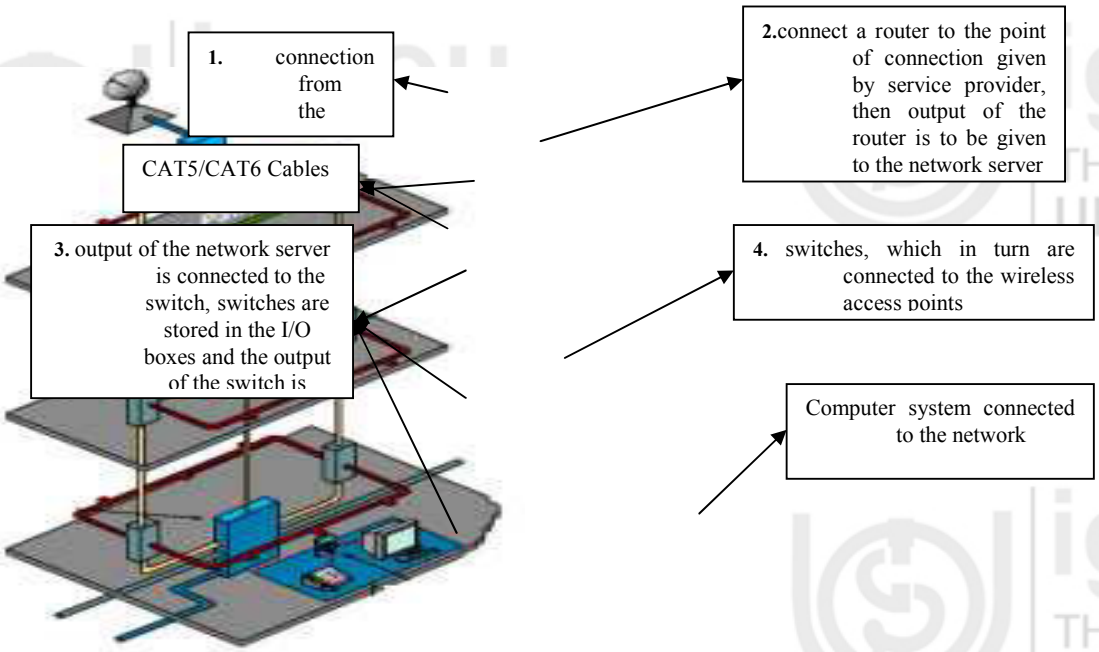
11. For Crimping, push the connector all of the way in and then squeeze down all the way on the crimper. Remove the connector from the crimper body.

12. Repeat the procedure on the other end of the cable using the same wiring diagram. NOTE: If you wish to make a crossover cable, than use the other diagram (in this case 568-A)

13. Test the cable using a high quality four pair LAN cable tester.

Now you are perfectly ready to do structured cabling and design the network of your own. To perform the structured cabling in a building or so you need to refer to Figure 6, given below. It will clear your understanding, related to structured cabling in big layouts, thus it relates to the role of structured cabling in network design. The Figure 6 explains that, Once the connection from the

service provider is installed in the institutional premises, they left it with connecting point, after which you are suppose to start your network. You are required to connect a router to the point of connection given by service provider, then output of the router is to be given to the network server which is responsible for content management, bandwidth regulation, malware protection etc. The output of the network server is connected to the switch with desired number of ports. The switches are stored in the I/O boxes and the output of the switch is cascaded with the other switches, which in turn are connected to the wireless access points. Now in between the devices the paired cable, dully connected with the connectors at both the ends is running. Nowadays patch cords/cables, as per the standards are also available, but they are bit expensive. In general, networking engineers purchases the cable bundle and crimp the RJ45 connectors at the ends of the cables through the crimping tool.



Check Your Progress 1

1. Differentiate between Straight Through Cable and Crossover Cable?

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2. Identify the suitable cable i.e. straight through/ crossover cable, required to connect the following

a) Computer to Computer
b) Switch to Switch
c) Computer to Modem
d) Computer to Switch
e) Switch To Router

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3. Differentiate between 10 Base T and 100 Base T - IEEE standards of twisted pair cabling

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1.3 INTEGRATING HOME COMPUTERS

Electronic environment of any house involves wired or wireless connectivity among various devices viz. computers themselves, between computers and printers, etc. Since, you had already studied the concept of structured cabling, you are expected to firstly understand "How the patch cables can be used to directly connect the computers?" , then we will extend our discussion in the subsequent section, to let you understand "How switches or Hubs can be used to connect the computer systems?" and in the similar manner we will proceed for the development of wireless networks too

So, let's start our discussion with "**How to connect two computers simply by cross-over cable (without router or switch)?".**The steps are listed below, just follow them and you will get it done

1.3.1 How to Connect Two Computers by Using Cross-Over Cable?

This section involves the connectivity of the computers through a cross over cable, without using the network devices like switch or hub. However we will discuss the establishment of computer network by using the network devices in our subsequent section 1.4.1. In this unit we are assuming that the user are having Windows operating system .

