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Introduction

Have you ever heard of the saying **"The whole is greater than the sum of its parts"?** This statement is really much more meaningful when applied to computers and their associated resources. A computer network is an interconnection of computers. There are various reasons why computers may be interconnected to one another. Suppose that you have two or more **stand-alone computers**. (Note: A stand-alone computer is a computer that is not linked to another computer.) Although you can do quite a lot with these computers, the benefits are multiplied when you link your computers together to form a computer network. There are certain things which you cannot do with stand-alone computers, or which you can manage to do but with many difficulties. For example, think about this scenario: *Mrs Mweemba, Ms Chanda, Mr. Mubita and Mrs Silomba are teachers and they share the same office. Each one of them has a stand-alone PC on the desk. Mrs Silomba's has a printer connected to her computer. The other three teachers feel that they must also have their own printers. What is the solution?*

Computer networks are designed to solve such kind of problems. In this module you will learn some useful details about computer networks; what roles they play and how they are setup. You should ensure that you familiarize with new concepts, which will, of course, be clearly explained.

Objectives

1. State what is meant by computer network.
2. State reasons why organisations set up computer networks.
3. State the three types of computer network.
4. State the basic differences between types of computer network.
5. State what is meant by LAN topology.
6. Name the different types of LAN topologies.
7. Draw diagrams to represent the Star topology, Ring topology and Bus topology.
8. Describe how communication is effected in each of the three types of LAN topologies.
9. State the relative advantages and disadvantages of each type of LAN topology.
10. Name the basic networking requirements, i.e. transport media, protocols and naming system.
11. Briefly describe Ethernet technology, TCP/IP and DNS.
12. State what the word Modem means, and what a modem is used for.
13. State what the letters NIC stand for, and what a NIC is used for.
14. Mention the various communication channels that can be used to send data from one computer to another computer.
15. State some advantages and disadvantages of the communication channels mentioned above.
16. Identify by name a communication channel given its drawing or picture.
17. State the use of each of the following computer network devices: Router, Switch , Hub, Bridge , Gateway, Firewall
18. Set up a local area network to share resources, e.g. printer and data.
19. State what is meant by Internet and World Wide Web (WWW).
20. State the role of Internet browser software.
21. Name some popular Internet browser software.
22. State the difference between a Website and a Web page.
23. State the role played by the Internet Search Engine.
24. Name some popular Internet Search Engines.
25. State what is meant by e-mail.
26. Create an e-mail address.
27. Send and receive e-mail.
28. Mention advantages of e-mail over ordinary mail.

Chapter 1   ROLE OF COMPUTER NETWORKS

1.1   Introduction

A computer network is an interconnection of network nodes. Although computers have made tremendous impact on our lives, computer networks have done so in a much more remarkable way. They have changed the way we live and do business.

1.2   Advantages of computer networks

So, what are the specific advantages that we draw from networking computers?

Some of the advantages of computer networks are as follows:

1. Data can be shared. For example a school can create databases to store all records of pupils, all data of staff members, all facilities which the school owns, etc. If one teacher enters test results in the pupils' database, everyone authorised can retrieve information from the database without having to print or type the details again. What is the advantage of this? You will agree that this saves on time and printing resources, e.g. ink/tonner and paper. Many people nowadays share data or information (in any form, e.g. text, graphic, audio or video) in a more cost-effective way by means of computers. By sharing information this way, there is greater efficiency, and many operational costs are reduced.
2. Tasks can be shared. What is the advantage of this? This helps improve the quality of information and the speed at which results are obtained. For example, co-workers can collaborate on the same task but working on different computers which are networked.
3. Computer resources, e.g. storage facilities, printers and software, can be shared. This greatly reduces the cost of using computers. For example, it is not economical for everyone in an organisation to have their own printers, antivirus software, and large storage facilities. It is more economical to put these facilities on a computer network to be shared by everyone.
4. Communication is easier and more economical. For example, if Mr. Mwamba sends an e-mail to Mrs Soko, Mrs Soko will find the message when she starts her computer. She will send a response, and Mr.

Mwamba will find it. There are many other ways of communicating by means of networked computers in addition to e-mail.

Exercise 1.0

1. What is a stand-alone computer?
2. What is a computer network?
3. What advantages can you think of for networking computers?
4. In what way do computer networks reduce operational costs?
5. In what way do computer networks increase operational efficiency?

Chapter 2   TYPES OF COMPUTER NETWORK

2.1 Introduction

Having learnt about what computer networks are and reasons for forming them, you must be wondering how computers can be networked. Before we come to this, let us first understand some fundamental details about computer networks. How to link computers will depend on what type of network you want to set up.

To start with, let us answer these questions?

- **How many types of computer network are there?**
- **What determines the type of computer network to set up?**
- **What are the different computer networks?**

Generally, there are three ways in which computers can be linked. The determining factor is usually the **distance** over which the network will span. If computers are within the same locality, e.g. in the same room, or in the same building or in the same school campus, the network is called the **local area network (LAN).** If the computers are in the same town or district, the computer network is called the **metropolitan area network (MAN),** and if the computers are in different geographical areas or locations, e.g. in different towns or countries or in different continents, the computer network formed is known as the **wide area network (WAN)**. An example of the WAN is the Internet which links many computer networks in the world.

Exercise 2.0
1. What is the difference between a LAN and a WAN?
2. Which computer network would be set up between your school and the DEBS office in your district?

Let's now learn details of the LAN.

2.2   Local area networks

As has been stated, a LAN is an interconnection of computers, actually nodes, within the same place. Local area networks are particularly useful because they enable co-workers at a place of work to share company resources and improve their

work output. This is why many organisations set up local area networks at their places of work.

Notice that it is often more accurate to refer to a computer network as an interconnection of nodes rather than of computers. The reason is that on such networks many resources are found. In other words, it is not only computers that are found on computer networks.

So, how can computers are connected to form a LAN?

There are various ways in which computers can be linked with each other to form a local area network. For example, computers can be linked to form **a star, a ring** or **a bus** network. (See http://www.giac.org/cissp-papers/32.pdf) The way computers are interlinked is called a **topology**. Therefore, you often hear people talk about star topology, ring topology, bus topology, and so on. You will learn about each of these topologies in the next few sections.

2.2.1 Star topology

In this topology, there is a central node called the **server** to which all other computers are linked. The computers connected to the server are called **terminals** or **workstations** or **slaves**.

by Chris Woodford
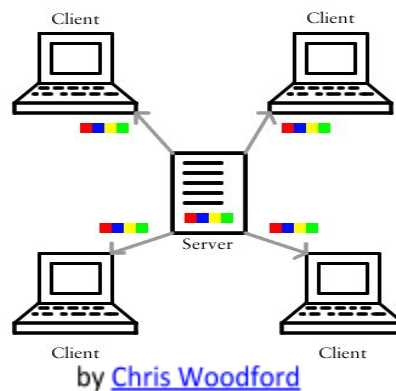
The server is usually a high-speed computer, e.g. a minicomputer or a mainframe computer. (Note that a high capacity and high speed microcomputer can also be used as the server). The terminal computers are also commonly known as **clients**. Thus a star network is also known as a **client-server network**.

What are the advantages and disadvantages of star topology?

Advantages of star network
1. It is relatively cheaper because computer resources, e.g. printers and software are concentrated on the server.
2. There is better or improved security and control for data and other resources because these are located on the server computer where access can be monitored and controlled easily.

3. It is easier to set up.
4. It is easier to troubleshoot, i.e. to identify and solve network problems.
5. One faulty node of link does not affect the whole network.
6. Signal collisions are not very frequent.

Disadvantages of star network
1. Communication is somehow slow due to the presence of the intervening computer (the server computer).
2. During the down-time of the server computer, the whole network is affected.

