Information Communication Technology

Year 1

SECTION

4

GUIDED AND UNGUIDED NETWORK SYSTEMS

Network Systems for Transmitting Information

Guided and Unguided Network Systems

Introduction

This section is designed to introduce you to how computers and other digital tools are linked to communicate. You will explore the fundamental concepts of computer networks, how networks are structured, how they operate, and their applications in various settings. As you embark on this journey, you will explore and learn how computers and other digital tools are connected together to share information and resources easily and effectively offering deeper understanding guided and unguided network systems.

We will start by defining what a computer network is, network topologies, network architectures, guided and unguided transmissions and identify common devices required to create a network. We will also discuss in the section how data transmission occurs under different circumstances in a network.

Remember, creating networks is just like making new friends and establishing a relationship with them to communicate and share information regardless of where they are. So, stay curious, ask questions and take advantage of this opportunity to learn skills and understand the importance of communication networks in today's crucial digital world.

At the end of this section, you will be able to:

- Classify Network Types and Topologies
- Classify transmission media used to send receive data in a network environment

Key Ideas:

- A **Computer Network** is a group of computers and other devices connected together to share information and resources with or without cable irrespective of their locations.
- **Network Type**: computer networks classification based on geographical setting
- **Network Architecture**: refers to the design and layout of a computer network. It's like the blueprint for how different devices (like computers, routers, and printers) connect and communicate with each other.
- **Cloud Network**: refers to using the internet to access and manage resources like storage, applications, and services instead of relying on local servers or hardware. It is like having

an online school library, computer lab, and filing cabinet all in one location.

- **Network Topology**: is the arrangement of devices and connections in a network. It determines how data travels and how devices are linked, impacting the network's efficiency and reliability
- **Guided transmission media (wired)**: the use of cables to connect a device to another in a network. They are called "guided" because the signals are directed along a specific path, usually within a cable. Example Coaxial, Twisted pair etc.
- **Unguided transmission media (wireless)**: refer to the methods of sending data without using physical cables. Instead, the signals travel through the air, water, or even space. These are commonly used for wireless communication. Example Bluetooth, Wi-Fi etc.

What is a Computer Network?

If you can make friends and communicate with them irrespective of where you are, then you have created a network. In the same way computers are connected to other devices to communicate among themselves.

A computer network is a group of two or more computers or devices connected together so they can share information, resources, and communicate with each other. This connection can be made using wires, like Ethernet cables, or wirelessly, like Wi-Fi.

A standalone computer is a computer that works independently, without needing to be connected to a network or other computers.

Advantages of a Computer Network Over Stand-Alone Computers

Computer networks offer many benefits, which have significantly transformed how we communicate, access information and conduct business. Some of the key advantages of computer networks over having a set of stand-alone computers include:

Advantages	Computer network	Stand-alone computer
Resource sharing	Allows sharing of resources like printers, files, and internet connections.	Resources are used individually without sharing.
Data sharing and collaboration	Facilitates easy data sharing and collaborative work.	Data sharing is manual and often less efficient.
Shared Internet access	Enable sharing of internet services with other devices	The internet cannot be shared with other devices.
Centralised management	Enables centralised management of resources and security.	Each computer must be managed individually.

Communication	Provides built-in communication tools like email and messaging systems.	Communication tools are often separate and less integrated.
Improved efficiency	Applications can be installed on a central server and accessed by multiple users.	Applications cannot be accessed by multiple users.
Remote access	Allows access to files and resources from remote location	Typically requires physical access to the computer
Scalability	Networks is set up in a way that makes it easy to add more devices and users.	Depends only one user at time.
Cost savings	Reduces costs by sharing expensive hardware and software.	Requires individual purchases of hardware and software.
Global connectivity	WAN and internet are huge webs of connected computers which allow people to share different information	It relies only on software and information installed on them.

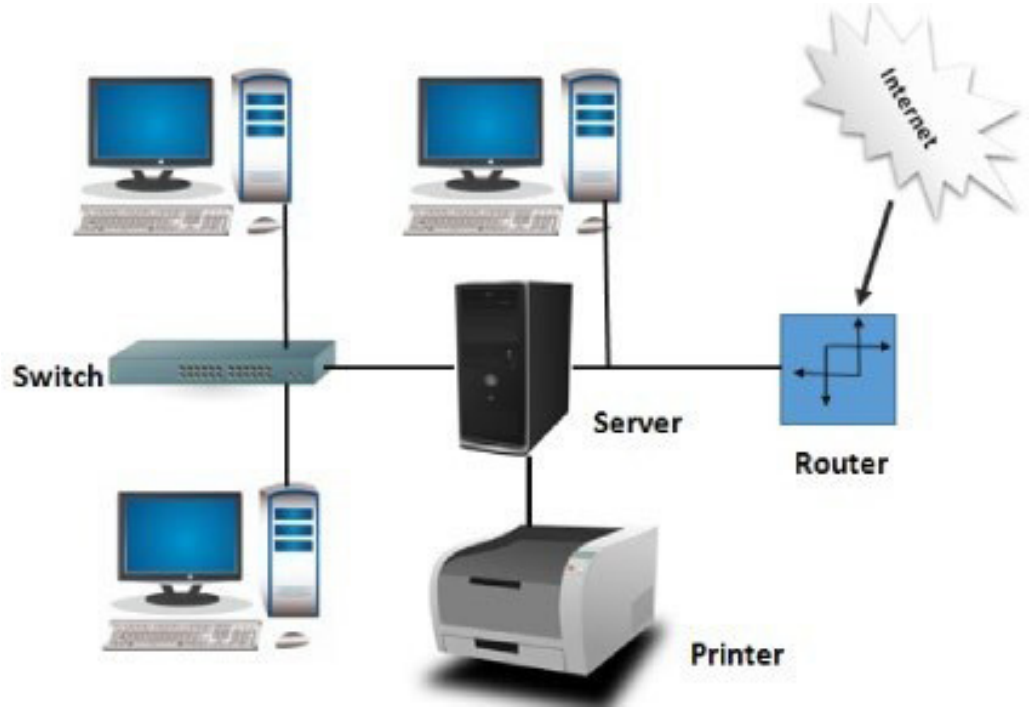


Figure 4.1: A possible layout of a local Area Network

Activity 4.1

In this activity you are to research on the benefits of computer network in our everyday lives. Perform this activity in groups or as an individual.

Materials needed: Computer with internet access, Projector, Smartphone with internet access, exercise book and pen.

Instructions:

Choose one of following topics:

- Resource Sharing
- File Sharing and Data Accessibility
- Communication and Collaboration
- Centralised Data Management
- Improved efficiency

Discuss the **benefit, real-world examples and applications**.

You should consider how this benefit impacts different fields, such as education, business, or healthcare.

Steps:

1. Open any web browser on your computer.
2. Type the name of your chosen topic e.g. **Resource sharing**
3. Click on any hyperlink to display the content (if the content does not reflect a good understanding of desired searched result, go back and select on another hyperlink) search results.
4. Read and make relevant notes on the **benefit, real-world examples and applications**.
5. Share your findings with your peers.

Note: In the absence of internet connection, consult your teacher or textbooks.

Network Hardware

There are several hardware components that are used in network connectivity. The following are the key components that are needed in every network system:

1. **Nodes:** A node can be anything that sends, receives, or forwards information. This could be a computer, a printer, a router, or even a smartphone. Each of these devices can talk to each other over the network, sharing information like messages, files, or accessing the internet. So, a network node is basically any device that can connect and communicate within a network.

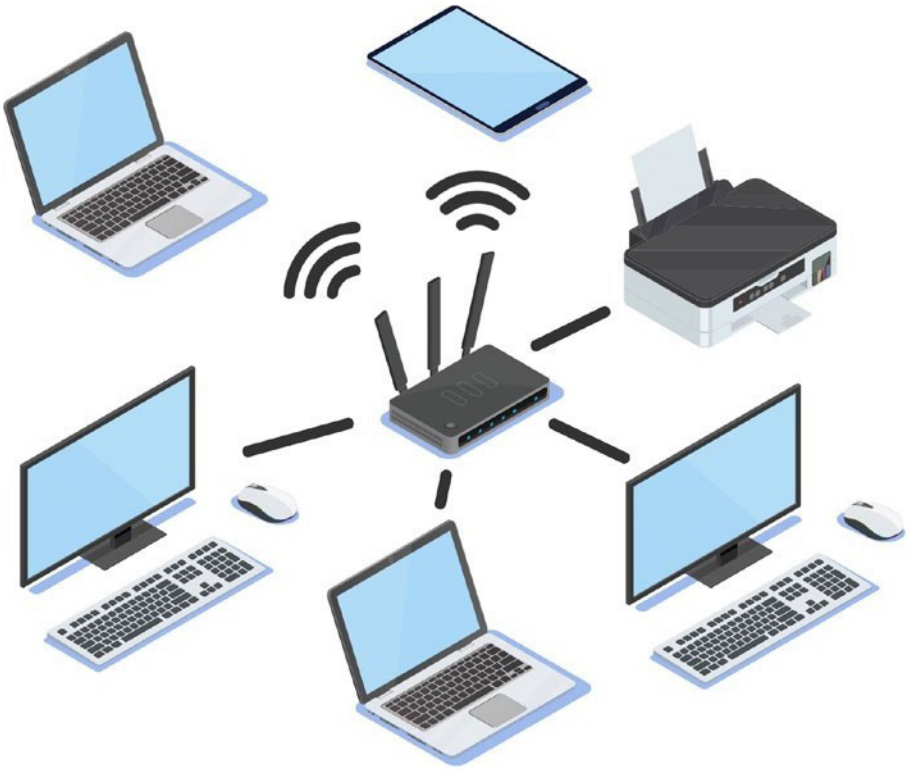


Figure 4.2: Network with 6 connected nodes

2. **Network interface card (NIC):** A Network Interface Card (NIC) is a piece of hardware in a computer that allows it to connect to a network, like the internet or a local area network (LAN). Think of it like a translator between your computer and the network. Just as you might need a translator to help you understand another language, your computer needs a NIC to "talk" to other computers and devices over the network. The NIC takes data from your computer, converts it into signals that can travel over a network cable (or wirelessly), and then sends it to the right place. It also does the reverse: it takes signals from the network, converts them back into data that your computer can understand, and then delivers it to the right application. Without a NIC, your computer cannot be able to connect to the internet or communicate with other computers.

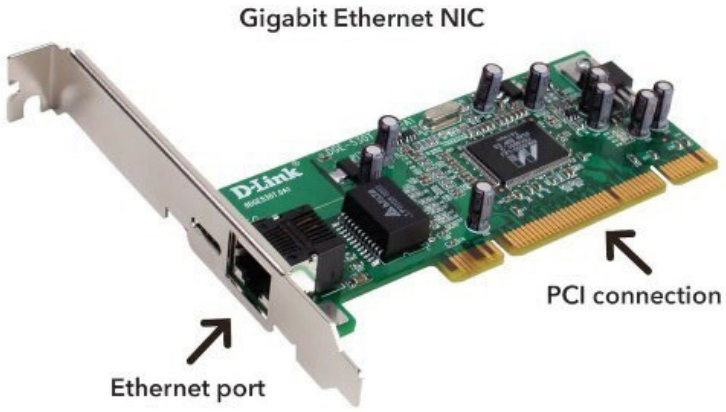


Figure 4.3: Network interface card

3. **Communication Channels:** A communication channel is like a path that allows information to travel from one place to another. Imagine you are sending a message to a friend. The way you send that message could be through a spoken conversation, a text message, or an email. Each of these methods is a different "communication channel." In computer networks, a communication channel is a pathway that data (which is like the message you send) moves between devices. This data could travel through wires, like in Ethernet cables, or wirelessly, like Wi-Fi signals. The channel makes sure the information goes from one device to another so they can "talk" to each other, just like how you talk to your friend using different methods.
4. **Hub:** This device serves as a central connection point for multiple devices in a network. It relays any signal it receives with some amplification back out to all the devices connected to it. Hubs are less common today due to their inefficiency (bandwidth is shared) and lack of intelligence in data transmission, causing potential security breaches.

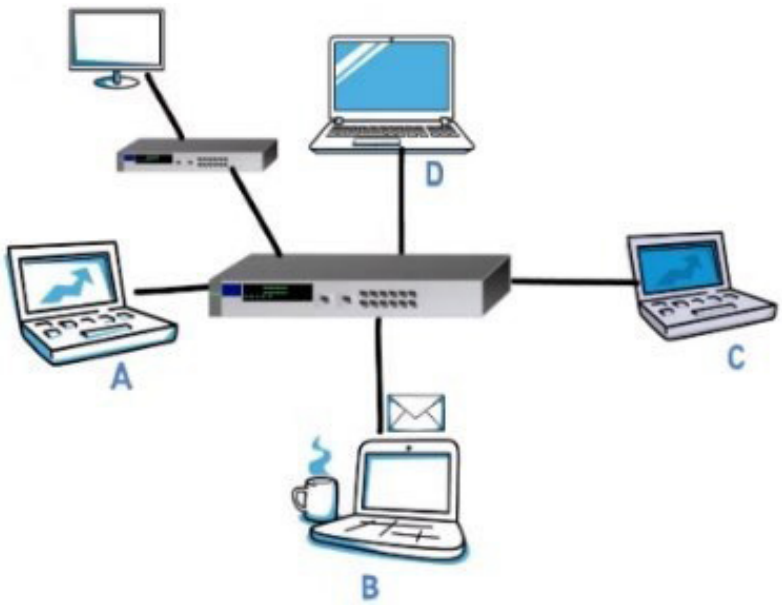


Figure 4.4: A hub connected to devices

5. **Switches:** These are devices that facilitate the connection and communication between multiple devices within a local area network (LAN). They use MAC addresses (media access control addresses) to forward data to the intended recipient. A MAC address is a 48-bit number assigned to each device connected to the network. This intelligence difference between a hub and a switch is illustrated in Figure 4.5.