STEPS

1. Switch ON the computers
2. Connect both computers with a cross over cable(Cat 5/6) having RJ 45 connector crimped at its both ends.
3. Go to control panel
4. Click on network connections
5. Right click on cable connections.
6. Click properties
7. Pick internet protocol (TCP/IP) & press properties.
8. Click on choose following IP address

   IP address: 1 choose 192.168.1.1
9. Network is 255.255.255.0
10. Press ok and close
11. Now repeat the steps (1 to 10) on the other computer but choose different IP address say it is 192.168.1.2

12. Now test the connection by using cmd command
    - Go to start
    - Click Run
    - Type cmd
    - Type ping IP address if you are on system with IP 192.168.1.1 (i.e. ping 192.168.1.2)
    - If it says time-out, that means that you don't have a connection with other computer

    Interconnectivity facilitates the data sharing among the computers. So, you are required to understand, "How to share the data among the computers, connected to each other in either mode i.e. wired or wireless " Just follow the steps listed below and you will get the data shared among the computers, listed steps work for both wired and wireless connections.

1.3.2 How to Share Data Between Two Computers?

In this section we are going to exploit one of the basic need of computer network, i.e. the sharing of data between the computers. The section gives you the stepwise guidance, to perform the task of data sharing. In this unit we are assuming that the user are having Windows operating system .

STEPS

1. Assign IP address to both computers (in the same manner as discussed above)
2. Go to control panel.
3. Choose network and internet option.
4. How choose network and sharing center option.
5. Choose manage network connections option.
6. Right click area connection and select properties option.
7. Select TCP/IPV 4 and click properties
8. Select "Use the following IP address" say it be 10.1.1.1, say subnet mask is 255.0.0.0. now click ok.
9. Now click close.
10. Close the network connections window.
11. Close the network and sharing center window.
12. Close the network and internet option window.
13. Connect both computers by cable
    a) for different devices: straight cable e.g Switch → Computer
    b) for same devices: Cross over cable
14. Now you have to share folder or file that you want to access from other computer
    i) Create a folder say on desktop

ii) Right click the folder and choose properties

iii) Select the sharing tabs.

iv) Select the advanced sharing button.

v) Check the share this folder option.

vi) Press the permission button.

vii) Check the permission say full control/ Change/ Read to be allowed or deny.

viii) Click the apply button for all opening you made in sharing section and then finally close the sharing properties tab.

15. Turn file sharing ON.

a) Go to control panel.

b) Select network and sharing center.

c) Turn ON the file sharing option and click apply.

d) Choose the option "No make the network that I am connected to a private network" if you don't want data to be shared by All. Otherwise choose "Yes, turn on file sharing for all public networks".

e) For security you may activate the "Password protected sharing" by turning ON the password protected sharing and click apply.

f) Now close all the windows/ tabs opened till the above task is done.

16. To access folder that you have shared

a) Go to other computer by typing //10.1.1.2

b) Select share folder icon

c) Create new folder and close the opened windows.

17. To get other computer on to your screen

a) Type or Run mstsc command in the search option.

b) Remote desktop option get activated.

c) Type the IP of the computers you want to connect to say 10.1.1.2 in the computer section and click connect

18. Now you can share the data of 10.1.1.2

1.4 `

Till the moment you understood that a network could be as simple as two users sharing information through a diskette or as complex as the Internet that we have today. The Internet is made up of thousands of networks interconnected through devices called hubs, bridges, routers and switches. These connecting devices are the building blocks of a network and each of them performs a specific task to deliver the information that is flowing in the network. So, it's time to learn how to connect the computers by using these connecting devices. We will limit our discussion to hubs and switches only, as they are widely used in developing LAN. So, let's understand the devices and their utilities in brief.