2.2.2 Ring topology

In this topology, there is no server and no client; all the computers are **peers**. The computers are connected to a cable that runs round forming a ring as illustrated below.
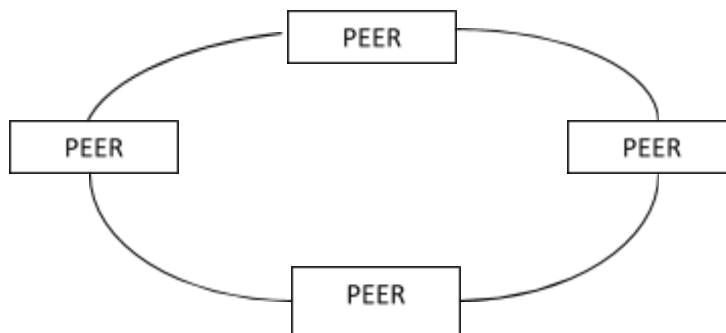
Because there is no server computer to control communication, a special signal called a **token** is sent round the network. The computer with the token is the one that is able to send while the other computers are able to receive only. This ensures that only one computer can transmit at a time.

What are the advantages and disadvantages of ring network?

Advantages of ring network
1. Theoretically, this type of LAN is faster than the star network due to the absence of the intervening server.
2. There are no signal collisions during transmission due to the use of a token which goes round the network in one direction only.
3. All stations have equal access.
4. Because each station on the ring acts as a repeater, ring networks can span longer distances than star networks.

**Disadvantages of ring network**

1. There is poor security for data.

2. It is the most expensive topology because it requires two sets of cabling – one in each direction- so that should the cables on one side get cut, the signals can be sent through the other side.
3. Failure of one node may affect others.
4. For these reasons, ring networks are no longer popular.

2.2.3 Bus topology

What is a bus network?

In this network, a cable called a **bus** runs through. All the computers in the network are linked to this cable.
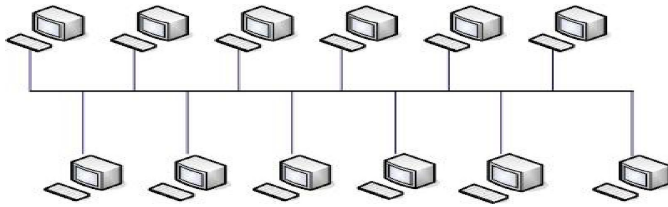
By [Jim Murray](#)

Theoretically, this is a very fast network because computers are allowed to transmit their signals simultaneously. One major drawback of this type of network is the possibility of collision of data signals. Another problem is that if the bus is cut at some point, no signals travel along as the circuit becomes open. Special software is used to ensure that collision of signals is avoided. A technique or a protocol known as **Carrier Sense Multiple Access/Collision Detection** (**CSMA/CD**) is used to control transmission of signals on this type of network.

How does CSMA/CD work?

2.2.4 How CSMA/CD works

1. A computer wishing to transmit a signal first **listens in**, i.e. first checks the network to find out if another computer is also transmitting. This is done to ensure that no two computers transmit at the same time. If two or more computers transmit at the same time, a signal collision occurs.
2. If no other computer is transmitting, it sends its signal.
3. The transmitting computer then listens in for the second time to ensure that no other computer transmitted a signal while it was sending its own.

4. If a computer detects a signal on the network when it listens in, all computers that sent signals terminate transmission and wait for some time to give each other chance. Each computer waits for a random time, i.e. each computer chooses a different time period to wait for other computers to transmit their signals.
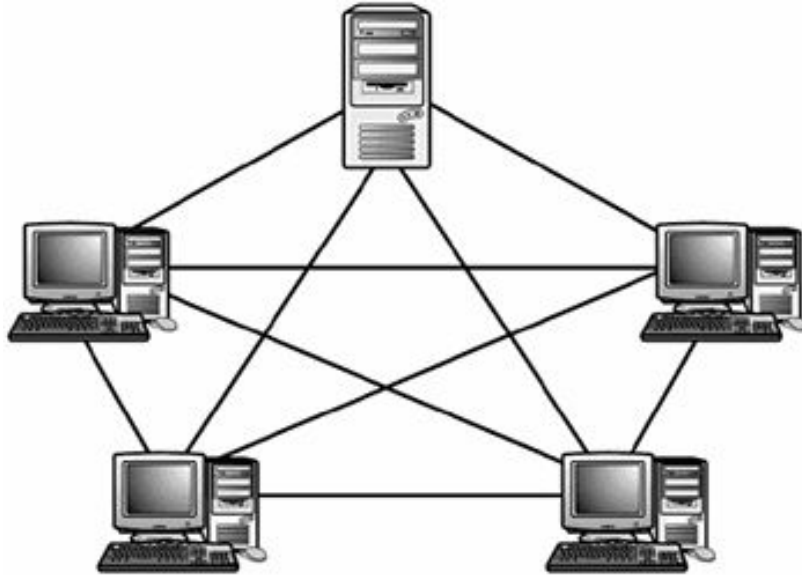
Although a bus network is theoretically supposed to be very fast, in practice its efficiency can greatly be affected, especially where the network is large with many computers.

Other network topologies are tree and mesh as illustrated below.

2.2.5 Tree topology
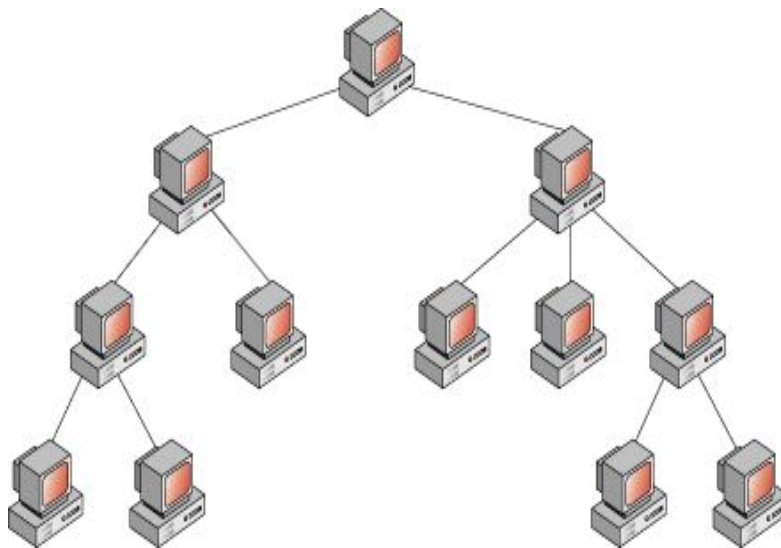
2.2.6 Mesh topology

Exercise 2.1

1. What is meant by LAN topology?
2. Draw diagrams for each LAN topology.
3. Explain why the star topology is the most common LAN topology.
4. How are signal collisions avoided on star topology, ring topology and bus topology?
5. What do the letters CSMA/CD stand for?
6. Ring topology is not common anymore nowadays. What are the reasons?
7. In what kind of situation would you not want to implement a bus network? Explain.

Chapter 3   HOW TO SET UP A NETWORK

In this chapter you will learn details about how you can set up your own computer network. But before we look at the details let us ask the following question:

What is required for a computer network to be set up?

3.1   Requirements for setting up computer network

In order to set up any computer network you need three things. What are they? You need **transport media**, you need **protocol**, and you need **a naming system**. Why are these things required? You will discover in this chapter. So, continue reading, but do it carefully so you don't miss vital points.

Let's start with transport media?

What is transport media?

You will agree that since a network involves sending of signals from one point to another point there must be some resources to convey the signals between the two points. Therefore, transport media refers to the set of resources for conveying signals from one node or network to another node or network.

3.1.1   Ethernet
The most common transport media used to convey network signals is called **Ethernet**.   Ethernet technology consists of communications channels such as UTP or fibre optic and network repeaters such as hubs and switches. You will learn more about these things in the sections that follow.

3.1.1.1   *Communications Channels*
A communications channel is a route through which signals travel from one point to another point on a computer network. It is like a road through which traffic flows from one place to another. In the next section you will learn about the types of communications channels. Therefore, a communications channel is a link between two computers, or between a computer and a network, or between one network and another network.

3.1.1.2   Types of communications channels

There are two types of communications channels. These are **wired** and **wireless**.