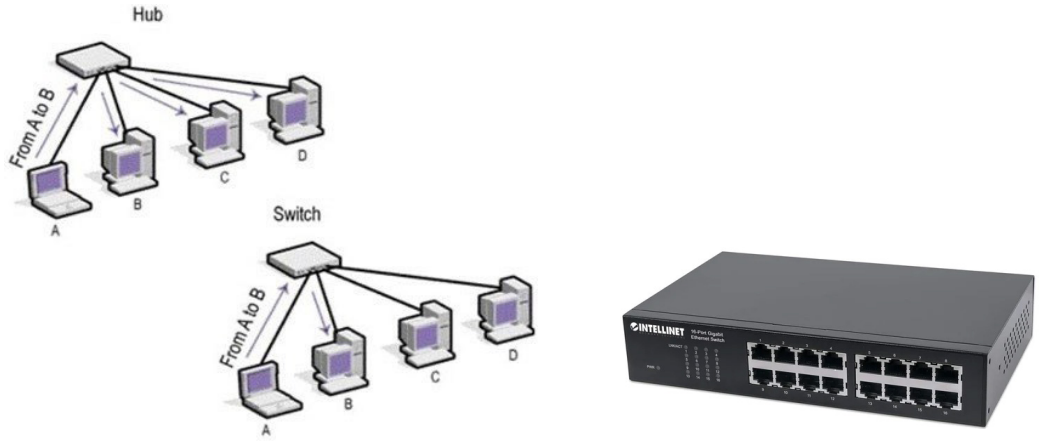


Figure 4.5: *A hub and a switch – the switch sends the data to ONLY the correct recipient, whereas a hub sends any data to ALL devices.*

6. **Routers:** A router is like a traffic manager for your home or office internet. When you connect to Wi-Fi, the router takes the data from your device (like a laptop or phone) and sends it to the right place on the internet, and then it brings back the information you asked for, like a website or a video. It helps different devices on the same network talk to each other and ensures everything goes to the right destination, much like a postal service sorting letters and packages to deliver them to the correct addresses.

Figure 4.6: *Router*

7. **Modems:** A modem is a device that allows your computer to connect to the internet. These devices are used to modulate and demodulate digital signals to enable communication over analogue communication channels such as telephone lines. A modem is an essential piece of hardware for a computer to connect to the internet. Modem router combo devices combine the functionalities of routers and modems.

Figure 4.7: Modem

8. **Network Cables and Connectors:** These physical cables (e.g., Ethernet cables) and connectors are used to establish wired connections between devices in a network. A network cable is like a road that connects different devices, such as computers, printers, and routers, so they can share information with each other. Just like cars travel on roads to get from one place to another, data (information) travels through network cables to move between devices.

Figure 4.8: *Network Cables with connectors*

9. **Wireless Access Points (WAPs):** These provide wireless connectivity to devices within a local area network, allowing them to connect to the network without the need for physical cables. Some WAPs can be wall-mounted – see Figure 4.9.

Figure 4.9: *A Wireless Access Point (WAP)*

10. **Workstation:** A term sometimes used to describe a computer (usually desktop) connected to a LAN. Each of these components play a specific role in a network, contributing to the efficiency and effectiveness of its operation. They work together to enable data sharing, resource sharing and communication between network devices and users.

Figure 4.10: *A Workstation*

Activity 4.2

This activity tests your understanding on the various types of network hardware and how prepare budget for its purchase.

Materials needed: Computer with internet access, Smartphone with internet access, exercise book and pen.

Instructions:

- Open any web browser of your choice.
- Using a search engine, research different types of networking hardware.
- Select at least three network hardware detailing features, costs, and brand reputation.
- Use reliable sources for your research (e.g., manufacturer websites, tech reviews).
- Using your research, please put together the price to construct a network and justify your choices.
- Prepare a short presentation on your findings. Deliver the presentation to the entire class.

Activity 4.3

Instructions:

This activity will test your knowledge in network hardware and how its functions. Read the scenario in the last column and write the correct corresponding network hardware in the answer column. The first column has the possible network hardware which are mismatched to guide your answers.

Material Needed:

- Exercise book
- Pen or Pencil
- Ruler

Network Hardware	Answer	Scenario
A 		I am a traffic controller, and my job is to manage the flow of cars coming from different directions to ensure each car reaches its correct destination without getting stuck or crashing into another car. Which hardware device is this?
B 		Imagine you have two tin cans connected by a string, and you are talking to a friend through them. The string carries the sound from one can to the other, allowing your friend to hear you. Which hardware can be attributed to the string?
C 		The first hardware resource you need before you can setup any network.
D 		The master computer on a network, that provide and receive services is?
E 		Imagine you are in a large building with many rooms, and you need to send a letter from one room to another. The postal worker knows exactly which room each letter should go to. When you hand over your letter, the postal worker reads the address and delivers it to the correct room through the quickest and most efficient path.
F 		This device is like a translator for your computer in a school network. Imagine your computer is a student trying to communicate with other students (computers) in the school (network). Which device is this?

Activity 4.4

In this activity, create a presentation slide on the following information:

1. Research for different definitions of computer networks.
2. Identify and explain at least five benefits of using computer networks
3. The functions of the following network hardware:
    a. NIC,
    b. Router,
    c. Switch,
    d. Modem and
    e. WAP.

Note: *Use images and videos to enhance your presentation.*

4. Save your presentation as "Computer network".
5. Deliver your presentation to the entire class for appreciation and feedback.

Classification of Network Types According to Area

Previously we looked at networking and its benefits in our everyday lives. This section covers the classification of network types according to geographical area it covers. A Network can be confined in a room, building(s), a locality, metropolis, continent or the entire world. It also discusses the comparison between the different area networks in terms of ranges, examples, transmission speed, fault tolerance, maintenance and congestion.

Network Types According to Area

Area network refers to a type of computer network that connects computers and devices within a specific geographic area. It can be classified into following types:

- Personal Area network (PAN)
- Local Area network (LAN)
- Metropolitan Area Network (MAN)
- Wide Area Network (WAN)

Personal Area Network (PAN)

A Personal Area Network (PAN) is a small network used to connect devices that are close to each other, usually within a range of just a few meters. Think of it as a way for your gadgets, like your phone, smartwatch, and wireless headphones, to communicate with each other without needing the internet or long cables.

For example, when you connect your phone to your Bluetooth speaker to play music, you are using a type of PAN. The connection is short-range and only for your personal devices, making it convenient for things like listening to music, transferring files, or even connecting a wireless keyboard to your computer. So, a PAN is like your own private network that lets your devices "talk" to each other directly and wirelessly when they are close by.

Figure 4.11: *Personal Area Network*

Local Area Network (LAN)

A **local area network** (LAN) consists of a collection of computers in a single building or building complex and covers a limited distance (typically 10m to 1km). For example, the computers in a school or those in a manufacturing plant might be connected by a LAN. A Local Area Network (LAN) is like a small community of devices that can talk to each other. Imagine you're in a classroom, and everyone has their own computer. Now, you want to share files, play games together, or maybe even print something from the same printer. A LAN is what allows all these computers to connect and communicate with each other.

Local: This means it's nearby, like in the same building or a few close buildings, such as your school or home.

Area: It covers a specific area, not too big, just like your classroom, a few rooms, or maybe the whole school.

Network: This is the system that connects all the devices (like computers, printers, or phones) so they can share information.

How It Works:

Wired Connection: In many LANs, devices are connected with cables (like Ethernet cables). These cables plug into a device called a router or a switch, which helps direct the information to where it needs to go.

Wireless Connection: Some LANs use Wi-Fi, so the devices connect without cables. You might already know this from how your phone or laptop connects to the internet at home or school.

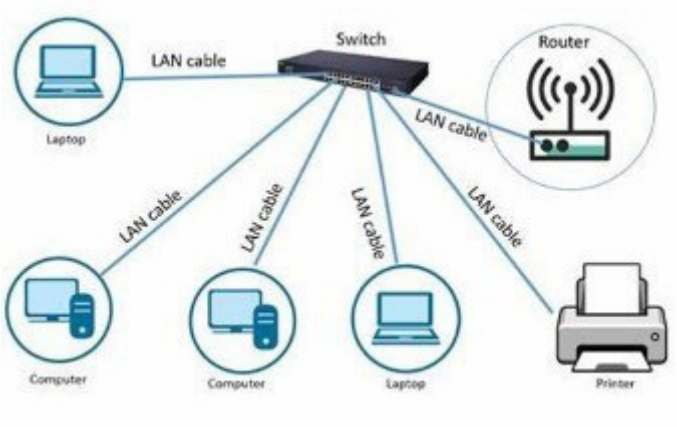


Figure 4.12: *Local Area Network*

Metropolitan Area Network (MAN)

A metropolitan area network or MAN is a computer network larger than a LAN but located in a single geographic area. For example, a campus, a city or a region with multiple cities. It can connect several LANs and is capable of spanning an area of between 5 to 50 km in a range. Imagine it as a network that connects multiple buildings or offices within a city or large campus. For example, a MAN could connect various school buildings across a city, allowing them to share resources like files and printers, and access the internet more efficiently than if they were all standalone. It's like having a supercharged school network that spans the whole town.

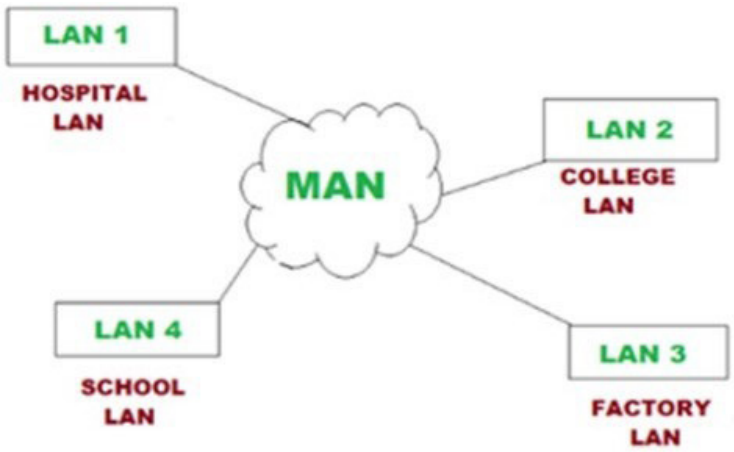


Figure 4.13: *Metropolitan Area Network*

Wide Area Network (WAN)

A WAN covers a large geographical area. It can spread over a country, countries and continents. It can also connect small and medium networks like LANs and MANs using wired or wireless technologies. WANs are mostly used in large organisations, businesses and institutions with various branches worldwide. The internet is essentially a huge international WAN.

How It Works:

Multiple LANs: A WAN is made up of several LANs connected together. Each LAN might be in a different location (like different offices of the same company or different schools in a district).

Internet: The internet itself is the biggest example of a WAN. It connects millions of smaller networks all over the world, allowing them to communicate with each other.

Telecommunication Lines: WANs often use telephone lines, fibre-optic cables, or satellite links to connect the different LANs. This allows the data to travel long distances quickly.

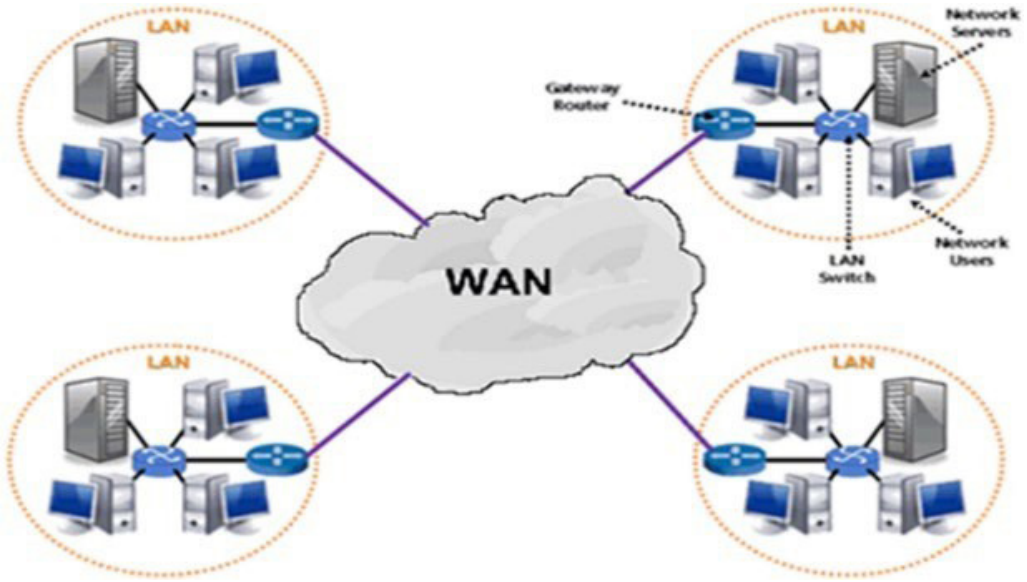


Figure 4.14: *Wide Area Network*

Differences Between Different Types of Networks

The below table identifies the three different types of area networks including LAN, MAN and WAN and what makes them different, some of these areas will be covered in more detail later.

Criterion	LAN	MAN	WAN
Area	A network that connects devices in a small geographic range.	A network that connects larger areas than LANs, such as small towns or cities.	The network covers a large area such as a country or several countries.
Range	10m to 1km	5 km to 50 km	Can be global
Example	School network	University network	Internet, ATM network
Ownership	Private	Public or private	Public or private
Topology	Star, Bus or Ring	Ring, Mesh, Hybrid	Point-to-point[1], Mesh
Transmission speed	High	Moderate	Low
Fault tolerance	More fault tolerance	Less fault tolerance	Less fault tolerance
Maintenance	Easy to maintain, as has a less complex structure	More complex structure than LAN and is also more difficult to maintain.	Maintenance and design structure are more complex compared to LAN and MAN.
Congestion	Less	More	More

Activity 4.5

This activity tests your research skills and brings out information about types of networks.

Instructions:

1. Select one of the following types of network areas to research:
   - Local Area Network (LAN)
   - Wide Area Network (WAN)
   - Metropolitan Area Network (MAN)
   - Personal Area Network (PAN)

- Campus Area Network (CAN)
- Virtual Private Network (VPN)
- Storage Area Network (SAN)

2. Focus on the following areas in your research:
   - **Definition**: What is this type of network? What are its characteristics?
   - **Real-life Examples**: Identify at least two real-life examples where this network type is used.
   - **Suitability**: Explain why this type of network is appropriate for these particular uses. Consider aspects such as range, speed, security, and cost.
   - **Technological Components**: Discuss any specific technologies, hardware, or software associated with this network type.
3. Create a Presentation:

Using tools like PowerPoint, Google Slides, or Canva, create a presentation summarizing their findings. The presentation should include:

- **Introduction Slide:** Name of the network type and the student/group members.
- **Definition Slide:** A clear and concise definition of the network type.
- **Example Slides:** One slide per example, with details on where it's used, and why it's suitable.
- **Technology Slide:** Describe any key technologies involved.
- **Conclusion Slide:** Summarise the key points and reflect on why this network type is important.