HUB : A hub is a connecting device that all end workstations are physically connected to, so that they are grouped within a common domain called a network

segment. A hub functions at the physical layer of the OSI model; it merely regenerates the electrical signal that is produced by a sending workstation, It is a shared device, which means if all users are connected to a 10Mbps Ethernet hub, then all the users share the same bandwidth of 10 Mbps. As more users are plugged into the same hub, the effective average bandwidth that each user has decreases.

SWITCH: Switch is another important device when we talk about computer network on broader spectrum. It is used at the same place as hub is but the only difference between the two is that switch possess switching table with in it. Switching tables store the MAC addresses of every computer it is connected to and send the data to only requested address unlike hub which broadcasts the data too all the ports.

NOTE:

1. A switch functions at the same OSI layer as the bridge, the data link layer. In fact, a switch can be considered a multi-port bridge. While a bridge forwards traffic between two network segments, the switch has many ports, and forwards traffic between those ports. One great difference between a bridge and a switch is that a bridge does its job through software functions, while a switch does its job through hardware implementation. Thus, a switch is more efficient than a bridge, and usually costs more.

2. Switches are introduced to partition a network segment into smaller segments, so that broadcast traffic can be reduced and more hosts can communicate at the same time. This is called micro segmentation, and it increases the overall network bandwidth without doing major upgrade to the infrastructure.

3. Hub is Unmanaged device where as switch can be a managed or unmanaged. Both support full duplex communication i.e. any computer can send data to any other computer connected through the connecting device. The devices can have 4/8/16/32 ports and you may connect two or more than two switches or hubs, to form the cluster of networks. To a N port hub/switch, one port may be used to connect to the server and other N-1 ports may be used to connect the client devices.

4. you are not desired to configure the HUB/SWITCH they got automatically adapted to the networks, unlike the case of Routers and Access points where you need to explicitly configure the network.

1.4.1 How to Connect Computers USING HUB / SWITCH ?

In section 1.3.1 we discussed How to connect computers using cross over cable?, in this section we are extending the concept of the computers connectivity through network devices like hub/switches. The steps desired to be performed are given below:

1. Connect the hub to the power source through its adapter and switch it ON

2. Take Straight cables with RJ 45 connector connected to its both ends, use it to connect the Network Interface Card(NIC) of all computer system to the different ports of Hub/switch as shown in the figure below.

3. Switch ON the computers
4. Go to control panel
5. Click on network connections
6. Right click on cable connections.
7. Click properties
8. Pick internet protocol (TCP/IP) & press properties.
9. Click on choose following IP address
10. IP address: 1 choose 192.168.1.1
    Network is 255.255.255.0
11. Press ok and close
12. Now repeat the steps (1 to 10) on the other computer but choose different IP address say 192.168.1.2 for second computer and so on.
13. Now test the connection by using cmd command
    a) Go to start
    b) Click Run
    c) Type cmd
    d) Type ping IP address if you are on system with IP 192.168.1.1 (i.e. ping 192.168.1.2)
    e) If it says time-out, that means that you don't have a connection with other computer

1.4.2 How to Create Cluster OF Switches/Hubs ?

Let say you have a network at home, the Hub/Switch you bought only got 4 Ethernet LAN ports. 2 ports are connected to computers and 1 port is connected to notebook. You then found out you still have 1 computer and 1 notebook to connect to network, but you only left 1 Ethernet LAN port on Hub/Switch, so how to connect both devices to the network and solve this problem?

The solution is easy. You can create a network cluster by connecting one more hub/switch to one of the ports of the existing hub/switch by using cross-over cable. After that, you can connect computer and notebook to the switch's normal port by using straight cable, finally they are all connected to network and able to access Internet. The LED on the switch will show you which ports are connected.

1.4.3 How to Configure a Wireless Network?

After going through the sections given above , you might have understood the efforts involved in the development of any wired network. So, to simplify the complexities of wired networks, the technology has explored the option of wireless network, which involves one more network device i.e. Access Point. In this section we will let you understand the configuration of wireless network. The steps to configure a wireless network are given below :

1. Switch on the computer and Access point
2. Activate the wireless network mode of computers

3. Connect Access point to the computer through straight cable
4. Open the web browser
5. Type the IP address of Access point given with the access point at the place where URL is typed, and press enter
6. Access point window will be opened
7. Generate SSID and Password from the opened Access point window
8. Ping the access point through you computer by typing "ping ip address of access point" from the command prompt, successful response assures the connectivity
9. Now you may disconnect the wired connection between the computer and the access point.
10. Activate the wireless network mode of other computers in the near vicinity of the access point, they will automatically detect the network.
11. Once the network is detected, to get connected to that wireless network, just select the respective network and it will ask for the SSID code and Password.
12. Provide the assigned SSID code and password, press enter and you are connected to that network.
13. Now you may assign the respective ip addresses to the computer systems connected to the access point and use the same process as discussed above to verify the connectivity among the computers

☞ **Check Your Progress 2**

True / False

a) Switch is used to partition the network

b) Hub is an unmanaged device

c) Hubs/Switches got automatically adapted to the networks,

d) Routers and Access points are required to be configured explicitly.

e) A switch can be considered a multi-port bridge.