Communications channels differ from each other mainly in the amount of data signals which they can transmit at a time. This is known as the **bandwidth**. A channel with a greater bandwidth carries more signals, and therefore transmits data faster than a channel with a lower bandwidth. The bandwidth of a communications channel is given in **bits per second** (i.e. **bps**). Data is sent in form of bits. **Bits** are a short-cut for **bi**nary digi**ts**. Binary digits are 0 and 1. Therefore, data consists of strings of 0s and 1s, e.g. 01000001 which stands for A in a coding scheme called American Standard Code for Information Interchange (ASCII). For example, the bandwidth of a communications channel could be 100Mbps. This means that the channel can transmit 100million bits in one second. This is clearly faster than one which is rated 10Mbps. Do you agree?
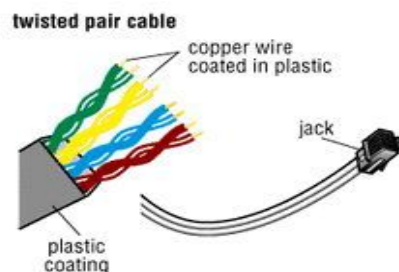
What are wired channels, and what are the examples?

3.1.1.3   Wired channels

Having looked briefly at few details about communications channels in general, let us now learn about the wired channels.

Wired channels form physical links between computers or other devices. Examples are **UTP**, **Coaxial cable** and **Optical fibre**.

UTP

UTP stands for **U**nshielded **T**wisted **P**air. This is a pair of copper wires that are twisted around each other and are not protected from environmental interference.

Advantages of UTP
1. The cables are cheaper.
2. UTP is easier to install.

3. Modern UTP (e.g. Cat 6) has higher data transfer rates or bandwidth.

Disadvantages of UTP
1. Data transfer rates are low for old UTP.
2. It has a distance limit of approximately 100m.
3. There is more environmental signal interference.

Coaxial Cable

A coaxial cable consists of a central copper wire as one conductor surrounded by a mesh of wire as an outer conductor. Coaxial cables transmit data faster than UTP. The drawing below shows the structure of a coaxial cable.
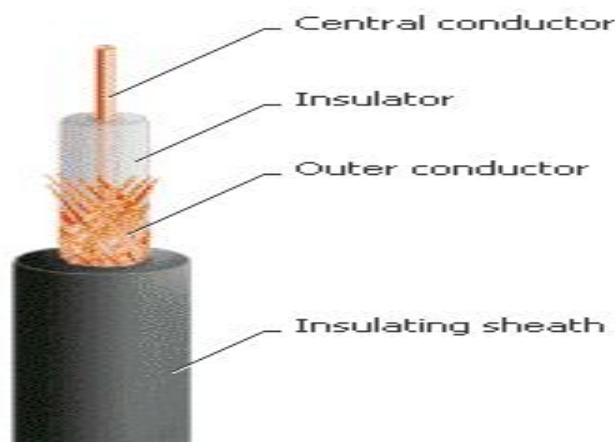
Advantages of coaxial cable

1. Coaxial cables transmit data faster than UTP because their bandwidth is larger.
2. Coaxial cables can cover longer distances than UTP.
3. There is less signal interference from the environment.

Disadvantages of coaxial cable
1. They are more costly to produce and to install than UTP.
2. They are very bulky, i.e. large and heavy.
3. They are not supported by some network standards.
For these reasons, coaxial cables are not very commonly used in computer networks nowadays.

Optical fibre (or Fibre optic)

This is a very thin rod of extremely pure glass the size of your hair. Signals are transmitted in form of light instead of in form of an electric current like in UTP and coaxial cable. Each fibre is bent at a special angle to allow for total-internal reflection of light. (Do you recall total-internal reflection from your Physics lessons at school?) Several glass fibres are bundled together to form the optical fibre.
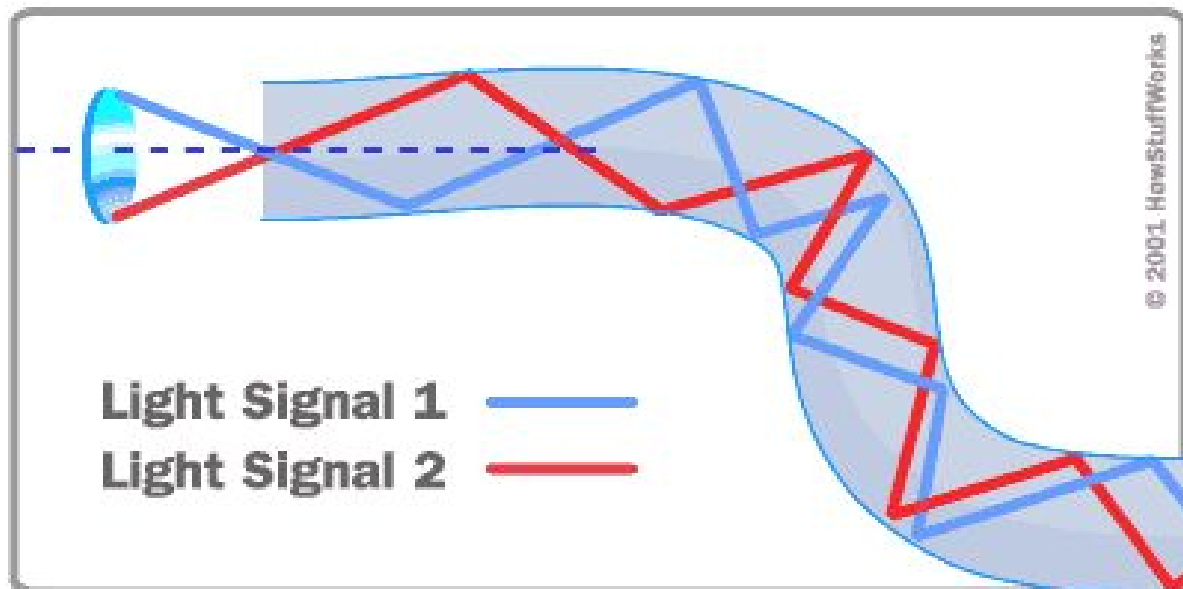
Advantages of fibre optic

1. Fibre optic cables carry more data because they have a much greater bandwidth than metal cables.
2. Fibre optic cables are less susceptible (i.e. vulnerable) than metal cables to interference.
3. Fibre optic cables are much thinner and lighter than metal wires.
4. Data can be transmitted digitally rather than analogically.

Disadvantages of fibre optic

1. The main disadvantage of fiber optics is that the cables are expensive to buy and install.
2. In addition, they are more fragile (i.e. brittle) than wire.
3. The glass can be affected by various chemicals including hydrogen sulphide gas.
4. Most fibres become opaque when exposed to radiation.

5. Optical fibres cannot be joined together as easily as copper cable and require additional training of personnel to handle them.

Now let us learn some details about wireless channels.

### 3.1.1.4   *Wireless Channels*

What are wireless channels, and what are the examples?

These are communications links that allow for the sending of data as electromagnetic waves. Examples are **infrared**, **radio**, **microwaves**, and **satellite**. The advantage of some of these channels is that data can be sent over very long distances by remote. (Remote means with no physical connection between sending and receiving systems.) The bandwidth is also large. The picture below shows a satellite dish.

Satellite Dish

A satellite dish transmits and receives signals to and from a satellite which is positioned in space above the earth. (See illustration below.)