4. Presentation:

Present your findings to the class or share with your peers.

Activity 4.6

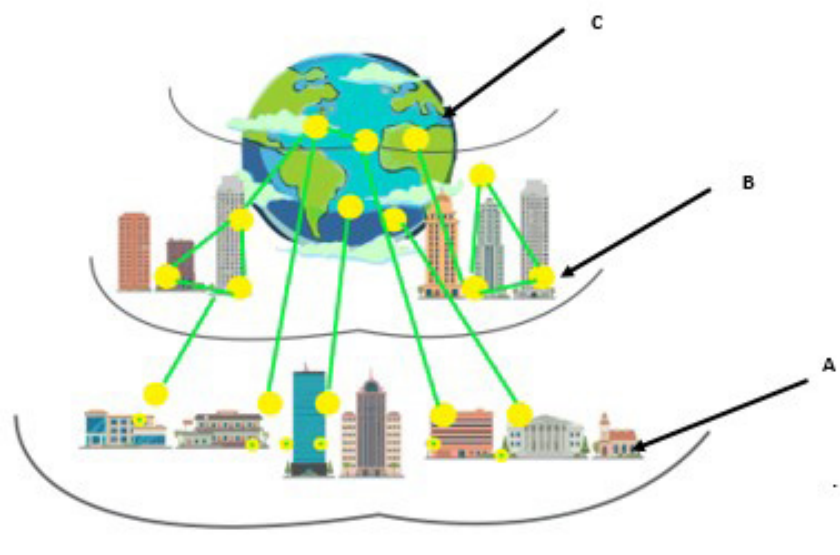
The diagram below shows all the area networks. Identify the location the arrow is pointing to and name the type of area network. Justify the reason for your choice.

Materials needed:

- Exercise book or jotter
- Pen or Pencil

Instructions:

1. Study the diagram below and identify the type of area networks.



2. Write your answer in your exercise book or jotter.
3. Submit your answer to your facilitator or share it with your peers for discussions.

Activity 4.7

The table below has different types of networks. Compare their range, use cases, data transfer speed and typical infrastructure.

Materials needed:

- Computer/Tablet or smartphone connected to the internet.
- Markers and sticky notes.
- Pen and paper.

Type of Network	Range	Typical Use case	Data Transfer speed	Example Devices/ Infrastructure
PAN				
LAN				
MAN				
WAN				

Instructions:

1. Research the types of networks in the table above, their network range, use cases, data transfer speed and sample devices or infrastructure.

2. Discuss your findings with your peers.
3. Use your findings to fill the table provided.
4. Compare your work with other students' or share it with your teachers.

Classification of Networks Types According to Architecture

Network architecture refers to how the network is designed. The architecture determines how the nodes are organised in a network and how tasks are allocated between these nodes. There are two main types of network architecture models, namely;

- Client-server and
- Peer-to-peer (P2P).

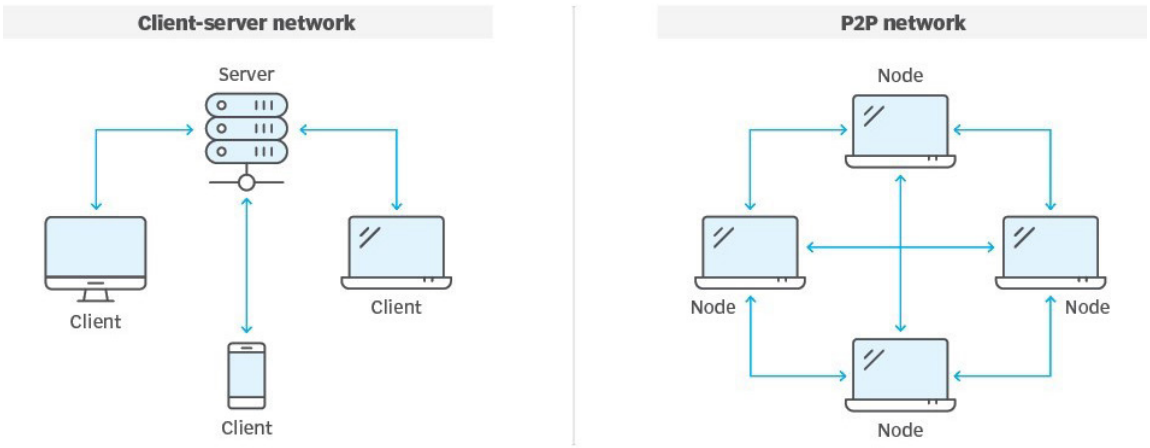


Figure 4.15: Client-server and P2P network

Client-server architecture: In this model, nodes may be servers or clients. Server nodes provide resources like memory, processing power and data to client nodes. They may also manage client node behaviour. Servers tend to be quite powerful computers, and there are different types of servers, including:

1. File servers - store and maintain user files
2. Applications servers - allow programs to be run over a network
3. Web servers - store and share web pages
4. Print servers - manage printing across a network
5. Mail servers - handle emails between users

Figure 4.16: Client server network

A client is any node connected to the network that can request access to a service provided by a server. For example, a workstation on the network could send a request to a file server to access a file stored on the server. Clients can communicate with each other over the network. The client-server model can be found in small and large networks.

To summarise, client-server architecture refers to a network design where a server provides resources or services, and a client requests them.

Peer-to-peer architecture: Peer-To-Peer network architecture is a type of network in which all the computers are linked together with equal privileges and responsibilities for processing the data. With this model, all connected nodes have equal status - no connected node (called a peer) has control over the network and there is no central server for coordination. Each peer can act as a client or a server and may share some of its resources, such as memory and processing power, with the entire computer network. An example is a company using P2P architecture to host a memory-consuming application, such as a 3-D graphic rendering program, across multiple digital devices. The P2P model is generally found in trusting environments with less than 10 computers.

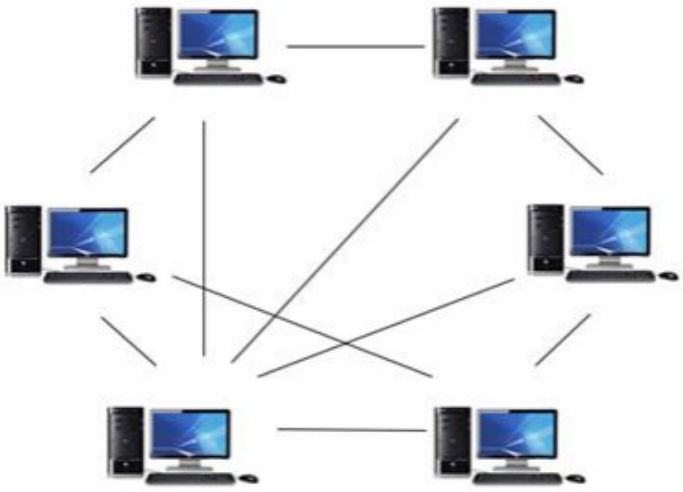


Figure 4.17: P2P Network

Comparing Client-Server to Peer-To-Peer Networks

The key difference between these two technologies is that, in a peer-to-peer network, every node can ask for assistance and deliver services. While in a client-server network, the client nodes demand services and the server node answers with assistance. The following table summarises the rest with respect to given criteria:

Criteria	P2P Model	Client-Server Model
Communication	Devices communicate directly with each other	Devices communicate with a central server
Resource Sharing	Nodes share resources such as storage, processing power, and bandwidth among themselves	Central server controls resources and data (All clients depend on the server for resources (device, application)
Scalability	Network can easily scale up to accommodate more nodes	Network may require more resources to handle traffic
Flexibility	Nodes can join and leave the network dynamically	Server controls client connections and resource access
Security	More difficult to secure due to lack of centralised control	Easier to secure and manage with centralised control
Speed	Slower to respond to requests since each node processes its requests	Faster to respond to requests with centralised control
Flexibility	More flexible and cost effective due to resource sharing	Creates a single point of failure

In conclusion, whereas Client-Server network has inherent merits which make it suitable for specific conditions, so too has the Peer-to-Peer network. The Client-Server model can be useful where there is the need to have centralised management and is more scalable than the Peer-to-Peer model, which is suitable for scenarios where there is decentralisation and direct sharing of the resources. Such a distinction might help in choosing the right type of a network model depending on the particular need and demand.

Activity 4.8

Your brother at a lower grade came home with an assignment with a list of network servers. The assignment was given to the class after a lesson in which the teacher mentioned the various types of servers, but did not explain them. Instead, he asked the children to go and find out more information about them in terms of functions and features. With the understanding gained so far in this section, conduct research on any four of the following categories of network servers and create a summary on the functions and the features of each and write is in a way that you could explain to your brother:

- File server
- Print server
- Email server
- Web server
- Database server
- Proxy server
- DNS server
- Cloud server
- Application server

Activity 4.9

Compare a client-server network to a peer-to-peer network using the criteria specified in the first column of the table. Present this comparison in a tabular form using MS Word; include a labelled diagram of each network design.

CRITERIA (PARAMETER)	CLIENT-SERVER NETWORK	PEER-TO-PEER NETWORK
Communication		
Resource Sharing		
Scalability		
Flexibility		
Security		
Speed		

Activity 4.10

a. Copy and complete the table below by filling in the corresponding empty cells. You may do it alone or together with a classmate.

NEWORK MODEL OR ARCHITECTURE	SCENARIO
	A school with multiple offices in the same building as well as different buildings on campus shares one printer
Peer-to-peer (P2P)	
	An office with ten computers whereby each computer comes with at least one resource (software/hardware) that others do not have, as a result, the users of each of the various computer at a point have to fall on one another's PC to get a given tasked or processing need accomplished.
Client-server	

b. Create a glossary of network terminologies you came across in this section

CLOUD TECHNOLOGIES

Imagine keeping your files or documents somewhere where you can access from any location, whenever the need arises: Besides storing information on your computer at home or office, recent advancement in information technology permits you to upload it to a remote computer from which you can access anywhere, provided you have access to the Internet. You can depend on this for a storage for your digital documents or files even if you do not own a personal computer or run applications that are not found on your local computer from a remote computer. This brings us to the concept of cloud storage.

Cloud Networks

The term 'cloud' in this context refers to servers that are accessible over the Internet, together with the software and databases that run on those servers. Cloud servers are located in data centres all over the world.

In a cloud network, the user's network is on-premises, but some or all resources used to manage it are in the cloud (a remote server). These resources are rented from a third-party cloud provider (cloud vendor).

Cloud network can be described as the infrastructure that supports cloud computing (i.e., the delivery of various computer related services through the Internet). It involves

a network of remote servers hosted on the Internet to store, manage and process data, rather than a local server or a personal computer. Subscribers require Internet connection to enable them access to cloud resources.

A cloud network can employ a client-server architecture. In this model, the cloud acts as the server that provides resources and services, whereas the clients (which can be end-user devices like computers, smartphones, etc.) request and consume these services. The cloud-based services delivery ensures that, clients can access resources on-demand via the Internet.

The client-server architecture in a cloud environment is designed to:

- Be easily scalable and efficient.
- Allow for a robust network that can handle varying workloads.
- Provide services to a large number of clients simultaneously.

With cloud networking, an organisation can shift its network management, control and data connectivity from on-premises to a cloud infrastructure. Cloud networking allows organisations to create complex networks using only the Internet. The figure below (4.18) illustrates the general concept of cloud networking:

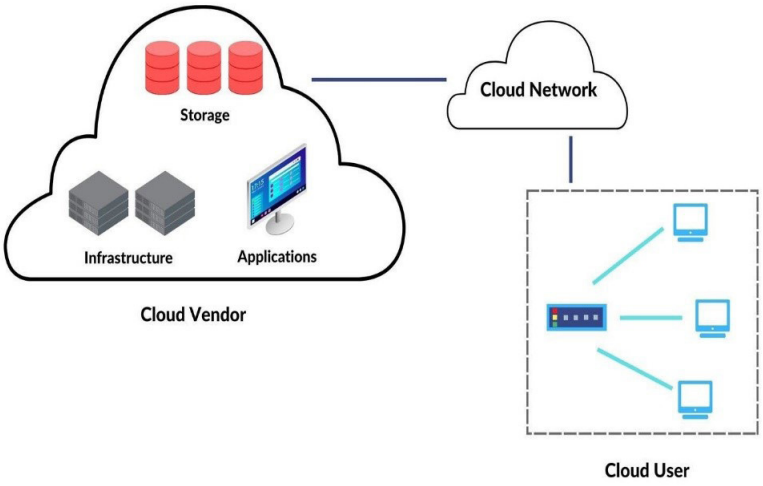


Figure 4.18: *Cloud networking*

Classification of Cloud Computing: By service, cloud computing is usually classified as:

- **Infrastructure as a Service (IaaS)**: A foundational (base) cloud service layer that allows organisations to rent IT infrastructure such as storage space (hard disks), servers, OS, and networks from a cloud provider or vendor.
- **Platform as a Service (PaaS)**: This is a layer that rides on top of IaaS, and provides the ability to run application software; Users or subscribers can use it to build user-level tools and application software.
- **Software as a Service (SaaS):** This is a layer on top of PaaS, and allows users to run or use cloud-based apps remotely over the Internet. For instance, Office 365 together with OneDrive is one of the world's most popular SaaS.

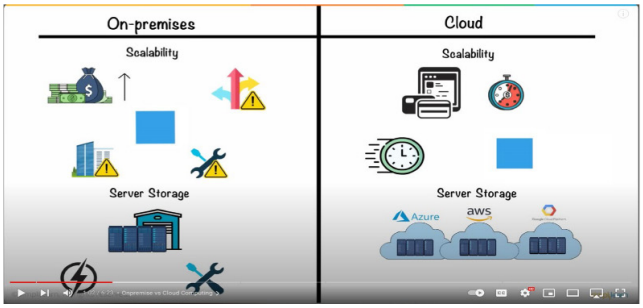
Differences Between Cloud Computing and Traditional Computing

Cloud computing and the traditional (conventional) computing differ in various ways. These differences have been summarised in the table below:

Criteria	Cloud Computing	Traditional Computing
Model	Subscription – monthly cost	Up-front infrastructure costs
Scalability	Can easily increase or reduce services when the need arises.	Scaling up often requires new hardware and/or software.
Data Access	Data can be accessed anywhere provided there is Internet connection.	Can only access data on-site. Internet access is not required.
Cost	Lower expenses but includes monthly fees.	High initial costs
Maintenance	Responsibility lies with cloud service providers. Data backups can be done automatically at frequent intervals.	Companies have to recruit and pay local IT staff to manage the data, including data backups.
Security	Involves sharing sensitive data with a third-party provider, which raises concerns about data security and privacy. It however has the advantages of robust and tested disaster recovery solutions to ensure applications and data are available in the event of outages or disruption.	Can offer a high level of data security if access and transfer of sensitive data stored on-site is controlled by the company using security measures such as firewalls and encryption. Does not offer convenience means of data backup and restoration

A cloud network infrastructure offers a flexible, scalable, and cost-effective solution for modern businesses. However, traditional on-site network infrastructure is not without merit. For example, in some instances, it can offer more robust security measures.