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1.5 CASE: DESIGNING & DEVELOPMENT of SMALL NETWORKS

A reputed educational group has three institutes in the same campus. All institutes have separate independent facilities to administer and manage. However the institute was lagging in information resource management as a whole. All facilities are available but people are unaware to use them optimally and systematically. The Campus was catered with fantastic internet facility of 2Mbps speed Lease line and broadband too. The broadband connections were available in their hostels, which are off campus for boys and in campus for girls.

The off campus students were catered with internet facility through the separate

broadband connection, which were generally tempered by the students residing there and hence connectivity problem was a regular feature, apart from this the occupancy of the hostel was approx 27 students, nine students at each floor and a connection is available at ground and second floor, the third floor students are sharing the connection with the broadband connection available at second floor. As 18 students got attached to one connection the speed of internet got considerably decreased, so the students contacted the IT department for a solution. The problem was expected to be solved without going for a separate broadband for third floor.

However the in campus, girls hostel was enjoying the uninterrupted internet access because the 2Mbps speed was directly at their disposal. The students here were using it generally for chatting, movie download, torrents etc. and the purpose was not at all academic. As many movies, software and other downloadable contents were put in process of download, the actual working of entire campus was hampered. The internet speed was drastically reduced and sometimes it got choked too, thus entire campus was suffering.

The IT situation was pathetic in the sense that other departments were not at all utilizing the existing resources in the sense, the Computer Lab as a whole was on WIFI and the systems deployed there were desktops; the accounts section was taking data backup on CDs. The faculties were using pen drives to carry their presentation to the classes which actually let VIRUSES to enter into the network and hence the systems need frequent maintenance. The students who participates in the lab sessions frequently complaints that on which ever system they worked in the last class they are unable to get that computer system in the subsequent class and as a result the tasks executed in the previous class are non traceable. Apart from this the students were also equipped with laptops and entire campus is WIFI, the students have a regular practice to change their IP addresses assigned to them by IT department as a result of which IP conflict occurs and it leads to create problems in accessing the internet for other students too.

The internet service provider is a reputed organization , providing sufficiently nice services but generally because of the excavation process and other tasks performed by other companies in real estate or so, the cables required to provide internet services in the institute campus are damaged hence working/communication of entire institute is disturbed. IT manager was expected to resolve this issue too. Apart from this problem, the institute is in expansion mode and frequently new EPABX numbers are desired with a traceability that how many lines are making calls outside the campus and their billing was also expected to be maintained and informed to the accounts section for necessary actions. Sometimes the faculties are on leave and their lecture suffers, it was desired by management to make some arrangements that , faculty should be able to deliver the lecture even when he/she is out station. Institute was planning to develop this facility of video lectures to use for conferences or so, to be organized in the campus. After all, institute need to have internet website/intranet website and extranet facility to facilitate the employees working even from outside.

After going through the case given above, you might have realized the presence and importance of networking in our day to day life. Apart from this you might have identified various network components required to establish the computer network. Since you had already gone through various networking concepts in the previous units of this course BCS 041, you are required to make yourself comfortable, to do the tasks given below

ASSIGNED TASKS:

TASK-1 Being an IT manager of the Institute, Identify the problem areas and problems specific to the identified area in the institute. Present your identified

problems in a tabular format.

TASK-2 Identify solutions (both hardware and software), which may be used to resolve the identified problems. Identify the cost effective solution you wish to implement, justify your choice with suitable arguments.

TASK-3 Prepare a summarized requirement report, targeting the identified problem with the proposed solution, in the form of a table, so as to simplify decision making at management end.

SOLUTIONS TO THE ASSIGNED TASKS

Lack of knowledge related to networking and related techniques is the prime cause of problems in the entire campus of the educational institution. Technical Workforce of the institute is unaware of network devices and their usage viz.

1. where to go for wired networking and where for wireless networking
2. which servers are to be designed viz. DNS, Backup server etc
3. non awareness of firewalls or content filtering software
4. how to administer the network connection directly coming from the service provider.