Communications satellite
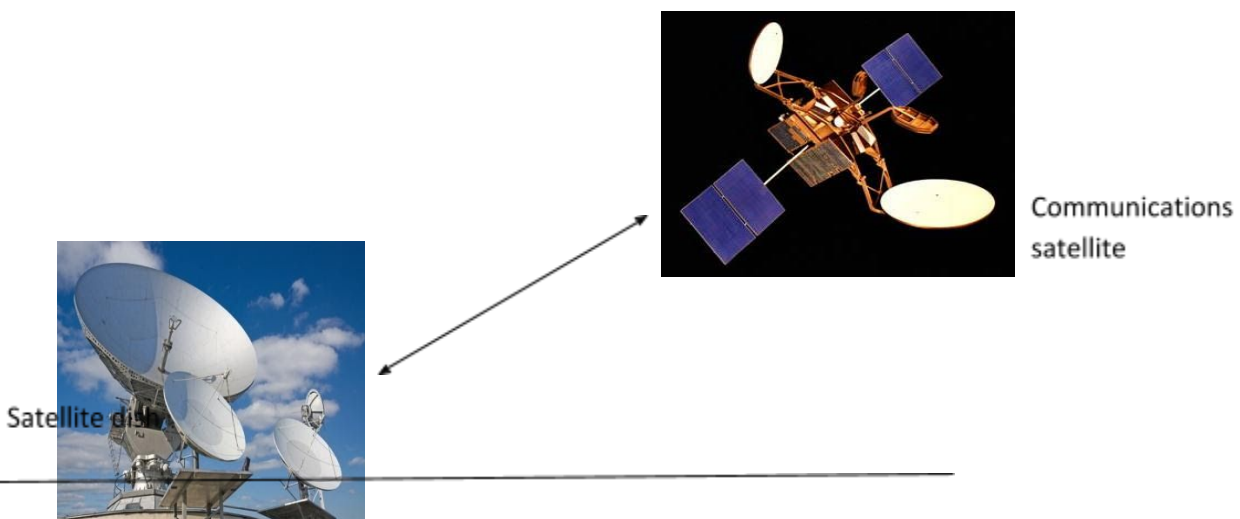
Satellite dish

Using satellite communication, messages can be sent round the globe in just a fraction of a second. A common type of dish is the VSAT such as the one at TVTC. VSAT stands for **Very Small Aperture Terminal**.
(See the website: http://www.explainthatstuff.com/satellites.html for more details by Chris Woodford.)

What are the advantages of wireless networks?

Advantages of wireless networks

1. **Mobility** - network access can be available all the time.
2. **Fast setup** – one can easily or automatically connect to wireless networks within range.
3. **Cost** - Setting up a wireless network is much less costly than buying and installing cables.
4. **Expandability** - New computers can be added to a wireless network very easily.

Disadvantages of wireless networks

1. **Security** – unauthorized people can easily gain access to a private network.
2. **Interference** - wireless networks are more susceptible to interference from lights and electronic devices.
3. **Inconsistent connections** - wireless connections are not as stable as those through a dedicated cable.
4. **Speed** - wireless networks are generally slower than cable networks.

Having learnt about communications channels, we now turn attention to repeaters. What are they?

3.1.1.5   Repeaters
When a signal is sent along any communications channel, it becomes weaker as the distance from the source increases. It is the same with sound and light. This is called **attenuation**. See illustration below.

Attenuation is not good for network signals because it might cause the signals to fail to reach their destinations. Therefore, when setting up a computer network measures have to be taken to ensure that attenuation will not cause signal losses. One approach used to go round this problem is by including devices called **repeaters** at certain points along the network. You must have an idea about repeaters because they are widely used in TV signal transmission. For example, to transmit TV signals from our Lusaka and Kitwe studios too far away areas such as Kasama, a number of repeaters called substations have been installed along the way. The repeaters are located at convenient points. They receive the transmitted TV signal, boost it (or amplify it) and then re-transmit it towards its destination to the next repeater. This is repeated until a strong signal gets to the final destination.

This technique is used to convey computer network signals. The repeaters used are **hubs** and **switches**. However, hubs and switches do not only work as repeaters; they perform other functions such as distributing signals to the correct destination. Let's learn more details about them.

3.1.7 Hubs and Switches

Suppose that we have two LANs which are 150m apart, as illustrated below, that wish to communicate.
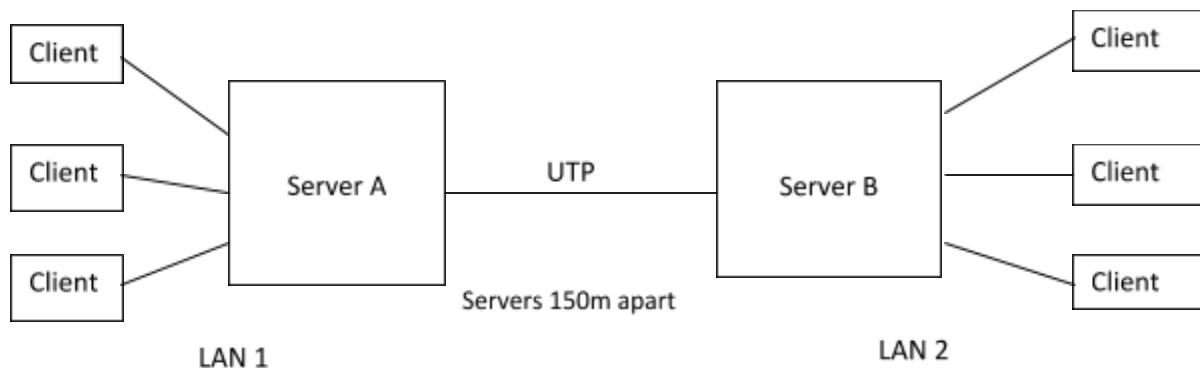
Since the two networks are linked by UTP which has a maximum distance of approximately 100m, signals cannot be conveyed between the two. A hub or a switch can be connected between the two networks to boost the transmitted signals. See illustration below.

Servers 150m apart
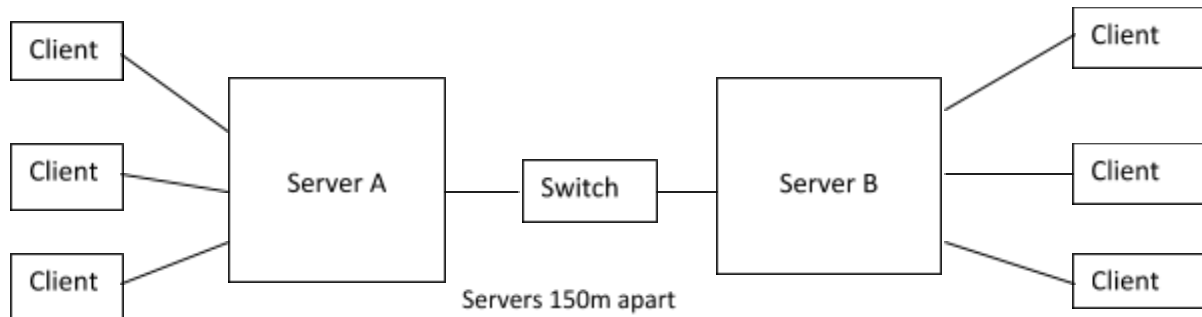
If the switch is placed, for example, 75m from either server, it will amplify signals that pass through it in either direction. The switch will also direct transmitted signals to their correct destination.

What is the difference between a switch and a hub?

A hub differs from a switch in certain respects. A switch is more "intelligent" than a hub. When a hub receives data meant for one device, it **broadcasts** the signal to all the devices on the network. Unlike a hub, a switch first identifies the owner of the data and then sends only to that destination. A switch also works faster than a hub. Since switches are more efficient than hubs, they are also more expensive. See pictures of switch and hub below.


Hub

Hub

Notice that the outside appearance of switch and hub might be the same. It is their internal circuits and operation that differ.