Use the following link or scan the QR code to watch a YouTube video for further explanation of the concept of cloud computing: https://www.youtube.com/watch?v=M988_fsOSWo.



scan to watch the video

Activity 4.11

Research and discuss with your colleagues on cloud computing; take into consideration the following aspects:

- Infrastructure (components)
- Services
- Advantages
- Disadvantages

Instructions:

1. You may make use of the Internet and/or resource persons such as your ICT teacher, website designer or other relevant persons to aid your investigation.
2. Summarise your result using MS Word or pen and paper.
3. Show it to your ICT teacher or a known IT expert for verification.

Activity 4.12

Assume your older brother runs a photo studio in an in-house network storage environment, but with the knowledge gained so far, you have realised it would be better if he switches to a cloud-based network storage system. Write a business case proposal of at least one-page to your brother, outlining the reasons why you consider a cloud-based storage or network a better option. Your proposal should compare the two options in terms of merits and demerits to justify your recommendation.

Instructions:

1. You may use the Internet, relevant books from your school library or a library close to you or a resource person to gather required information.
2. Make your notes with pen and paper or type it with MS Word and print it out.
3. Show your final write-up to your teacher or ICT expert for verification.
4. Edit your findings if necessary.
5. Show the verified finding to a classmate (in place of your brother) and explain it to them.

Activity 4.13

A business uses a client-server architecture for their computer network but wishes to transfer its network to a cloud environment. With at least one of your

classmates, investigate what processes would be involved (including costs) for this migration.

Instructions:

1. You may make use of the Internet and/or resource persons such as your ICT teacher, website designer or other relevant persons to aid your investigation.
2. Create a report that summarises the findings of your investigation using MS Word - Include diagrammatic illustrations and description of how a cloud network works.
3. Present the report to your IT teacher or expert for assessment.
4. Present the verified report to a classmate (in place of the business owner).

Activity 4.14

Investigate how cloud networks evolved over the past 20 years. Use MS Word or pen and paper to create a timeline to show the main markers or indicators in this development.

Instructions:

1. The Internet can be a great source of information for this research. For instance, to search for information on how cloud networks evolved over the past 20 years, you can use the following steps:
   - With your connected to the Internet, open the browser
   - Lauch a search engine such as Google by typing www.google.com in the address bar of the browser
   - Type a keyword such as “evolution of cloud networks” in the search box and click the search button
   - Click the various relevant hyperlinks that show up and extract the required information
2. Compile and edit the information gathered using pen and paper or MS Word
3. Present your write-up to your ICT teacher or an ICT resource person for verification
4. Share the final work with your colleagues or class mates
5. Add the new terminologies introduced in this section to your computer network glossary.

Instructions:

Your glossary should be in the format shown in the sample below:

Network Topologies

This section focuses on how devices in a network are arranged and connected to each other. It will show us how data moves between devices and how the main types of network topologies have their own ways of connecting devices, making them useful for different purposes.

Classification of Networks According to Topologies

Network topology refers to how the different parts of a network, like computers and cables, are arranged. It plays a big role in how well the network works, how reliable it is, and how easily it can grow. The topology can be physical, showing where cables and devices are placed, or logical, showing how information moves within the network.

There are different types of network topologies, each with its own pros and cons. The choice of topology depends on factors such as the size of the network, how much backup (network redundancy) is needed to prevent failures, costs, and the specific requirements of the organisation or application.

Network redundancy means adding extra devices, equipment, or communication paths to a network to make sure it keeps working even if something fails.

There are **many types** of network topologies, these are the main types.

1. **Bus topology:** It is a network setup where all devices are connected to a single, long cable. This cable has a special device called a terminator at both ends to stop signals from bouncing back. In this setup, each device can directly communicate with the others, and data can travel in both directions along the cable. The cable acts like a shared communication line, so all devices on the network receive the same signal at the same time.

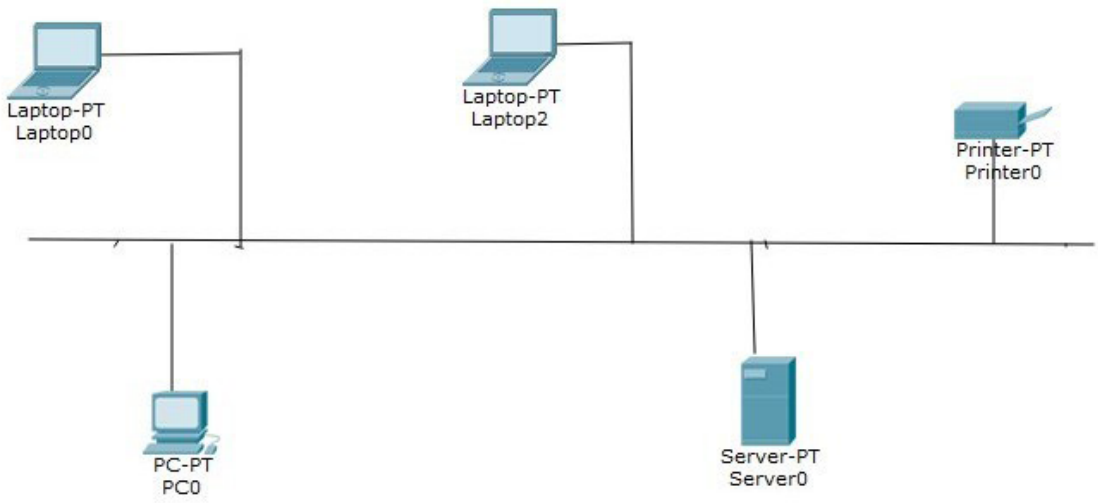


Figure 4.19: Bus Topology

The advantages of a bus topology include:

- **Low installation cost**: Since the network uses just one main cable, it is cheaper to set up because less cable is needed.
- **Easy to expand**: Adding new devices to the network is simple—you just connect them to the main cable.

The disadvantages of a bus topology include:

- **Bus cable dependency**: If the main cable in the network stops working, the entire network will fail.

2. **Star Topology:** It is a network setup where all devices are connected to a central device, like a switch or hub. Each device has its own direct connection to this central point. If one device stops working, it doesn't affect the rest of the network, unless the central device fails. Star topology is the most common setup used in local area networks (LANs).

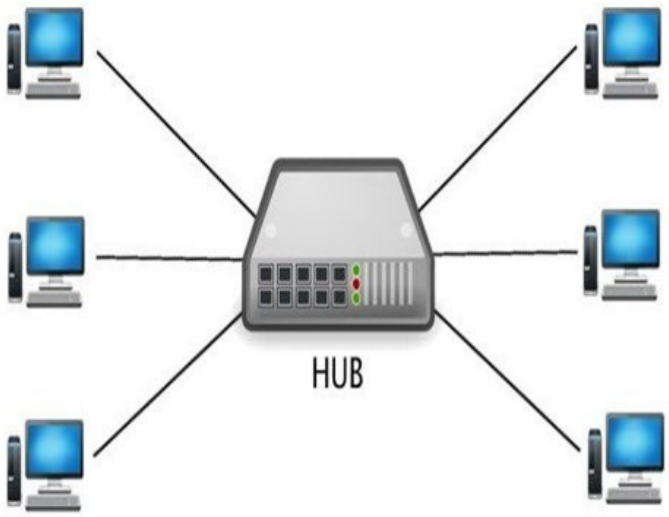


Figure 4.20: Star Topology

The advantages of a star topology include:

- **communication**: Devices can easily talk to each other through the central node.
- **Simple setup**: Setting up a star topology is straightforward, as each device only needs one cable to connect to the central hub.
- **Easy to fix problems**: Troubleshooting is simple because you can identify and remove a faulty device without affecting the rest of the network, as long as the central node is working properly.

The disadvantages of a star topology include:

- **Central node dependency**: The whole network relies on the central node. If it fails, the entire network will stop working.
- **Need for long cables**: In a wired star topology, every device needs to be connected to the central node, so long cables are required.

3. **Ring Topology:** It is a network setup where each device is connected to two other devices, forming a closed loop. Data travels in one direction around the ring, passing from one device to the next until it reaches its destination.

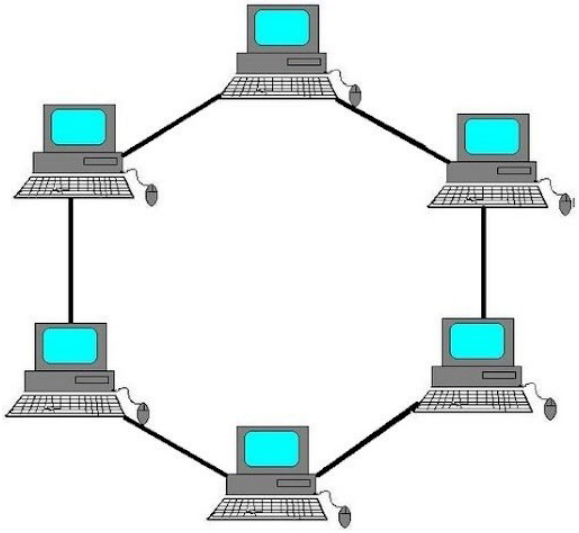


Figure 4.21: Ring Topology

The advantages of a ring topology include:

- **Easier data traffic management**: Since data moves in only one direction, there are fewer chances of data collisions, making it easier to manage data traffic.
- **Simple network structure**: There's no need for a central hub or server to control connectivity. Every device has equal access to network resources.
- **Cost-effective**: It's relatively cheap to set up and expand compared to other network topologies.

The disadvantages of a ring topology include:

- **Node failure causes network problems**: If one node fails, it breaks the ring, causing the whole network to stop working. To fix it, you need to remove or repair the broken node. This is why ring topologies are less common—they're risky if one node fails.
- **Hard to find faults**: It can be tough to find and fix problems in a ring network because it's hard to locate exactly where the issue is.
- **Difficult to expand**: Adding new node is not easy because you have to stop the network while connecting new nodes.

4. **Mesh Topology:** In mesh topology, every device is connected to several other devices, creating a web-like structure. Instead of having a central hub, each device connects directly to many others. This setup offers multiple paths for data to travel, which makes the network more reliable and able to handle failures better. Although mesh topologies are very resilient and often used in Wide Area Networks (WANs), they can be expensive to set up because of the many connections needed.

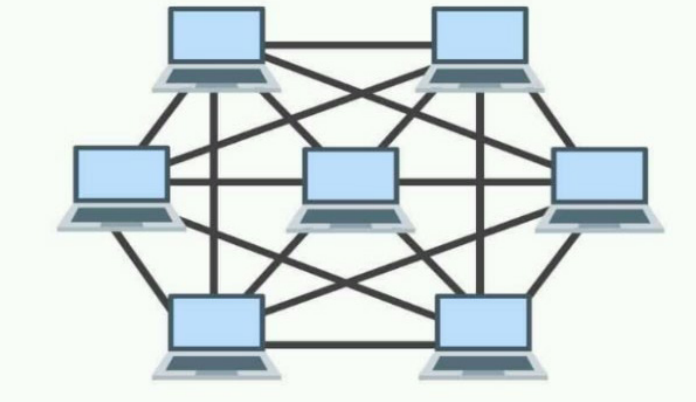


Figure 4.22: *Mesh Topology*

The advantages of mesh topology include:

- **High fault tolerance**: This means the network can keep working even if one or more devices fail. If a node has a problem, the network can still use other nodes to keep running smoothly.
- **Enhanced redundancy**: There are many different paths for data to travel, so if one path has an issue, others are available.

The disadvantages of a mesh topology include:

- **High cost**: Setting up a mesh network is more expensive than other types because it needs lots of cables and ports. All nodes have to stay active, which means more power is used, leading to higher costs for installing and maintaining the network.
- **Complex installation and maintenance**: Installing and keeping a mesh network running is tricky and takes a lot of time because every node has to be connected to each other.
- **Challenging troubleshooting**: Finding and fixing problems in a mesh network can be difficult because of how all the devices are connected together.

Note:

1. There are other network setups too, like tree topology. This type combines star and bus topologies. It has groups of devices arranged in a star shape, all connected to a main bus cable that acts like a backbone.

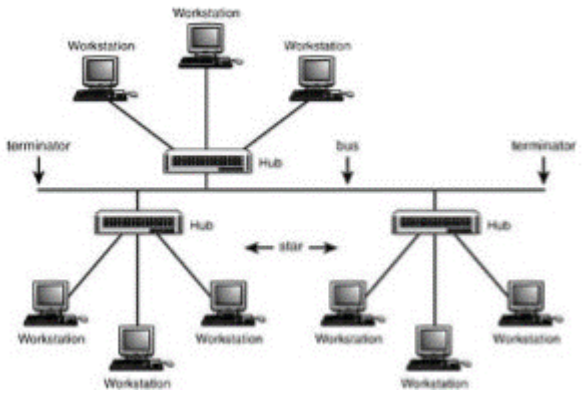
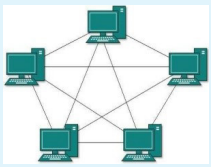
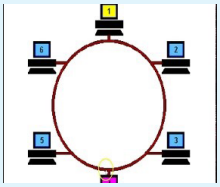
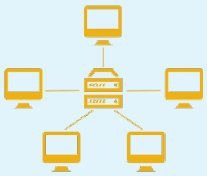
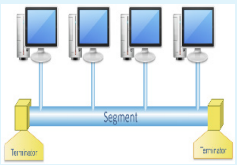


Figure 4.23: *Tree Topology*

2. Network topology and network architecture are closely related. Network topology is about how the different parts of a network, like routers, switches, and computers, are arranged and connected. Network architecture, on the other hand, is the overall design and plan of how the network is setup.
3. In wireless networks, common setups include star and mesh topologies. The simplest setup is the star topology, where each node connects to a central node, like a wireless access point (WAP), which handles sending and receiving data between nodes.
4. Choosing the right network topology is very important because it affects how well the network performs, how reliable it is, and how easily it can grow or change.