Apart from the mentioned lacunas in the existing network of the campus, there are many more deficiencies; we will discuss them as the discussion proceeds.

From the given Case, we identified following ***problems*** persists, in the respective areas and sub areas :

1. **Entire Campus :**
   a) The connectivity from service provider is wired connectivity, as a result of which as and when the connection cable got damaged due to excavation the entire campus got disconnected from the internet services.
   b) The bandwidth distribution is open in the sense, the lease line from the service providers router is directly catering the institutes access points, thus the bandwidth can be used by the persons outside the institutional premises, and this is quite unsafe because someone it's a security abuse for the institutional network.
   c) Further, the usage of bandwidth by outsiders leads to network choking i.e. network hangout.
   d) Students equipped with laptops were changing the ip addresses, thus ip conflict is a frequent issue of the respective network.
   e) No Intranet or extranet web facility, total reliance on Internet. Thus, in the absence of Internet connectivity, entire communication is on standby mode.
   f) Comparatively low bandwidth, as desired for video conferencing or online lectures.
2. **Hostel :**
   a) On Campus Hostel :

      Since there is no control over the bandwidth regulation, the users are consuming the available bandwidth for non – academic jobs, viz. online

gaming, movies download etc.

b) Off Campus Hostel :

i) The Internet connectivity is given through broadband connection, the positioning of the broadband device is not safe, thus the users were able to hack the device password by using hacking software by directly connecting their systems to the broadband device through the network cable.

ii) The broadband connection was overloaded, thus the Internet speed is slowed down.

3. **Computer Lab. :**

a) Just to save the cost of wiring the entire laboratory systems were on wireless connectivity through the access points, I agree its cost effective, but at the time of lab maintenance and up gradation, the situation become quite challenging, because the network speed is quite slow in wireless mode. Apart from this if connection is lost in between the software installation, then entire file gets corrupt.

b) Since it is very much impossible to find the seat on the same computer system in the subsequent class, the students are to redo the task performed in previous session. Thus the students are unable to recollect the data or the task executed in their past classes.

c) Usage of flash memories/pendrives for porting the data, leads to virus prone network.

4. **Accounts Section :**

a) The backup is taken on the CD/DVDs. if prior to take the backup, system crashes out, and then nothing can be done.

We know that if the problems are identified then half of the job is done.

So, its time to talk about solutions and related alternatives, further we are suppose to identify the optimal and feasible solution.

Network solutions are proposed in the sequence, the problems are identified above As per the identified problem following are the requirements for troubleshooting.

Hardware: Gigabit Ethernet cards, Cat 6 cables, servers (Domain name Server, Backup server),Online Ups for servers, switches, I/O boxes, Connectors, LAN meter, Crimping tools etc.

Software: Proprietary or Open source server software, content filtering software, Bandwidth regulator , Anti- malware software, or Software Firewall.

Let's see how above mentioned resources should be utilized in network designing and development, such that the identified problems of respective identified areas are solved. First, let's start from the Campus Related issues.

Identified Network Solution for identified areas and sub areas:

1. **Entire Campus :**

a) Solution to connectivity problem: The campus should have wireless lease line and not the wired one or may have both types, because wired connectivity has its own advantage related to the speed of operation.

b) Solution to bandwidth distribution: Instead of directly connecting the access points to the service provider connection available through their router. The Network Input/output mechanism should be laid by using the Gigabit Ethernet cards, where the cards are installed on the motherboard slots of the computer system, such that connection from the service provider router goes to the input cards and the output card is connected to the access points through the switches. In between the input and the output card, respective software works viz. open source content management software like squid, software firewalls, anti viruses, anti spyware, anti spam software etc, thus the connection is secure and well regulated. Actually, this computer system acts as a server, which is responsible for bandwidth regulation, content management etc.

c) Solution to usage of bandwidth by outsiders : The router should be protected by necessary SSID(Service Set Identifier) number and password protection mechanism, which prevents outsiders from accessing the network connectivity.

d) Solution to ip conflict: To get rid of the ip conflict problem, we may bind the allotted ip address with the Mac id of the laptop OR we may keep the administrative rights with the system administrator and let the student to act as a user, so no permissions are available to change the ip address.

e) Solution to total reliance on Internet: The institute must design at least a mail server, such that the in campus communication goes on without hindrance. Further, they should design an intranet website, because everything cannot be for public domain.

f) Low Bandwidth: Bandwidth requirement is to be reworked as per the usage, and the connection capacity is to be revised from 2 mbps to the required one.