A switch or a hub can be used to interconnect network resources directly as shown below. Network resources such as printers are often shared using this approach. Given below is an example of a network of three computers sharing a printer.
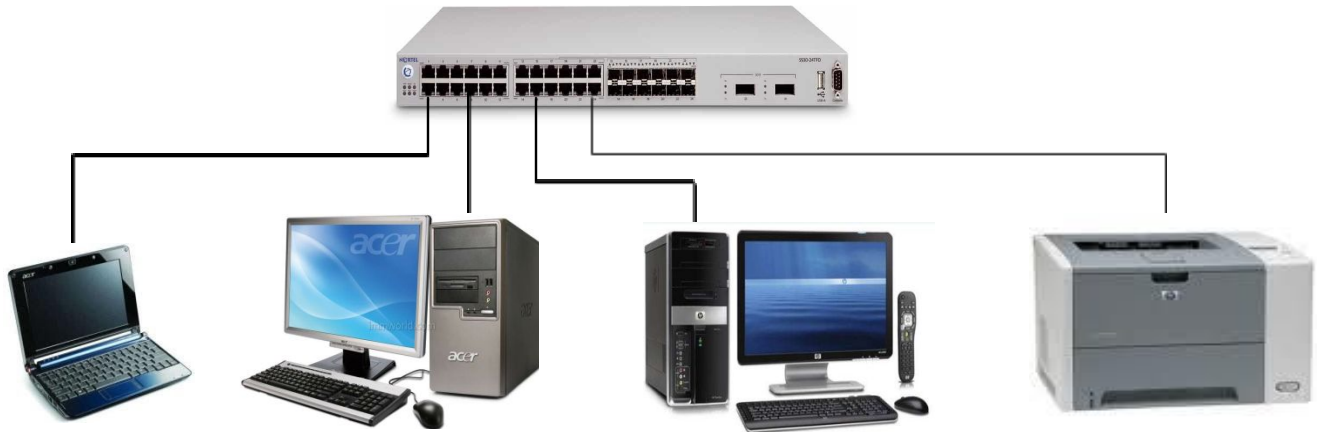
So far you have been learning about transport media, or Ethernet. Let's now learn about protocol.

3.1.2 Protocols

What is a protocol? A protocol is a set of rules that govern how something is done or must be done. Computer networks require a number of rules to ensure that communication is possible between and among different devices. Just like people speak different languages, network resources also 'speak' different languages. Protocols ensure that network resources and procedures are standardized. For example, human beings have standardized the way they greet each other by means of hand-shakes. Which hand do you use to greet someone? What happens if the person you are greeting extends his/her left hand to shake yours? Another way in which we are using standards is in footwear. If you go into shoe-making business, you have to follow the standard sizes or else your enterprise gets into 'maningi' (serious) trouble.

In networking technology, similar difficulties will be faced if every network device manufacturer, implementer and user begins to employ their own standards. For example, since computers and telecommunications devices are made by different people in different places around the world, how should they be made in order that they will be compatible with each

other? Or if one node on a network is sending a signal to another node, how should the sending node alert the receiving node about this transmission, and how could the receiving node tell whether or not the data received is exactly the same as the one that was sent? Furthermore, how should data is prepared for more efficient transmission? For this last one, think of how you would prepare your harvested maize for efficient transportation to millers. You see that the standard procedure (in Zambia now) is to package the grain into sacks of 50kg capacity. What happens if you try to be 'clever' and make under-weight bags?

Well, I think you now have followed the rationale for protocols in networking. Protocols are simply about creating standards that ensure that communication is efficient and effective regardless of the type of machine or device used.

So, which protocols are used in computer networks?

There are many protocols used. Some of them work in specific situations only but there are others that are more general. Actually, to ensure that there is harmony in networking, international standards have been established. The organization which sets these international standards is called the **International Organization for Standardization** (**ISO**). You can call it the International Standards Organization if you like. The ISO does not set standards for computer networks only. It also sets standards for all products and services. For example, if you would like to produce goods or offer services to international quality in order to capture the global market, you should look at what the ISO has stipulated for those goods or services. The branch of the ISO that sets standards for computer networks is called the **ISO-OSI**. This stands for **International Organization for Standardization-Open System Interconnection**. However, the rules set by the ISO-OSI are for reference purposes only. The more specific protocols used in the world today are called the **TCP/IP**. Let's learn about these briefly.

3.1.2.1   TCP/IP

TCP/IP stands for **Transmission Control Protocol/Internet Protocol**. Doesn't sound good; does it? TCP/IP has become a sort of international networking standard. Basically, it indicates how the network hardware and other resources should be made, how they should be connected to form

computer networks, and how signals must be sent and received on the networks.

I hope you're enjoying all this. Let's move on. We will now learn about the naming system which is a third requirement for setting up a computer network.

3.1.3 Naming System

As you can rightly guess, a naming system is important in networking especially where you have many nodes all interlinked with one another. Just like people have names, network nodes also require names for identification purposes. The ISO-OSI dictates that appropriate names should be used, and rules have been set for coming up with the names for network nodes. The idea is that each device on the network must be uniquely known so that signals are sent to the correct destination. The naming system used for this is called the **domain name system** (or **DNS**). To understand DNS, think of how you send a letter to someone. You must have an address and the other person must also have an address. Imagine you wanted to send a letter to a person who had exactly the same name and same address as another person. The two people wouldn't easily know whose letter it was.

Let's learn some details of DNS.

3.1.3.1 DNS

DNS is a system of ensuring that signals on a computer network always find their destination. Without DNS it is impossible for two or more nodes to communicate because they would not be able to identify each other. Each node on a network is allocated a unique address to be identified with it. This unique address is called the **IP address**. Usually the IP address is a decimal dotted number such as 192.168.1.117. Notice that the dotted decimal IP address always has four numbers separated by dots or periods. Therefore, if

you wanted to gain access to your friend's computer that has this IP address, you would simply type 192.168.1.117 in a special window on your screen. However, due to the fact that addresses written like this are not easily remembered, **domain names** are allocated to IP addresses. For example, the IP address could be allocated a domain name such as ***tvtc.edu.zm***. It is usually written as ***www.tvtc.edu.zm***. Therefore, entering ***www.tvtc.edu.zm*** is equivalent to typing 192.168.1.117. It does not matter which approach you use. It's just like you; you can be called by your name or by your NRC number, or college number. But as you will agree, it is easier to call people by their names.

Let's now understand a few details about IP addresses.

3.1.3.2 IP addresses
An IP address has three parts. These are:
a) The kind of protocol which should be used in order to access the computer
b) The name of the computer (or organization which owns the computer), and
c) The nature of the organization and the country in which the organization is located.

Let's use the IP address ***www.tvtc.edu.zm*** to understand the parts of an IP address that would be associated with a domain name. Writing ***www.tvtc.edu.zm*** is actually a short way of writing the IP address. In full, this is written as ***http://www.tvtc.edu.zm*** and it tells us that to get to the computer of this address the communication rules in the http will be used. (Http stands for **hyper text transfer protocol**). www indicates that this computer is part of the Internet. (www standas for world wide web, and I will soon explain the difference between the Internet and the WWW.) In this address, tvtc stands for the name of the computer on the Internet, or the name of the organization which owns the computer. edu indicates that the computer belongs to an education establishment, or that the owner of the computer is an education institution. You can guess what zm means. It means that the computer or the education institution is in the country Zambia. Every country has been allocated an identification code, e.g. zm for Zambia, us for United State of America, za for South Africa, jp for Japan, and nl for Netherlands. Com stands for commercial organisation, net for network, mil for military, org for non-governmental organisation, and gov for

government organisation. The IP address such as ***http://www.tvtc.edu.zm*** is also called the **uniform resource locator** (**URL**).

**What other resources are required for linking nodes together to form a network?**

3.1.3.3 NIC and MODEM

You also need a **network interface card** (**NIC**) or a **modulator-demodulator** (**MODEM**).

Why are these required?

To understand why NIC or Modem are required, let's first learn about the nature of computer signals. As was mentioned in Module 2, data in a computer is represented in binary, e.g. 01000001 for letter A (in ASCII). In order that the bits representing one character must arrive at the same time in the computer, each bit follows its own line. This means that the bits travel in **parallel** (i.e. side by side) within the computer. (This is why the size of the **bus** matters.) Now, a problem arises when the data has to be transmitted out of one computer along a communications channel such as UTP to another computer. Along UTP the bits of data will be transmitted in a **serial** manner (i.e. one behind the other). We say that computers handle data in **digital** form and wires transmit data in **analog** form. This is similar to the problem which two or more people who are running side by side along a wide road would face if they try to go into a narrow bush path. Along the narrow path, they would have to break into a single-file.

To transmit data out of the computer introduces this similar challenge. The data must be converted from parallel to serial and then back to parallel again as it enters another computer. The devices for achieving this are NIC and modem. Only one of the two is required depending on how you want to connect the computers to one another. If you want to connect a computer to an Ethernet LAN, you need a NIC, but if you want to connect to another network through your telephone line (i.e. landline, e.g. Zamtel lines) you need the modem. Nowadys what is popular is the use of a NIC. In fact every new computer now comes with a NIC socket into which UTP can be connected. This socket is called the RJ45 port.