Activity 4.15

In this activity, you are going to match the correct type of topology with its corresponding images of topology individually. Write your answers in your exercise book. **Materials needed:** Exercise book, pen or pencil and ruler.

Types Of Topologies	Images
Star Topology	
Bus Topology	
Mesh Topology	
Ring Topology	

Activity 4.16

In this activity, you are to create a PowerPoint presentation on the four key network topologies, their advantages, and disadvantages. Include diagrams in your presentation. Perform this activity in groups.

Materials Needed:

- Computer with and internet access and PowerPoint presentation software
- Smartphone or Tablet with internet access
- Projector
- Notebook and pen for planning

Instructions:

1. Individually, choose one of these four network topologies; (Bus, Star, Ring, and Mesh) and research as a group.
2. Open any web browser on either your computer, smartphone or tablet.
3. Using a search engine, search for your chosen network topology; (Bus, Star, Ring, and Mesh).
4. Click on any hyperlink to display the content network topologies. If the hyperlink does not show you a good understanding of the desired searched result, go back and select on another hyperlink search results.
5. Read through the content and make relevant notes on the advantages and disadvantages of your chosen network topology from the search results.
6. Share your findings with your group members.
7. What did your other group members write that you did not write.
8. Write down the differences in your notebooks.
9. Find or draw diagrams for each of the network topologies. You may use online resources or create your own simple diagrams.
10. Create a PowerPoint presentation to present your findings to the whole class for further discussion and contributions from other group members.

Activity 4.17

In this activity, you are going to research on a tree topology and its common uses, advantages, and disadvantages. Create a diagram to illustrate the tree topology. Perform this activity in groups.

Materials Needed:

- Computer, Mobile Phone or Tablet with internet access for research
- Drawing tools (e.g., drawing software, paper, pen or pencil and ruler)

- Notebook for taking notes

Instructions:

1. Research on tree topology to understand its structure, common uses, advantages, and disadvantages. You should focus on:
2. Individually, search on tree topology, its uses, advantages, and disadvantages and research on as group.
3. Open any web browser on either your computer, smartphone or tablet.
4. Using a search engine, search for 'tree topology'.
5. Click on any hyperlink to display the content tree topology. If the hyperlink does not consider as a good understanding of the desired searched result, go back and select on another hyperlink search results.
6. Read through the content and make relevant notes on the common uses, advantages and disadvantages of tree topology from the search results.
7. Share your findings with your group members.
8. Understand what your other group members write that you did not write.
9. Write down the differences in your notebooks.
10. Fill in the blank space with your findings to complete the table.

Network Topology	Common Uses	Advantage	Disadvantage
Tree Topology			

11. Draw a diagram to illustrate the tree topology. You may use online resources or create your own simple diagram.
12. Present your findings to your teacher for further clarification.

Activity 4.18

In this activity, you are going to analyse key factors that influence the choice of network topology and apply this knowledge to select the most suitable topology for given scenarios, providing reasoning for your choices. Perform this activity in groups.

Materials Needed:

- Computer, Smartphone or Tablet with internet access for research
- Projector Pen or pencil and paper or digital note-taking tools

Instructions:

1. In your groups, discuss the key factors that influence the choice of your network topology, for example:
    - **Network Size**:
    - **Required Reliability**:
    - **Cost**:
    - **Ease of Implementation**:
    - **Future Scalability**:
2. Briefly explain how each factor influences your choice of topology.
3. You are to consider the following network scenarios below and analyse each scenario based on the discussed factors.
    - **Designing a Network for a Small Office**: Consider factors like cost and ease of implementation.
    - **Setting Up a Network for a University Campus**: Focus on scalability and reliability.
    - **Creating a Network for a Remote Office**: Look at cost and ease of implementation.
    - **Designing a Network for a Busy City Hospital**: Emphasise reliability and fault tolerance.
4. Select the most appropriate network topology for each scenario and provide reasons for your choice based on the factors discussed.
5. You should write a brief explanation for each scenario, detailing:
    - The chosen topology.
    - How the factors influenced their choice.
    - At least one reason why the selected topology is best suited for the scenario.
6. Present your choices and reasons to the whole class for further discussion and contributions from other group members.

Wired Transmission Media

This section covers transmission media, which are the ways data travels between devices. They can be either **guided (wired)**, which uses physical cables, or **unguided (wireless)**, which uses signals through the air (e.g., Wi-Fi). Guided media include twisted pair, coaxial, and optical fibres, each with different speeds, costs, and uses. Understanding these helps you to select the best option for connecting devices in a network.

Classification of Network Transmission Media

In computer networks, transmission media are the physical paths that data travels through when moving from one device to another. These paths are generally divided into two main types:

- Guided media (like wires and cables)
- Unguided media (like wireless signals through the air).

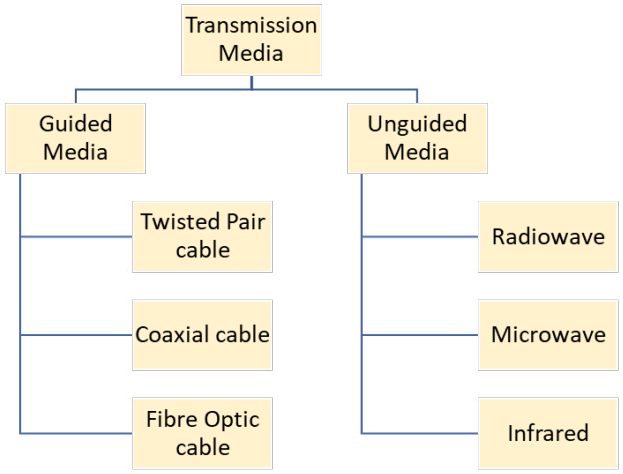


Figure 4.24: *Types of Transmission Media*

Features of Guided (Wired) Media

Guided network transmission media, often called network cables, use physical connections to send data between devices in a computer network. There are three main types of guided transmission media: twisted-pair cables, coaxial cables, and optical fibre cables.

1. **Twisted-pair cable**

A twisted pair cable is a common type of cable used in LAN networks (see Figure 4.25) and for telephone connections. It has two separate copper wires, each covered with insulation, that are twisted together inside a protective cover. The twisting helps to reduce interference between the wires, making the signal clearer.

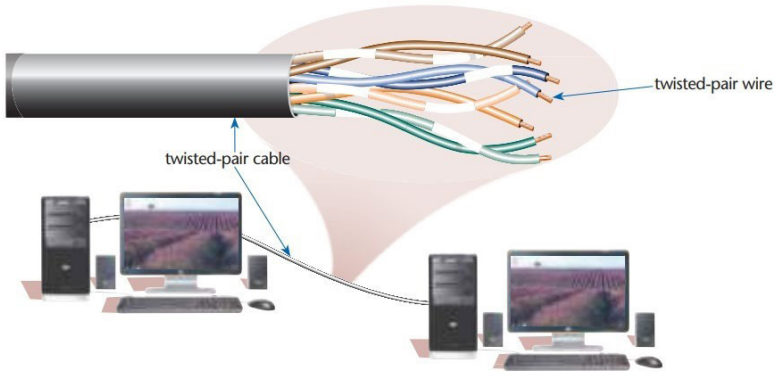


Figure 4.25: *Twisted-pair cabling, the most common choice for networking cabling.*

There are two types of Twisted-pair cabling: UTP and STP.

- **Unshielded Twisted Pair (UTP):** This is a type of cable often used in LANs. UTP cables have twisted pairs of copper wires inside. They are thin and flexible but don't have extra protection against electrical interference.

Figure 4.26: *UTP cable*

- **Shielded Twisted Pair (STP):** This type of twisted pair cable has an extra layer of foil or copper around it to protect it from problems like cuts, noise, and interference. It is often used underground and is more expensive than UTP cables. STP cables can handle higher data speeds over long distances.

Figure 4.27: *STP cable*

Ethernet cables, also known as network cables, are used to connect devices in a LAN based on rules called the Ethernet protocol. You can use these cables to connect computers to routers, switches, or other network devices. Ethernet cables come in different types, like Cat5, Cat5e, Cat6, Cat6a, Cat7 and Cat8. Each type has its own specifications for how fast it can transfer data and how well it handles different frequencies, but they are all twisted-pair cables.

Figure 4.28: *Ethernet cable (Cat5e)*

2. Coaxial cable

This type of copper cable is designed with special metal shielding and other parts to block interference from signals. It has a copper core inside insulation, covered by a metallic shield, and an outer layer for protection.

Coaxial cables are commonly used today to connect cable modems to the internet and for cable broadband. They are also used in cars, airplanes, military and medical equipment, and to connect satellite dishes, radio, and TV antennas.

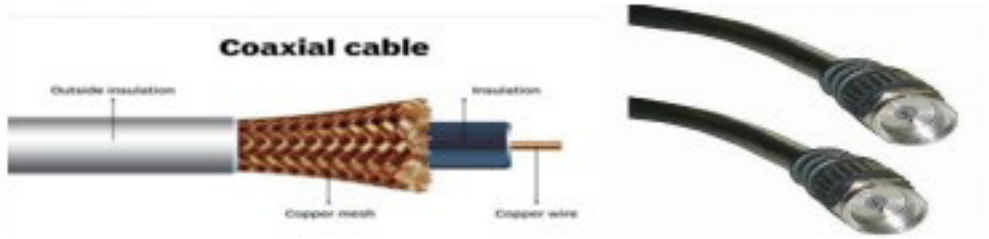


Figure 4.29: *Coaxial cable*

3. Fibre-optic cable

Fibre-optic cables, or optical-fibre cables, use thin strands of glass or plastic to send data as pulses of light. They provide very fast data speeds, work well over long distances, and are not affected by electromagnetic interference. These cables are often used in high-speed networks, telecommunications, and data centers.

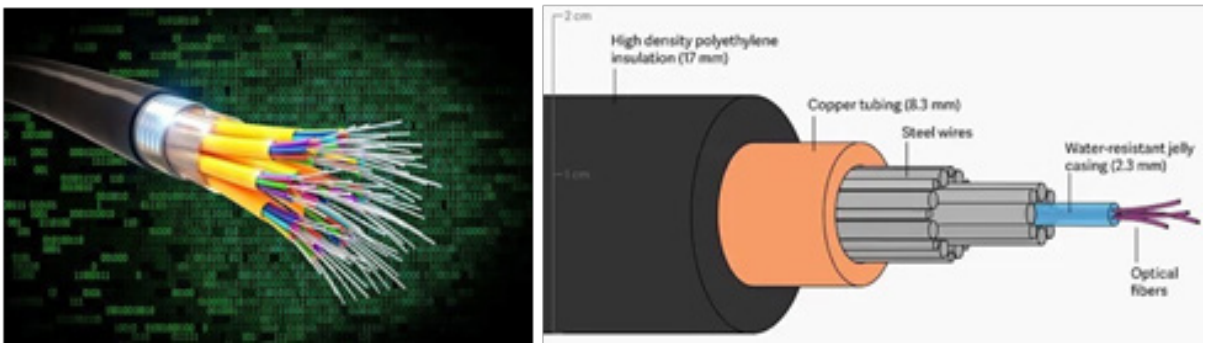


Figure 4.30: *Fibre-optic cable*

Comparing Different Guided Transmission Media

Characteristics	Twisted pair cable	Co-axial cable	Fibre-optic cable
Signal transmission	Takes place in the electrical form over the metallic conducting wires.	Takes place in the electrical form over the inner conductor of the cable.	Takes place in an optical form over glass or plastic fibres.
Installation and Implementation	Simple and easy	Relatively difficult	Difficult, fragile cabling
Cost	Very low	Moderate	Expensive
Diameter	Larger than optical fibre cable.	Larger than optical fibre cable.	Small diameter
Bandwidth[1]	Low bandwidth.	Moderately high bandwidth.	A very high bandwidth.
Electromagnetic interference (EMI)	UTP is susceptible to external interference	EMI is reduced due to shielding.	EMI is not present.
Attenuation[2]	Very high	Low	Very low

Note:

1. Bandwidth is the maximum data transfer rate over a network connection in a given amount of time. Network bandwidth is commonly measured in bits per second (bps).
2. Attenuation is the reduction in the strength of a signal

Conclusion

Each type of cable has different features and uses. Twisted-pair cables are the most common and affordable. Coaxial cables offer higher speeds and are used for fast connections. Optical fibre cables are great for very high speeds and are not affected by interference. The choice of cable depends on things like how fast you need to transfer data, how far the data needs to travel, the cost, the environment, and the kind of network you are setting up.

Activity 4.19

In this activity, you will further investigate on the types of network Cables (twisted-pair, coaxial, and optical-fibre), focusing on the structure of each medium, data transmission, advantages and disadvantages.

Materials Needed:

- Digital devices (computers, tablets, or smartphones)
- Textbooks or online resources about network cables
- Worksheet for recording findings
- Pen or pencil

Instructions:

1. Individually, choose one of these guided transmission media (twisted-pair, coaxial, and optical-fibre) and research on it.
2. Open any web browser on your Digital devices (computers, tablets, or smartphones) and open your preferred search engine.
3. Type the name of your chosen guided transmission media (twisted-pair, coaxial, and optical-fibre)
4. Click on a suitable hyperlink to display content of guided transmission media. If the hyperlink does not consider as a good understanding of the desired searched result, go back and select on another hyperlink in the search results.
5. Read through the content and make relevant notes on the structure, data transmission, advantages and disadvantages of your chosen guided transmission media from the search results.
6. Share your findings with your group members.
7. What did your other group members write that you did not write?
8. Write down the differences in your notebooks.
9. Fill out the worksheet below with the information gathered.

No.	Types of Cable	Structure	Data Transmission	Advantage	Disadvantage
1	Twisted-pair				
2	Coaxial				
3	Optical-fibre				

10. Present your findings as a group to the whole class for further discussion and contributions from other group members.

Activity 4.20

In this activity, you are to Create and Present a Comparison Chart for Guided Transmission Media (twisted-pair, coaxial, and optical-fibre), focus on Bandwidth, Susceptibility to interference and Typical use cases.