2. **Hostel :**

a) On Campus Hostel :

Since the on campus hostel is very much in premises so the solution to the bandwidth distribution discussed above, solves this problem. The software firewall have the feature to allot the bandwidth to the particular series of ip addresses which may be allotted to the students or teachers, they are having many other options too.

b) Off Campus Hostel :

i) Broadband connection safety: The broadband device should be protected by installing an I/O Box, mounted close to ceiling, thus the students cannot access the port connections of the broadband device.

ii) Overloaded broadband connection: Two solutions are possible; either we should go for one more broadband connection, which incurs a recurring cost to the institution. The other solution is that we install a switch for the top floor of the hostel where wired connectivity is provided, this involves one time cost of switch and cabling, further the advantage of mobility is curtailed.

3. **Computer Lab. :**

a) It is advised that the computer labs should have wired connectivity

because, wired network has better speed then wireless network. Apart from the speed the connection is dedicated, thus the possibility of losing network connection, in between the process of installation or so, is rare. We may be using the labs for exam purpose or so, in that situation loss of connectivity or so leads to tremendous problems. I agree that the wireless connectivity is quite manageable and cost effective, but at the time of lab maintenance and up gradation, the situation become quite challenging, because the network speed is quite slow in wireless mode. Apart from this if connection is lost in between the software installation, then entire file got corrupt. So, Labs should have wired connectivity

b) Recollecting the data: Here is the requirement to design a DNS (Domain Name Server), where some memory space is allotted to each student, which may be according to their roll numbers or so. Thus through DNS, students are always able to work in their allotted space, and can recollect the job done in previous class. But, there is a requirement of On-Line Ups with the DNS server, because if the power goes Off, then restart of DNS is time consuming

c) Data Portability: Again DNS will be the solution for accessibility of data in class rooms or labs or anywhere else, thus we can block the USB ports and let the entire network be managed through DNS and Intranet.

4. **Accounts Section :**

a) Backup on CD/DVDs : A Backup server is desired to be designed for solving this problem.

1.6 SUMMARY

After going through this unit you are now equipped with the skills desired to structure a wired or wireless computer network. Now you are required to make practice of the learned concepts and realize the facts and figures of networking. Here you learned the concepts related to the Structure Cabling which is further extended to the skill based assembling of Patch Cables, which are widely required to connect computers and network devices, in a wired network. The concepts of wired network are covered under the heading integrating home computers, which enables us to understand the concepts related to How to connect two computers by using crossover cable? and How to share data between two computers? The unit also explored the creation of a small network in both wired and wireless mode, by using hubs, switches and access points. The understanding of the concepts learned in this unit, enabled your application skills through a case given in the end. Hope, you are in the position to apply the learned concepts.

1.7 SOLUTIONS / ANSWERS

☞ Check Your Progress 1

1. The straight-through cables are used when connecting Data Terminating Equipment (DTE) to Data Communications Equipment (DCE), such as computers and routers to modems (gateways) or hubs (Ethernet Switches). The cross-over cables are used when connecting DTE to DTE, or DCE to DCE equipment; such as computer to computer, computer to router; or gateway to hub connections. The DTE equipment terminates the signal, while DCE equipment does not.

2. a) Computer to Computer – Crossover

   b) Switch to Switch – Crossover

c)	Computer to Modem	–	Straight Through
d)	Computer to Switch	–	Straight Through
e)	Switch To Router	–	Both (if problems, go with Crossover)

3. 10Base-T and 100Base-T are the IEEE (Institute of Electrical and Electronics Engineers) standards defining the electrical and physical characteristics of twisted-pair cabling for use in 10 Mbps (Megabits per second) and 100Mbps Ethernet connections. The "T" stands for Twisted pair, and these two Ethernet connections use wire pairs 2 and 3 to transmit and receive information, corresponding to the orange and green twisted pair Nowadays we use the Gigabit Ethernet (or 1000Base-T), where all four conductor pairs, are used to transmit and receive information simultaneously.

☛ **Check Your Progress 2**

True / False

a) True

b) True

c) True

d) True

1.8 REFERENCES

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- http://en.wikipedia.org/wiki/Structured_cabling
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EBOOKS

- Cisco Networking Academy Program CCNA 1: Networking Basics v3.1
- *IP Network Design Guide from IBM by Martin W. Murhammer, Kok-Keong Lee, Payam Motallebi,Paolo Borghi, Karl Wozabal*