RJ45 Sockets

k5633539 www.fotosearch.com

Digital signal in computer

Analog signal in wire
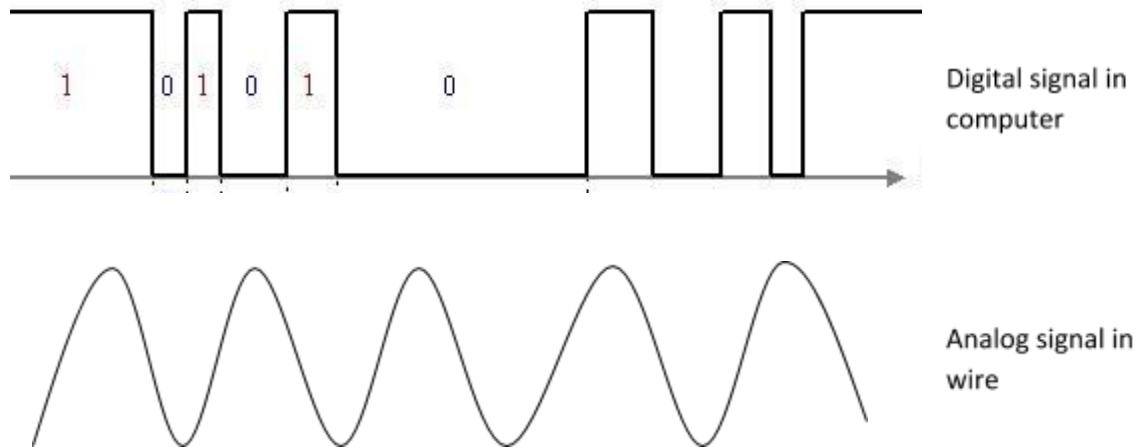
To summarise, we see that to set up a computer network you need transport resources (e.g. UTP and switches), protocols (e.g. TCP/IP) and a naming system (e.g. DNS). NIC and modem are a part of the transport resources.

EXERCISE 3.0
1. What is a modem?
2. How does a modem differ from a NIC?
3. In what way is a modem similar to a NIC?
4. Why does a computer require a modem or a NIC?
5. Mention the three wired channels.
6. Which wired channel is the cheapest, the most expensive?
7. What is bandwidth?
8. Which wired channel has the least bandwidth, the largest bandwidth?
9. Why is UTP common on LANs?
10. What are the advantages of satellite communication?
11. Mention three things that are required for networking.
12. What do you understand by IP address, and what is its importance?
13. In what way is a switch similar to a hub? In what way is it different?
14. Explain the meaning of the URL *http://www.assist.com*.
15. Explain why protocols are useful in computer networks.

Chapter 4   THE INTERNET

Did you know that the Internet is ranked one of the greatest inventions of all time? Other great inventions were the **wheel** and the **telephone**. (In what way were the wheel and the telephone great inventions?) The Internet is a global interconnection of computer networks. Nobody owns it, but anybody can connect to it.

Why is the Internet so popular? What is its use?

4.1 Use of the Internet

The Internet is a great achievement for mankind. Connecting to the Internet has three benefits in general.

1. **Communication**. One can communicate with other people globally at much reduced cost through use of many communication features, e.g. e-mail.
2. **Retrieval of information**. From the Internet, you can retrieve almost any information you want and on any subject.
3. **Commerce**. If you do business, you can advertise your products and services to global customers. You can also buy goods and services through the Internet.

What are the advantages of connecting to the Internet?

4.2 Advantages of the Internet

1) **Educational literature** e.g. books and latest publications can be accessed in almost every field.
2) **Entertainment**. One can listen to music, can watch movies and can play on-line games. These can also be downloaded, free or after paying some subscription fees.
3) **Business** can be done on the Internet, e.g. an advertisement for a wide range of products can be made to global customers. You can also browse the Internet for products that you want to buy. This is known as **e-commerce**.
4) **E-mail** (electronic mail) can be made use of. E-mail is the most widely used service of the Internet by an average Internet user.
5) **Computer software** can be downloaded on the Internet. Finding and buying software without the use of the Internet is extremely difficult. Sometimes it is impossible, especially in a developing country like Zambia. Most software requires regular updating once installed in a computer. Updating computer software, e.g.

operating system and antivirus software is impossible without internet connection. (Computer experts, unlike average users, find this, i.e. point number 5, to be the most important use of the Internet.)

4.3   Browsing the Internet

What is meant by browsing the Internet?

Browsing the Internet means searching it for whatever you want. To browse the Internet is simple. You simply start the Internet browser software, e.g. **Internet Explorer**, **Opera**, **Google Chrome** or **Mozilla Firefox.** Once in the browser you can navigate in so many ways. If you already know the address of what you want, you simply type it in the address box in the browser and then click on a button to get to the destination, or you can simply click your mouse pointer on any of the numerous **hyperlinks** to take you to the destination of your choice.

4.4   Internet Vs World Wide Web

What is the difference between the Internet and the WWW?

Some people find these two terms confusing. You shouldn't. The WWW is an infrastructure of information which the Web browser software allows you access to. The WWW consists of several sites called **Websites**. Websites are located in computers called **Web servers**. There are thousands of Web servers around the world. These computers store massive information on different topics. The information contained in these different Websites is what is collectively known as the World Wide Web (WWW). The WWW is actually a web of information. The Internet is a system of computers that accesses and retrieves information from the WWW. That is, you need the global network of computers (the Internet) to access the global network of information (the WWW).

4.5   Website and Web page

What is the distinction between Website and Web page?

This question sounds silly! It is really like asking someone the difference between a book and a book page. So you see, a Website consists of Web pages. The information you access on a Website is actually located in Web pages within that Website, just as the information you access in a book is located on a particular page within that book. A Web page is actually a document of information that you access from a Website. A website has an address like this: www.something.com. You will learn details of web addresses later in this module.

4.6   Web browser and Search engine

Yahoo and Google! What do they actually do?

Yahoo and Google are Search Engines. They are software used by the Web browser to open peoples' computers and take information from there. Somehow, they know where the information everybody wants is kept. They go right there as long as you give them the keywords. Of course, they are very good at making good guesses. They look at your keywords and then search the WWW for something similar to what you have requested for. They even arrange the stuff in the order of popularity, with the most popular site on top.

They must be very intelligent.

Yes, they are well trained. They have developed some kind of super memory (like you) which enables them to remember where they see information on the WWW. I hope I have satisfied your curiosity. Have I?

Yes. I think I'll also go to that college when I stop breastfeeding.

We'll be together; I want to go back for a degree to acquire more knowledge.

4.7   Electronic mail (E-mail)

One of the most fascinating things about the Internet for most users is e-mail. This is a facility available when one connects to the Internet. One can send and receive text and both video and audio messages using e-mail.

To send e-mail, one types the message, indicates the address to receive and clicks a button.

E-mail is meant to make mail more efficient. It also solves the problem of so much paper wastage, unattended to telephones and delays in going to buy envelops and stamps, and going to the post office to send the letters. It is also extremely cheap to send messages by e-mail. In fact e-mail is mostly free. You must have an e-mail address to be able to send or receive e-mail messages.

Notice that a website address such **www.tvtc.edu.zm** differs from an email address such as **mstembo@tvtc.edu.zm**. The website address, also called the **URL** (URL = Uniform Resource Locator), as you can see here, does not have the @ (at) symbol.

4.8   How to connect to the Internet

Due to the advantages of the Internet as stated earlier, having Internet access is very useful. It is not difficult to connect to the Internet. You can connect to the Internet by means of many devices such as cell phones, computers, e-readers, and IPad. To connect to the Internet by means of a computer, one requires some resources as listed below.
- A communications channel, e.g. UTP or fibre optic
- A router
- An Internet service provider (ISP)

What is ISP, and why is this important?