Materials Needed:

- Digital devices (computer, tablet, or smartphone) or textbooks
- Chart paper or digital presentation tools (e.g., PowerPoint, Google Slides)
- Marker or digital drawing tools
- Ruler (if using paper)

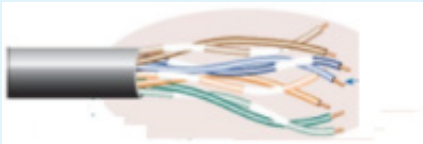
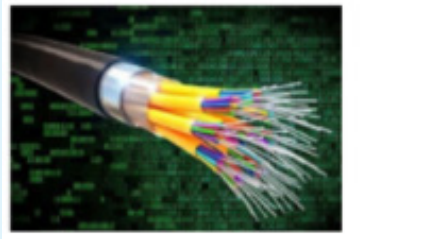
Instructions:

1. Open any web browser on your Digital devices (computers, tablets, or smartphones) and open your preferred search engine.
2. Type the name of the guided transmission media (twisted-pair, coaxial, and optical-fibre). Focus on: Bandwidth, Susceptibility (weakness) to interference and Typical use cases.
3. Click on any hyperlink to display content of guided transmission media. If the hyperlink does not consider as a good understanding of the desired searched result, go back and select on another hyperlink search results.
4. Read through the content and make relevant notes on the bandwidth, susceptibility to interference and typical use cases of your chosen guided transmission media from the search results.
5. Share your information gathered with your group members if done individually.
6. What did your other group members write that you did not write.
7. Write down the differences in your notebooks.
8. Create a comparison table with the information gathered.
9. Label the columns with the different cable types (Twisted-pair, Coaxial, Optical-fibre).
10. Label the rows with the key features (Bandwidth, Susceptibility to Interference, Typical Use Cases).
11. Each group should present their information gathered on the comparison chart to the whole class for further discussion and contributions from other group members.

Activity 4.21

In this activity, you are to match the image of a network transmission media type to its name and description on the right-hand side by drawing a line from the image to it.

NB: Lines are allowed to cross each other.

Image of network transmission media type	Name and Description
	**.....** High-speed, high-bandwidth cable made of glass or plastic fibers, used for long-distance and high-speed data transmission.
	**.....:** cable with single copper conductor surrounded by insulation, shielding and an outer cover commonly used for TV and broadband internet.
	**.....:** Cable consisting of pairs of insulated copper wires twisted together to reduce interference, commonly used for telephone lines and local area networks (LANs).
	**.....:** Typically consist of four twisted pairs of insulated copper wires. Each pair is twisted to reduce electromagnetic interference and crosstalk from other pairs or external sources, used for connecting devices in a LAN and comes in different types, such as Cat5, Cat5e, Cat6, Cat6a and Cat7.

Activity 4.22

In this activity you will review the advantages and the disadvantages of the various types of guided media (Twisted-pair, Coaxial, Optical-fibre). This activity should also inform your decision on which guided media you will use as a network developer.

Instructions:

1. Choose one of these guided transmission media (twisted-pair, coaxial, and optical-fibre)

2. Open any web browser on your digital devices (computers, tablets, or smartphones) and open your chosen search engine.
3. Type the name of your chosen guided transmission media (twisted-pair, coaxial, and optical-fibre) and search on its advantages and disadvantages.
4. Click on any hyperlink to display content of guided transmission media. If the hyperlink a does not display your desired searched result, go back and select another hyperlink.
5. Read through the content and make relevant notes on the introduction, data transmission, advantages and disadvantages of your chosen guided transmission media from the search results.
6. Document your findings using PowerPoint or Microsoft Word.
7. Present your work to your peers for questioning and review session.
   - **Slide 1:** The title, include the type of guided media and group members' names.
   - **Slide 2:** Introduction.
   - **Slide 3:** Data transmission.
   - **Slide 4:** Advantages.
   - **Slide 5:** Disadvantages.
   - **Slide 6:** The Scenario, discuss your specific scenario chosen and how the guided media would perform in that context.
   - **Slide 7:** Conclusion, Summarie the key points.
8. Each should present their slideshow to the whole class and answer questions from their classmates about the guided media they chose and its application to the scenario.
9. Your teacher will lead the class for discussion and compare the different types of guided media which might be best suited for various environments and why.

WIRELESS TRANSMISSION MEDIA

Activity 4.23

1. Write in your books names of electronic devices you have at home that use a remote control.
2. Discuss with your peers how the remote control is able to communicate with the electronic device in your homes.

3. Write in your books names of electronic devices you have at home that connect to share information and resource
4. Discuss ways that files can be share from one device to another device without using cables (e.g.: from a phone to a laptop).
5. After going through steps 1-4 effectively, write your explanation for unguided transmission media in your words with examples

By completing these steps, you should have gained the understanding of unguided transmission media.

Unguided (Wireless) Transmission Media

Unguided transmission media refers to communication methods where signals are transmitted through the air or space without the need for physical cables or wires. This type of media is often used in wireless communication systems.

So instead of connecting computers to peripheral devices or to another computer through ports and connectors, wireless communications technologies are used.

Wireless media are easy and flexible, but they can be affected by environmental factors and have limited range and security concerns.

Unguided transmission media play a vital role in shaping the way we live, work, and interact with one another.

Types of Unguided Transmission Media

1. Near Field Communication (NFC)
2. Infrared
3. Wi-Fi
4. Bluetooth

Activity 4.24

Now, get your get your tablets and smartphone ready. We are going put your internet researching skills into practice. You will search for the characteristics, features, advantages and disadvantages of these unguided transmission media (Near Field Communication, Infrared and Wireless Fidelity).

Are you ready: Let start the activity.

Materials needed:

- Computer/Smartphone with internet access,
- Projector,
- Notebook and pen

1. Choose one of these unguided transmission media (NFC, IR and Wi-fi).
2. Open any web browser and search engine of your choice.
3. Type the name of your chosen unguided transmission media (NFC, IR and Wi-Fi)
4. Click on any hyperlink to display content of unguided transmission media (if the content does not reflect a good understanding of desired searched result, go back and select on another hyperlink) search results.
5. Read and make relevant notes on characteristics, features, advantages and disadvantages of your chosen unguided transmission media from the search results.
6. Present and discuss your findings to your peers for further for discussion.

NEAR FIELD COMMUNICATION (NFC)

NFC is a proximity-based wireless communication standard that uses close-range radio signals to transmit data between two NFC-enabled devices. Examples of NFC-enabled devices include many smartwatches, most smartphones, some digital cameras, computers and smart televisions. Other objects, such as contactless debit and credit cards, and contactless travelcards also use NFC technology.

For successful communications, the devices either touch or are within a distance of 4 centimetres (1.6 inches) of each other. NFC interaction is limited to an extremely short range. Besides smartphones, you can sometimes find NFC on tablets, speakers, collectibles, and even gaming consoles.

Characteristics of NFC Transmission Media

1. Short Range: NFC has a very short range of typically up to 10 cm (4 inches).
2. Low Data Transfer Rate and power consumption: NFC has a relatively low data transfer rate of up to 424 Kbps and consume low power, making them suitable for battery-powered devices.
3. Wireless Connectivity: NFC enables wireless connectivity between devices.
4. Passive and Active Modes: NFC devices can operate in both passive (no power required) and active (power required) modes.
5. NFC transmission media enables peer-to-peer communication between devices.
6. NFC has built-in security features, such as encryption and secure authentication.
7. NFC connections are easy to set up and require minimal user intervention.
8. Low Power Consumption: NFC devices

9. Compatibility: NFC is compatible with various devices, including smartphones, tablets, and wearables and supports communication between multiple devices
10. NFC is easy to set up and its connections are established quickly, typically in a matter of milliseconds.

Weaknesses of NFC Transmission Media

1. NFC has a very short range of typically up to 10 cm (4 inches), making it less convenient for long-range applications.
2. NFC has a relatively low data transfer rate of up to 424 Kbps, making it less suitable for large file transfers.
3. NFC standards are still evolving, which can lead to compatibility issues.
4. NFC tags have limited storage capacity, making them less suitable for large amounts of data.
5. NFC is vulnerable to eavesdropping, data skimming, and other security risks due to its wireless nature. It can also be used to track user behaviour and location, raising privacy and security concerns.
6. NFC devices and tags can be more expensive than other technologies.
7. NFC devices emit electromagnetic fields, which can pose health risks to some individuals.

Infrared (IR)

Infrared connectivity is a wireless technology that uses infrared light to transmit data. It is used for short-range or medium-range communications between two devices. Examples include a TV remote control and, as shown in Figure 4.31 a wireless presentation pointer/clicker/remote. IR communication is among the simplest wireless communication methods and serves as a cost-effective way of transmitting a few bits of data wirelessly. It requires direct line of sight and operates only at close range.

Figure: 4.31: PowerPoint Presentation on IR remote

Characteristics of Infrared Transmission Media

1. Infrared requires a direct line-of-sight between the transmitter and receiver. Physical obstructions can block the infrared signal
2. It has a relatively short data transfer range of up to 10 meters (33 feet).
3. Infrared support medium bandwidth and its data transfer rates is up to 4 Mbps.
4. It is used in remotes for devices like TVs, air conditioners, applications like automatic door openers and certain security systems and other household electronic devices
5. Infrared communication systems tend to consume less power compared to some other wireless technologies, **making them ideal for battery-operated devices**

Weaknesses of Infrared Transmission media

1. It less suitable for environments where line-of-sight cannot be maintained since it cannot penetrate opaque objects. IR signals can be disrupted by environmental conditions
2. Infrared transmission is typically limited to shorter distances compared to other wireless technologies like radio frequency (RF). This makes it less ideal for long-range communication.
3. Although it is less prone to interference from radio frequency signals, IR can be affected by other sources of infrared radiation, such as sunlight, fluorescent lighting, or other IR-emitting devices. This can lead to signal degradation or loss of communication.
4. Infrared communication generally offers lower bandwidth compared to other wireless technologies, which can limit data transfer rates and make it unsuitable for high-speed data applications.
5. Misalignment with devices can reduced signal quality or complete loss of communicatio**n.**

Wireless Fidelity (Wi-Fi)

Wireless Fidelity, commonly known as **Wi-Fi**, is a technology that allows devices to connect to the internet and communicate wirelessly using radio waves.

Creating a Wi-Fi network

Typically, in a home environment, a wireless (Wi-Fi) network is created by using a device called a **router**. The router connects to the internet through a wired connection (like a cable). The router sends out data using radio waves, which are invisible waves that travel through the air. These waves are similar to how radio stations broadcast music, but they carry data instead. Devices like laptops, smartphones, and tablets have built-in Wi-Fi capabilities. They have antennas that can receive and send radio waves.

Connecting to a Wi-Fi network

To connect to a Wi-Fi network, your device needs to be within range of the router. When your device is close enough, it can "see" the Wi-Fi network and connect to it by using a name (also known as a SSID – Service Set Identifier) and sometimes a password. Once connected, your device can send and receive data through the router. This allows you to browse the web, stream videos, and communicate with other devices without needing physical cables.

Wi-Fi works best within a certain range from the router. The signal strength decreases the farther you are from the router, and walls or other obstacles can weaken the signal. The wireless technology primarily used by wireless local area networks (wLAN) is Wi-Fi.

Characteristics of Wireless Fidelity Transmission Media

1. Wi-Fi allows devices to connect to the internet or communicate with each other without physical cables and allows devices to move freely while maintaining connectivity.
2. Wi-Fi Transmission media uses radio waves to transmit data between devices.
3. Wi-Fi supports high data transfer rates of up to 9.6 Gbps (gigabits per second) and has a data transmission range of up to 100 meters (330 feet), depending on the environment and access point.
4. Frequency Bands: Wi-Fi operates on two main frequency bands: 2.4 GHz (for indoor) and 5/6 GHz (for outdoor)
5. Standards: Wi-Fi follows standards set by the IEEE (Institute of Electrical and Electronics Engineers), such as 802.11ac and 802.11ax.
6. Security: Wi-Fi has built-in security features, such as WPA2/3 encryption and firewalls.
7. Wi-Fi devices from different manufacturers can communicate with each other as a result Wi-Fi networks can be easily expanded or upgraded.
8. They are it suitable for real-time applications and supports QoS (quality of services), which prioritizes certain types of traffic.

Weaknesses of Wi-Fi Transmission Media

1. Limited Coverage: Wi-Fi signals degrade with distance from the router and can be obstructed by walls, floors, and other physical barriers. This results in reduced signal strength and speed in areas far from the router.
2. Wi-Fi networks share the same frequency channels among all connected devices. As more devices connect to the network, the available bandwidth per device can decrease, leading to congestion and slower speeds.
3. Setting up and managing Wi-Fi networks can be complex, especially for larger networks with multiple access points. Issues such as channel selection, network security, and coverage optimisation can require technical knowledge.

4. Wi-Fi can consume significant power, which may impact battery life in mobile devices like smartphones and laptops, especially when connected to multiple networks or transmitting large amounts of data.
5. Wi-Fi signals can be weakened by physical barriers and other electronic devices, leading to reduced signal quality and network performance
6. Though there are security protocols Wi-Fi networks can still be vulnerable to hacking, unauthorized access, and eavesdropping if not properly secured.

Activity 4.25

This activity is to help you understand the characteristics of NFC, IR, and Wi-Fi by creating a comparison chart based on their features researched in **activity 4.24.**

Materials Needed:

- Cardboard or large paper,
- Ruler,
- Markers,
- Notebooks,
- Pen or pencil and Computers or tablets with word processor (if using digital tools)

Instruction:

1. In your notebook, raw a table matching the one below:

Feature	NFC	Infrared	Wi-Fi
Signal Type			
Range			
Typical Uses			
Bandwidth			
Susceptibility to Interference			
Typical Use Cases			

3. Ensure you keep the order of the headings.

4. In your groups, fill the empty cells under the appropriate headings with relevant information obtained from the search made in **activity 4.24** on the characteristics of your chosen unguided transmission media.
5. Present your work to the whole class for discussion.

Connecting To A Wireless Network

Bluetooth Transmission Media

Bluetooth is a technology that allows devices to communicate wirelessly over short distances using radio waves. The devices such as laptops, smartphones, and tablets must have built-in Bluetooth capabilities.

Characteristics

1. Bluetooth is a wireless personal area network (PAN) technology.
2. Bluetooth has a range of up to 30 feet (10 meters).
3. Power Consumption of Bluetooth devices are low.
4. Simple Setup: It is simple can cost effective to set up a Bluetooth connections
5. Multi-Device Support: It supports multiple device connections.
6. Frequency Hopping: Bluetooth uses frequency hopping to minimize interference.
7. Data Transfer Rate: Bluetooth has a data transfer rate of up to 2 Mbps.