The Internet service provider (ISP) is an institution or organisation with facilities to connect computers to the Internet. It is an ISP which allocates a domain name and the IP address. In Zambia, examples of ISPs are Zamtel, Zamnet, CopperNET, Microlink, MTN and Airtel. ISP is important because connecting to the Internet uses very expensive resources in terms of hardware and software. Individuals cannot afford the costs. In addition, it may not be economical to provide your own resources to connect to the Internet. ISPs acquire these resources but charge fees for providing Internet services in order to gain from their investment.

What role does the router play?

As was mentioned, signals must be prepared and must be able to find their correct destinations on the Internet. The router performs these functions. It is the router which identifies the destination of a signal on the Internet. It

uses the IP address which the user has specified when making a service request. Another important function of the router is to prepare signals for more efficient transmission. Before your signal or message can be sent, the router **splits** it into smaller chunks or slices called **packets**. It is easier to send information in packets rather than in big chunks. This is just like we cut nshima into smaller lumps as we eat. Once the message has been split into packets, the router then identifies the most convenient route for each packet. Packets don't usually travel along the same route to their destination. Each packet is given, by the router, some accompanying information to ensure that it reaches its destination. The receiving computer re-assembles the packets to form the original message.

Another equally important use of the router is to ensure that only signals meant for a particular network are allowed to enter the network. The router acts in the same way as immigration officials at border posts to scrutinize documents of travellers. Without routers, networks would soon be flooded by many unwanted signals. See illustration below which shows how a LAN can be connected to the Internet.
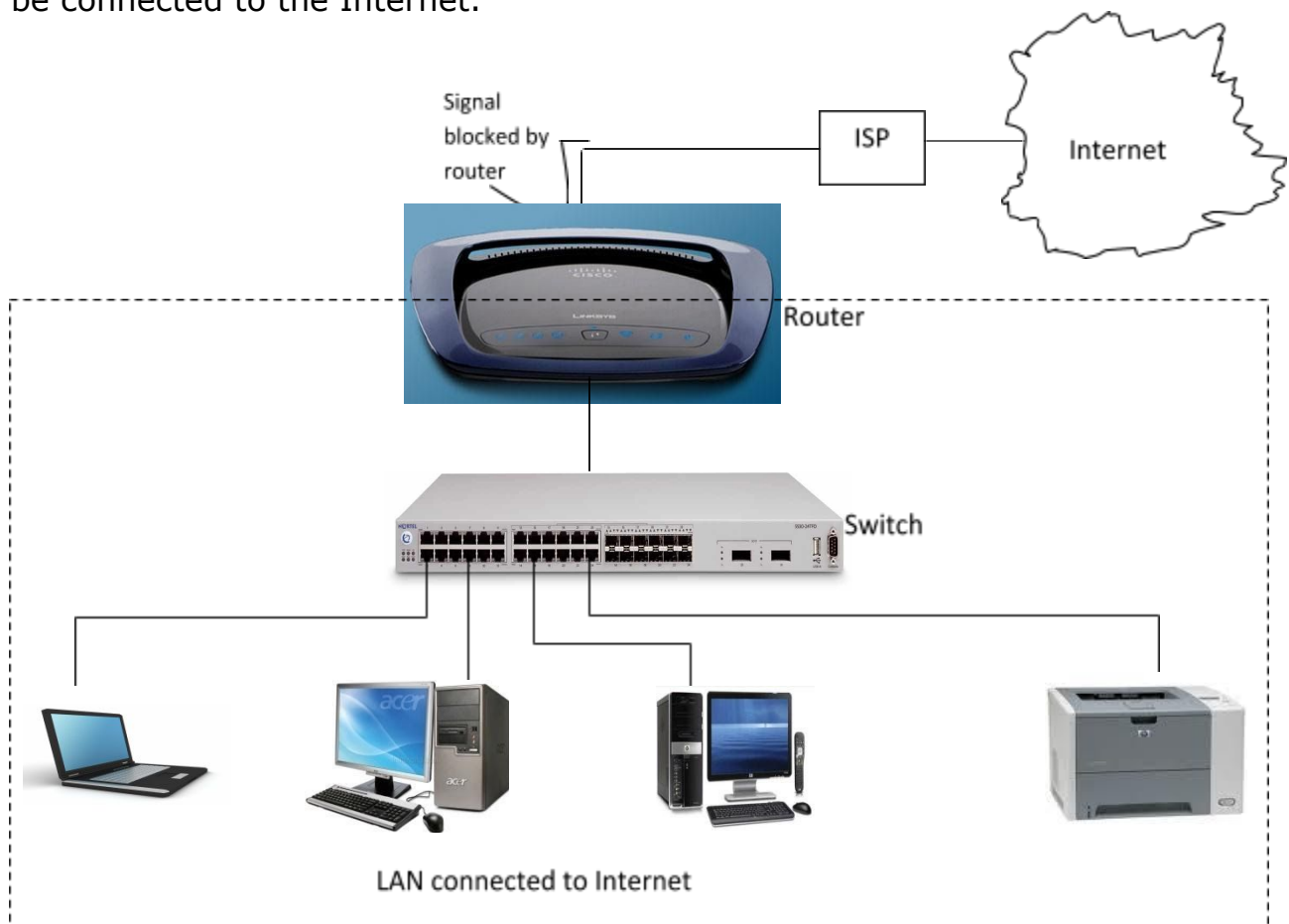
EXERCISE 4.0

1. What is Internet?
2. Mention the three functions of the Internet.
3. What is a web browser?
4. What are examples of web browsers?
5. What is a search engine?
6. Mention examples of search engines.
7. What is a website?
8. What is a web page?
9. What is email?
10. How does email make mail efficient?
11. How does a website address differ from an email address?
12. Explain the role of ISP.
13. State three roles of the router.

Summary

In this module you have been introduced to networking. It has been mentioned and explained that computer networks have advantages due to the fact that they enable us to share a number of resources such as data or information, hardware and software resources. They also make communication to be more efficient.

Different types of network: LANs, MANs and WANs were mentioned. LANS are those networks that interconnect computers in a building or school campus. The Internet is an example a WAN and interconnects several networks globally.

The module also described the various ways in which computers can be interlinked to form LANs. These various ways are called LAN topologies, and examples are star, ring, bus, tree and mesh. To interconnect computers to form a network you need three things: transport media, protocols, and a naming system. Ethernet is the most popular transport media. TCP/IP is a network protocol which has become like an international standard. The naming system used so that computers and networks can be easily identified is the domain name system (DNS). Using DNS principles, every computer and every network is given a unique address called the IP address. An IP address is a dotted decimal number such as 192.168.1.117. Because of the difficulties to remember IP addresses, they are given domain names such as tvtc.edu.zm for the Technical and Vocational Teachers' College.

To connect to the Internet you need an ISP, a router and communications channels. Various communications channels can be used such as UTP, coaxial cable and fibre optic. These form the wired channels. Wireless channels such as radio, infrared and satellite can also be used to link computers and networks.

Self-Assessment Questions

Question 1

In a_____, computers can exchange and share information and resources.
A   Office
B   Network
C   Restaurant
D   Organisation

Question 2
Which of the following is not a classification of computer networks?
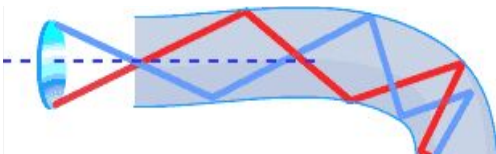
A   NIC
B   LAN
C   MAN
D   WAN

Question 3
A star network is characterized by the fact that
A   it is an expensive network to set up
B   there is frequent signal collisions
C   a token travels round the network
D   a host computer controls signals

Question 4
Examine a communications channel shown in the figure below. This must be

A Optic fibre
B UTP
C Coaxial cable
D Infrared

Question 5

Refer to Question 4 again. One characteristic of this communications channel is that

A   it is cheaper to install and maintain
B   signal interference is very common
C   signal transmission rates are higher
D   remote communication is possible

Question 6

To set up a school network you must definitely have a

A   Router
B   Firewall
C   Gateway
D   Switch

Question 7

Which of the following is the best description about the Internet?