Strength and weaknesses of Bluetooth Transmission Media

	Strength	Weaknesses
1	Wireless and requires no cables	The range of transmission is limited |Up to 30 feet (10 meters)
2	Setting up is simple and easy since it's a simple pairing process.	Signals can be disrupted or interfered
3	The energy consumption in this media is very low	Vulnerable to eavesdropping and hacking since it allows for multiple devices connection.
4	There is minimal interference	Devices from different manufacturers may not be compatible

5	Does not require cabling making it very affordable	Health Risks as a result of Electromagnetic radiation
6	Easy to use and is very portable	Dependence on Hardware because it requires specific hardware to function

Cellular Communication

Cellular communication is a type of wireless communication that allows mobile phones and other devices to connect and communicate over long distances using a network of cells.

The term "cellular" comes from the idea of dividing a large area into smaller sections called **cells**. Each cell is served by a **cell tower** or base station.

These towers are spread out across cities and towns to cover large areas and make sure you can stay connected even when you're moving around.

Cellular communication is essential for staying connected while on the move, enabling us to make calls, send messages, and access the internet without needing physical connections.

How Cellular Communication works

When you make a call or use data on your phone, your device sends a signal to the nearest cell tower. The cell tower then sends this signal to a central system that manages the network, which connects it to other cell towers or the internet. As you move from one location to another, your phone automatically switches from one cell tower to another without dropping the call or interrupting your data connection. This process is called **handoff**.

Examples of Cellular Communication

1. **Making a Phone Call:** When you call a friend using your mobile phone, your voice is converted into a signal that travels to the nearest cell tower. From there, the signal is routed through the cellular network to reach your friend's phone, which is also connected to a cell tower.
2. **Sending a Text Message:** When you send a text message, your phone sends the message as a signal to the cell tower. The cell tower then forwards this signal through the network to the recipient's phone, wherever it is, as long as it's in range of a cell tower.
3. **Using Mobile Data:** When you use the internet on your smartphone, such as browsing websites or streaming videos, your phone sends and receives data through the cell towers. The cell towers connect to the internet, allowing you to access online content.
4. **GPS Navigation:** Cellular networks can also help with GPS navigation. Your phone communicates with cell towers to determine your location and provide accurate navigation directions.

Satellite Communication

Satellite communication involves transmitting data signals to and from satellites in space. It iscommonly used for long-distance communication in remote areas and for global connectivity. Satellite communication helps us stay connected and access information even in remote or isolated places where other forms of communication might not reach.

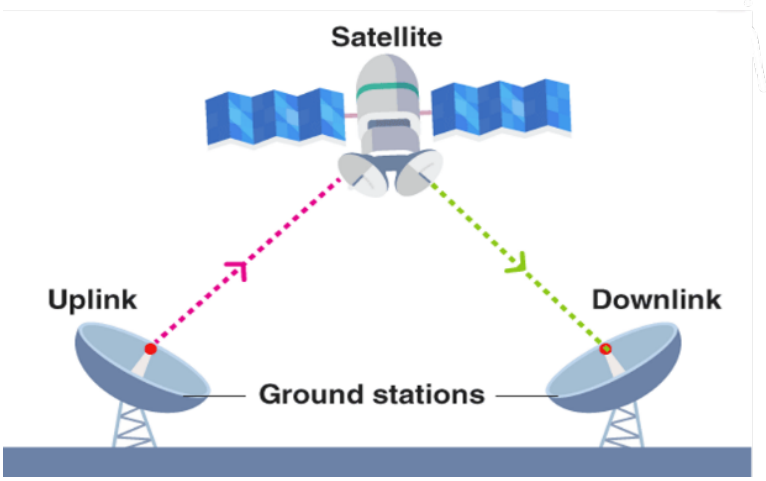


***Figure: 4.32**: Satellite communication*

How Satellite Communication Works

Satellite act like relay stations, receiving signals from one place and sending them to another.

When you use a satellite phone, watch TV through a satellite dish, or use GPS, your device sends a signal to a satellite. The satellite then sends this signal back down to a different location on Earth, where it's picked up by another device or a ground station.

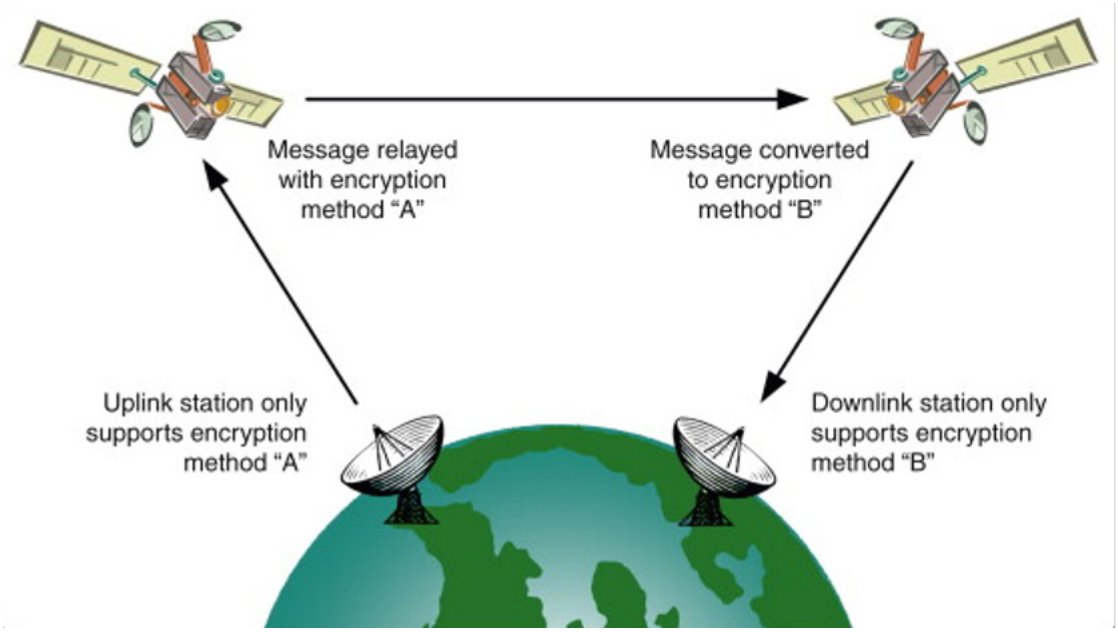


***Figure: 4.33**: how satellite Communication works*

Examples of Satellite Communication

1. **Satellite Phones:** Satellite phones can make calls from anywhere on Earth, even remote areas without cell towers. They send your voice to a satellite, which then relays the signal to another satellite or a ground station where it connects to the person you're calling.
2. **GPS Navigation:** GPS devices or apps on your phone use signals from satellites to determine your location. The satellites send signals to your device, which then calculates your exact position and helps with navigation.
3. **Satellite TV:** When you watch TV using a satellite dish, the dish receives TV signals from a satellite orbiting the Earth. The satellite picks up TV signals from a broadcasting station, sends them to the dish, and you can watch your favorite shows.
4. **Internet via Satellite:** In places where traditional internet connections like fibre or cable are not available, satellite internet can provide a connection. Satellites in space send data to a dish at your home, which then connects you to the internet.

Advantages and disadvantages of guide and unguided transmission media

The table below show the advantages a guided transmission media has over unguided transmission media based of factors such as cost, installation, security of connection, maximum transmission speed and distance for reliable communication.

	Guided networks (Wired)	Unguided networks (Wireless)
Cost	Installation costs can be expensive. As well as materials for setting up	Cheaper to set up, devices can connect if in the range of a wireless access point.
Installation	Installation requires technical knowledge and space to install cables	Installation is quick and simple as most wireless devices will connect automatically. A solution for outdoor locations that are impossible for cabling.
Maximum transmission speed	Up to 10 Gbps for Ethernet (Cat6)	Up to 9.6 Gbps (Wi-Fi 6E)
Maximum distance for reliable communication	Up to 100 metres for Ethernet. 40 to 100 kilometres for fibre optic (single mode)	Up to 50 metres
Security of connection	More secure as a physical connection is required to intercept data.	Less secure as wireless signal cannot be contained within a building and no physical connection is needed to intercept data.

Activity 4.26

Based on what you have learned on guided and unguided transmission media, take these instructions to find a solution for this scenario:

The management of your school wants to build a network to link all the block of the school to enable staff (both teaching and non-teaching) and students to share information effectively. As the network administrator recommend a type of transmission media (Guided or Unguided). Justify your choice with a reason outlining the advantages your choice has other the other.

Instructions:

1. Make a choice of the type of transmission media (guided or unguided) you will recommend
2. Discuss five strengths of your choice in your group and explain your points in your book
3. Discuss five weaknesses of the other types over your choice and explain your points in your book
4. Prepare a PowerPoint presentation on your findings, include pictures in your presentation if possible
5. Present your work to your peer or the whole class for further discussion and contributions from others.

Glossary

- ISPs: Internet Service Protocols
- IoT: Internet of Things
- Architecture:
- Installation

Setting Up Network Connections

Welcome to the digital age's vital lifeline: Setting up a network to share resources with devices you use in everyday life should not be a big deal at all. For example, setting up a new wireless network connection apple devices Wi-Fi, connecting to the internet using a hotspot, connecting to the internet using a cellular network, pairing Bluetooth enabled device to an iPad or iPhone and other device and connecting desktop computers and other devices such scanners, printers, laptop in a wired or wireless network environment.

Ever asked yourself how your computer talks to the internet? Get ready to uncover the fascinating journey of data and how it travels to you through the interesting connections.

Let's get those connections up and running for your gateway to a smarter, more connected world is just a few steps away!

How can I connect my device to a cellular network?

Cellular Network uses mobile data to connect to the internet. Smartphones, tablets, and dedicated mobile hotspots can connect to the internet through cellular networks.

Activity 4.27

To connect your mobile phone to the internet through cellular network;

1. Tap the ***Settings*** app on your home screen of your mobile phone.
2. Look for options labeled ***Network & Internet, Connections,*** or ***Data Usage*** (the exact name may vary depending on your device).
3. Tap ***Mobile Network*** or ***Data Usage***.
4. Find and toggle the switch for ***Mobile Data*** to the **On** position.
5. Ensure you see the mobile data icon in the status bar at the top of your screen, indicating that mobile data is active.

Note:

1. Check if you have enough mobile data to supports hotspot usage. If not, you can buy extra data from your cellular network provider.
2. You can set up data usage limits or warnings by navigating to data usage and configuring data Saver or Usage Limits.

How to set Up a New Wireless Network Connection on an iPad or iPhone

Materials Needed:

- iPads or iPhones
- Wi-Fi network details (SSID and password)

Activity 4.28

1. Turn on your iPhone or iPad
2. Locate and tap the ***Settings*** app on your home screen and tap to open. (The app icon looks like a gear.)
3. Locate ***Wi-Fi*** icon to take you to the Wi-Fi settings page where you can view available networks.

4. Tap on the ***Wi-Fi icon*** is turned on (it should be green). If Wi-Fi is off, tap the switch to enable it.
5. Select a Network: Find and tap on the name (SSID) of the network you want to connect to.
6. Enter the Network Password
7. After entering the password, tap ***Join***. Your device will attempt to connect to the network.

Note:

- Once you are connected, you should see a checkmark next to the network name, and the Wi-Fi icon should appear in the status bar at the top of your screen, indicating that you're connected to the internet.
- To test the connection, open a web browser and see if the home page will be displayed.
- You can also open an app that needs internet access to be launched.
- If the web browser or the app do not open then, there is a problem with the connection
- Troubleshoot to find the possible problem and reconnect.
- Ensure that your iPad or iPhone is successfully connected to the Wi-Fi network and run your test again.
- If it works, then you can start using your Wi-i connection to communication and access your desire information.
- Where the needed materials are not available, your teacher will show you a video on how this connection is done, after that you will discuss with your peer for better understanding
- You can also do it whenever you get access to the needed materials once you understand how the connection between apple devices is done.

Possible Troubleshooting result:

- Incorrect Password: If you entered the wrong password, you'll need to try again.
- Network Issues: If you cannot connect, make sure you are within range of the network and that the router is working properly.
- Insufficient or no data plan
- Forget Network: If you have trouble connecting, you can tap the network name and select **Forget This Network**, then try connecting again from the first step.

Connecting to the internet using a hotspot

If you have internet access on your device, you can allow others to connect to your device and use your internet access through hotspot.

When you do that, you have created a wireless network. Connecting to the internet using a hotspot means using a special device or feature on your phone to create a small wireless network that other devices can connect to.

This network provides internet access by using cellular data, just like how your phone gets online. Let us take this activity to establish this network connection

How will you Connect a computer and a smartphone using hotspot?

To connect your computer to a smartphone using hotspot, get the following;

1. Mobile Hotspot Device or Smartphone with Hotspot Capability
2. Data Plan from your cellular provider
3. Device to Connect (e.g., laptop, tablet, or another smartphone)
4. User Manual (for the mobile hotspot device or smartphone)

Activity 4.29

Check if you have enough mobile data to supports hotspot usage. If not, you could buy extra data from your cellular network provider.

1. Set up your smartphone by:
   - i. Going to your device's Settings.
   - ii. Locate and select Network & Internet (or similar).
   - iii. Tap Hotspot & Tethering.
   - iv. Select and tap Wi-Fi Hotspot and turn it on.
2. Configure your smartphone's hotspot settings
   - i. Choose the Network Name
   - ii. Provide Password.
3. Turn on the hotspot and the mobile data on your smartphone
4. On your connecting device (e.g., laptop, tablet):
   - a. Open the Wi-Fi settings.
   - b. Look for the network name (SSID) you set up for your hotspot.

c. Select the network and enter the password.

d. Tap Connect to create the network connection

5. Test your connection (**refer *to notes under activity 1 on setting up a new wireless network connection on an iPad or iPhone to run the test on your connection***)

Note:

- Monitor the data usage on your mobile hotspot device or smartphone settings to avoid exceeding your data limit.
- Some devices offer data tracking features; make use of these to stay informed.
- Make sure your hotspot network is secured with a strong password.
- Avoid sharing your hotspot password with others unless necessary.
- To conserve battery life and data, turn off the hotspot feature when you no longer need it

How to pair a Bluetooth device to an iPad or iPhone

From the previous activities in this lesson, you can now connect to apple devices to share information using Wi-i. Now based on your understanding from the previous lesson undertake this activity to pair Bluetooth device and apple devices (iPhone or iPad, apple watch or apple TV) and share music files.