A   Permission is required for any computer to connect to the Internet
B   It is formed by linking two or more computers anywhere in the world
C   Communication is the main function for which it was established
D   It is formed by linking many private local area networks in the world

Question 8
An ISP is required if one wants to connect a computer to the Internet because…

(a)   Connecting to the Internet must be cost-effective.
(b)   Users do not have any network hardware and software.
(c)   The law does not permit individuals to do so.
(d)   One computer cannot connect to the Internet directly.

Question 9

The type of computer network that can be set up between TVTC in Luanshya and ZIBSIP in Kitwe is a…

(a)   LAN
(b)   MAN
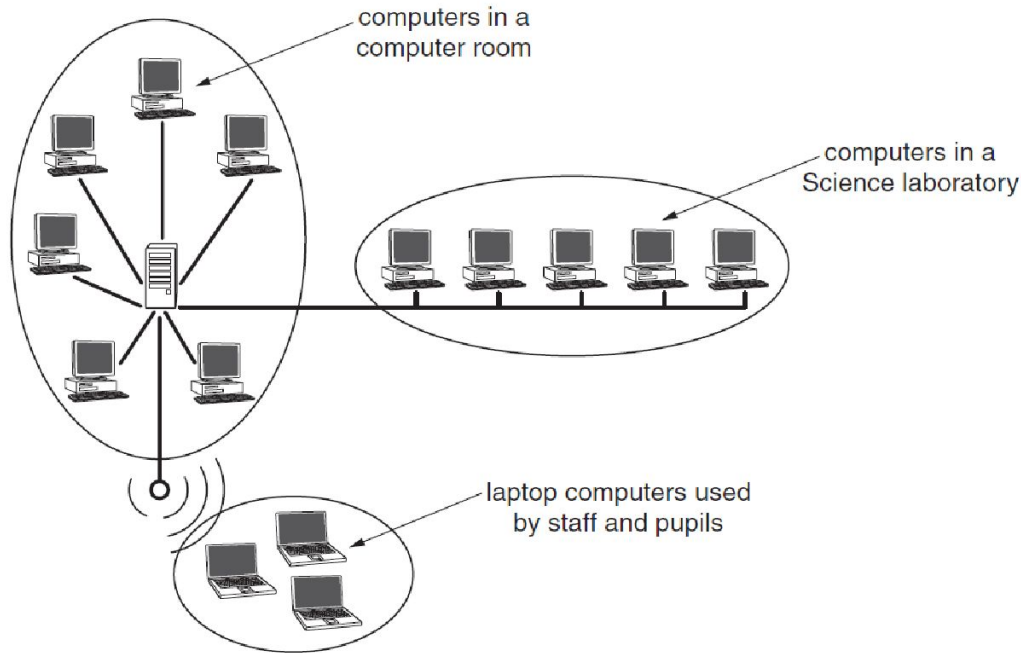(c)   WAN
(d)   Tree

Question 10

A _____ is a high-speed network that connects networks in an area such as a city or town and handles the bulk of communications activity across that region.

A   Local Area Network (LAN)
B   Metropolitan Area Network (MAN)
C   Wide Area Network (WAN)
D   Variable Area Network (VAN)

Question 11

A school's large network is shown below.

(a)   What type of computer network topology connects the computers in the computer room?

(b)   What type of computer network topology connects the computers in the Science laboratory?

(c)   Give two reasons for having a computer network in a school.

(d)   What is the name of a network of computers on one small site?

(e)   Other than cables, state one item of hardware that is needed to connect a network to the Internet.

(f)   The laptop computers are using a wireless connection to the network.
       Give one advantage and one disadvantage of using a wireless connection for the laptops.

Question 12

Luyando and Choolwe Partnership have branches in several towns. Each office has several computers all connected to a network. Staff at the different offices communicates by email.

(a)   Give two differences between a LAN and a WAN.

(b)   Which type of network would be suitable within one of the offices?

(c)   The Luyando and Choolwe Partnership are considering getting a broadband connection for each of their offices. Give two reasons why   they

should do this rather than continuing to use ordinary dialup   (phone line) access through modems in each branch.

Question 13

Computer networks have become very popular among individuals and organizations.

(a)   Draw a labeled diagram of a client-server network.
(b)   State what is meant by client-server network.
(c)   State two advantages of client-server network.
(d)   State two disadvantages of client-server network.

Question 14

Your school has three members of staff that share the same office. Each one of them has a desktop computer, and a printer has been allocated to the office to be shared.

(a)   State the network resources which must be made available for the sharing of the printer to be possible. (Do not include resources which the computers may already possess.)
(b)   Explain why each of the resources you have mentioned should be available.
(c)   Draw a diagram in the space given below to show how the printer would be shared.
(d)   "For our Internet connectivity, we'll need the following: Router,   ISP and Firewall". Suggests an IT technician. State reasons or use for each of the suggested items.

Question 15

To set up a computer network, three things are required. What are these resources, what are the examples and explain why they are required?

References

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2.	Williams, B. K. , Sawyer, S. (2007) **USING INFORMATION TECHNOLOGY**, 11th Edition, McGraw-						Hill, Boston

3.	Lauden, T., **INFORMATION TECHNOLOGY**, *Concepts and Issues* Beekman

Further reading

1. http://www.giac.org/cissp-papers/32.pdf
2. http://www.fotosearch.com/CSP563/k5633539/
3. http://www.google.co.zm/search?q=images+of+pupils+in+Zambia&btnG=Search&hl=en&tbm=isch&tbo=u&biw=1600&bih=754
4. http://www.google.co.zm/search?q=images+of+cisco+router&hl=en&prmd=imvns&tbm=isch&tbo=u&source=univ&sa=X&ei=QIKvT760CcHjtQadv6ypBA&ved=0CH4QsAQ&biw=1600&bih=754

Answers to Self-Assessment Questions

1	B		6	D
2	A		7	D
3	D		8	A
4	A		9	C
5	C		10	B

11   (a)   Star networks

       (b)   Bus network

       (c)   Any two reasons, e.g.
- sharing hardware resources
- sharing software resources
- sharing data
- collaborating on tasks
- communication

       (d)   Local area network or LAN

       (e)   Router

       (f)   Advantage: faster and cheaper to set up
                  Disadvantage: poor security

12   (a)   LAN interconnect computers at a local place, e.g. an office or a school campus, and WAN interconnects computers on a global scale, or between cities, or   between countries.

       (b)   LAN

       (c)   Two advantages for broadband connection:
- Has greater bandwidth, therefore there is fast signal transmission.
- Suffers less signal interference.

13   (a)   Diagram of client-server network:

       (b)   Meaning of client-server network:
                Network which has a central node which controls communication and to it are connected a number of terminals.

     (c)   Two advantages of client-server network:
- Easier to set up.
- Improved security.

     (d)   Two disadvantages of client-server network:
- When server is down, the whole network is affected.
- Data transmission rates are low.

14   (a)   Switch and UTP

     (b)   Switch - To distribute signals and to boost signals when they become weaker.

          UTP - To provide a path through which signals pass between nodes.

     (c)   Diagram showing shared printer:
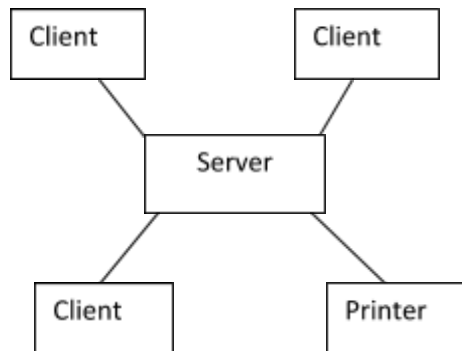
(d)   Router:
- To split signal into packets for easier transmission
- To determine direction of signals
- To prevent signals not meant for a particular network from entering it

     ISP:
- To provide internet access to clients
- To allocate domain names to clients

     Firewall:
- To prevent malicious code from entering or leaving a network or computer

15   Required resources for setting up computer network:
- Transport media, e.g. Ethernet.
- Protocols, e.g. TCP/IP, and
- Naming system, e.g. DNS
- Transport media is required for conveying signals between nodes or networks.
- Protocols are required for ensuring that nodes are able to communicate with each other.
- Naming system is required in order to ensure that nodes are uniquely identified on networks.