Activity 4.30

Materials needed

- Bluetooth device
- Apple devices

1. Choose an apple device and bring it to a close proximity with the Bluetooth device
2. Write down the steps you will follow to pair your choice of apple device and the Bluetooth device
3. Follow the steps that you have written one after the other to pair the Bluetooth and your apple device.
4. Play a music file from your device for the Bluetooth device to produce the sound.

If the Bluetooth is able to produce the sound from the music file for you, then the connection between the Bluetooth device and your choice of apple device has been create if not then, scan the QR code and retry.

QR code 4.1: Pairing Bluetooth Devices

Connecting To a Wired Network

Earlier in this section, you have been able to connect two or more devices without using cables or wires. Now, let us look at how you can connect your computer and other devices to share information by using cables.

Connecting to a wired network involves using physical cables to establish a direct connection between your device and a network. This type of connection is commonly used in office environments, homes, internet cafés and data centers. It is more reliable and has high transmission speed compared to wireless connections. Now get ready and let journey on these exciting activities to connect computers to other devices in a wired network environment.

Activity 4.31

In this activity, you will need a computer that has an ethernet port, router, switch or modem and ethernet cable.

1. Gather your materials. Eg:

Ethernet cable

Laptop with ethernet port

Router

Figure 4.34

2. Locate the ethernet port on your computer and the switch or router.

Figure 4.35

3. Pick your ethernet cable and plug one end into your computer's Ethernet port

Figure 4.36

4. Turn the power of your router or switch on and plug the other end of the ethernet cable into the router or switch.

Figure 4.37

5. On your computer, Go to Settings > Network & Internet > Status.
6. Right-click on the Ethernet connection and select "Enable" from the menu.

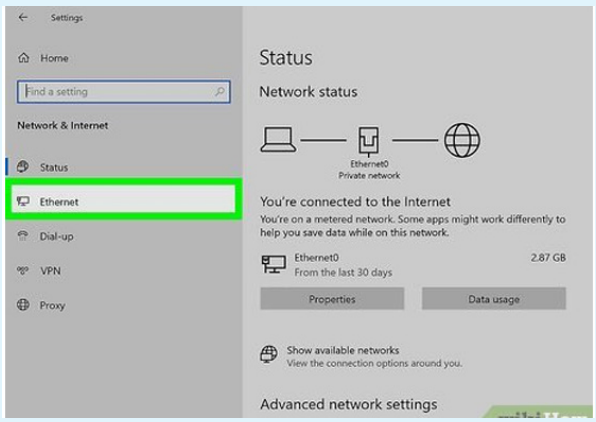


Figure 4.38

7. The laptop is now connected to the Ethernet network.

Note:

1. *To connect a Mac computer to a wired network, the steps are similar. The Ethernet port on your Mac is identified by the symbol shown in Figure 4.38*

Figure 4.39

2. *If your computer doesn't include a built-in Ethernet port, you can use an adapter to connect the Ethernet cable to the USB or Thunderbolt port on your computer.*

Figure 4.40: *Ethernet Adaptor*

Now that you have been able to able to create guided and unguided network connections, I want us to look at some guidelines for using a computer network

Guidelines for using a Computer Network

Navigating a computer network effectively is key to staying connected and productive. There are set of guidelines that help you understand how to use your network safely and efficiently. From ensuring secure connections to maintaining smooth performance, these tips are also to keep you safe and secure on computer networks all around the globe.

Now lets us take a look what to do to stay save on computer networks:

- **Acceptable IT Policy and Agreement:** these are IT policy documents that set out how technology can and cannot be used. IT policies on network usage are critical for maintaining security, efficiency, and compliance within an organisation.
- **Data Security and Privacy:** Measures that protect network users and their sensitive data on a network. Data security is crucial to protecting sensitive and confidential information from unauthorised access, breaches, and other cyber threats.
- **Health and Safety:** Ensuring health and safety in relation to network usage involves addressing both physical and psychological aspects of working with technology. It

addresses measures that keep network user safe and secure from any health-related problem while using networks.

After reading on these three major guidelines for using computer networks, let us look at what to do with regards to each of these major guidelines to make us secure and safe when using computer networks based on this scenario.

Activity 4.32

Scenario:

As the network administrator of a reputable company, you have been invited to give a talk to newly employed workers of the company on the Guidelines for using a Computer Network. (Health, Safety and Data Security and Privacy) with the help of Internet, search for relevant information on the topic and create a concept map to explain the ideas you intend to convey. You can create your presentation with PowerPoint or Microsoft word.

Instructions:

1. Open any web browser of your choice and open your preferred search engine.
2. Type the guideline you want to search on (eg.: Health and Safety with Networks)
3. Click on any hyperlink to display content of Health and Safety with Networks (if the content does not reflect a good understanding of desired searched result, go back and select on another hyperlink) search results.
4. Read and make relevant notes on Health and Safety guidelines on using computer networks.
5. Create a concept map with the notes that you have made from step 4
6. Present and discuss your findings to your peer for further understanding.
7. Prepare your presentation and share your file with other peers using wireless or wired network.

Note: *Make sure to share your files with at least five people in your class and you also make sure your peers share their files with you.*

REVIEW QUESTIONS

Review Question 4.1: Computer Network

1. **Scenario**

   Asamankese Senior High School is planning to upgrade its computer systems. Currently, each department has stand-alone computers, and the school's administration is considering networking them. To make informed decisions, the school's IT committee has posed a few key questions to assess the benefits and logistics of transitioning to a networked environment.

   a. Advise the school's IT committee on the best system to use and why?

   b. Identify the network hardware you may use and why?

   c. why do you think the school need the network connection?

2. Would you choose a switch or a hub to use in a school network?

Review Question 4.2: Computer Network

1. Create a table within MS Word to explain the differences between LAN and WAN in terms of coverage area and purpose.
2. Will you consider the internet as an example of a MAN? Give reasons to your response.
3. Explain how connectivity and security will differ between LANs, MANs and WANs.

Review Questions 4.3: Network Types

1. Explain why the following differences exist between a server and a client computer in terms of specifications.

   a. A server has a lot more RAM

   b. A server has lot more storage space

2. Evaluate the security implications of various network architecture designs, identifying potential vulnerabilities (weaknesses) and recommending mitigation (control) strategies.
3. Explain why client-server networks are considered more secure than peer-to-peer networks.
4. If a business with nine employees wants to facilitate internal communication and file sharing, which network architecture do you recommend and why?
5. Investigate the differences between a two-tiered client-server network and a three-tiered client-server network. Create a short presentation on your findings. Include diagrams to illustrate both architectures.

Review Questions 4.4: Cloud Services

1. Create a short report summarising the three main types of cloud computing services: Infrastructure-as a-Service (IaaS), Platforms-as-a-Service (PaaS), and Software-as-a-Service (SaaS).
2. Afia uses a personal OneDrive account for her files. She accidentally deletes a portion of a file and saves the changes. What does she need to do to get the unmodified version of the file back?
3. Imagine that you are a cloud readiness manager, and your job is to evaluate whether organisations are ready to take up cloud services. Which of the following organisations would you identify to get the most benefit from moving to a cloud service? Justify your choice(s).
    a. An insurance company with a well-established, low cost and efficient IT infrastructure.
    b. A retail organisation that has a history of peaks and troughs throughout the year with its online shopping app.
    c. A family-run organisation that is using a limited number of productivity applications.
4. Microsoft Azure and Amazon Web Services (AWS) are two of the main cloud service providers. Use the Internet to find out more about these two vendors. Summarise the services that they provide and what they charge.

Review Questions 4.5: Network Topologies

1. Your school's network is experiencing frequent data collisions. Based on your knowledge of network topologies, which topology might the school's network be using, and how would you redesign the network to reduce collisions and improve performance?
2. A small office with 10 employees wants to set up a network. They need a reliable network where data can still flow even if one device fails. Which network topology would you recommend and why? What are the possible challenges of implementing this topology?
3. Your school plans to add 30 new computers to the existing network (ring) in the computer lab. Which topology would be easiest to expand, and how would you ensure that the network remains stable and efficient as more devices are added?

Review Questions 4.6: Transmission Media

1. How does the design of twisted pair cables help minimise electromagnetic interference, and why is this important in network communication?
2. How is guided transmission media utilised in cellular/mobile networks, and what role does it play in ensuring effective communication?

3. What steps would you take to design a plan to upgrade an office network's cabling, considering the need to balance both cost and performance effectively?

Review Questions 4.7: Wireless Transmission Media

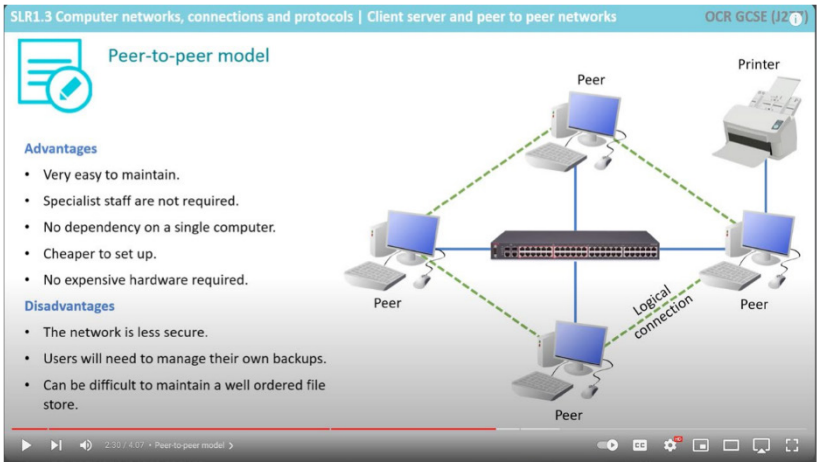
1. A home network is to be set up with internet access for all computers in the house to connect and share resources. Which unguided transmission media will you recommend and why?
2. Compare and contrast the use of guided and unguided transmission media in a hybrid network infrastructure, considering factors such as Data transfer rates, signal interferences, Cost and application (specific requirements).
3. As a network administrator, develop a plan for a city-wide Wi-Fi network for a company. The plan should have five identify the potential benefits and challenges of this proposed network, and how these challenges can be addressed.

Review questions 4.8: Connecting Devices to a Network

1. Find solution to these scenarios to access yourself on what you have learned in this unit.
2. An employee needs to access the company network remotely to complete a critical project. They are using a personal laptop that is not managed by the IT department. What guidelines will you recommend for the employee to be followed to ensure secure remote access?
3. Create a step-by-step guide for connecting a device of your choosing to a network, ideally this should be created in a MS Word document and include images, imagine that this guide is being created for someone who is not technical.
4. You have been asked to create an acceptable use policy for a new school, using the internet, research what should be included and put together a presentation of the different sections and considerations.

Extended Reading

- Types of Computer networks: https://www.youtube.com/watch?v=4_zSIXb7tLQ
- Difference between LAN and WAN: https://www.youtube.com/watch?v=NyZWSvSj8ek
- Computer networks: https://www.youtube.com/watch?v=tSodBEAJz9Y
- Network device: https://www.youtube.com/watch?v=eMamgWllRFY
- Advantages and disadvantages of network: https://www.youtube.com/watch?v=bY5OfBrBg1M
- Web Technologies - Old Questions. https://www.collegenote.net/question-answer/p-1-differentiate-between-2-tier-3-tier-and-n-tier-p-20751
- Use the following link to watch a YouTube video for further explanation of the concept of network architecture: https://www.youtube.com/watch?v=w_LyIDAh_bY&t=149s



scan to watch the video

- Instructions on how to restore a previous version of a file stored in OneDrive can be found at: https://support.microsoft.com/en-gb/office/restore-a-previousversion-of-a-file-stored-in-onedrive-159cad6d-d76e-4981-88ef-de6e96c93893
- An Investigation of Microsoft Azure and Amazon Web Services from Users' Perspectives. International Journal of Emerging Technologies in Learning (iJET): 10.3991/ijet.v14i10.9902
- https://youtu.be/zbqrNg4C98U (On Network Topologies)
- https://youtu.be/8UZlwhiWKmA
- https://beginnersbook.com/2019/04/computer-model-network
- https://www.wikihow.com/Create-a-Local-Area-Network-(LAN)

References

1. O' Leary, T. J., & O' Leary L. I. (2017). Computing Essentials, 26th edition. New York: McGraw Hill.
2. Wempen, F. (2014) Computing Fundamentals: Introduction to Computers. New York: Wiley.
3. Rajaraman, V. (2018). Introduction to Information Technology. PHI Learning Pvt. Ltd.
4. Vermaat, M., E., Sebok, S., L., & Freund, S., M. (2014). Discovering Computers: Technology in a World of Computers, Mobile Devices, and the Internet, Course Technology, Cengage Learning.

5. Differentiate between 2-Tier, 3-Tier and n-Tier. - Old Questions https://images.app.goo.gl/fGnbY2XhdLGeaqjw6
6. Geeks (2024) Difference between Client-Server and Peer-to-Peer Network https://www.geeksforgeeks.org/difference-between-client-server-and-peer-to-peer-network/
7. Vulnerabilities of P2P Systems and a Critical Look at their Solutions Marling Engle & Javed I. Khan (2006)
8. Security Issues in Peer-to-Peer Networks Malinda, T. (2023). 10.13140/RG.2.2.14096.38401
9. Firch J. (2024) Common Types of Network Security Vulnerabilities https://purplesec.us/learn/common-network-vulnerabilities/
10. Lawrence C. Miller and Peter H. Gregory (2016) Client-Based Security Vulnerabilities: https://www.dummies.com/article/academics-the-arts/study-skills-test-prep/cissp/client-based-security-vulnerabilities-225543/
11. Al-Sayyed R., Hijawi W., Bashiti, A. etal (2019) An Investigation of Microsoft Azure and Amazon Web Services from Users' Perspectives. International Journal of Emerging Technologies in Learning (iJET): 10.3991/ijet.v14i10.9902
12. Restore a previous version of a file stored in OneDrive: https://support.microsoft.com/en-gb/office/restore-a-previousversion-of-a-file-stored-in-onedrive-159cad6d-d76e-4981-88ef-de6e96c93893
13. ByLeeron H. (2024) What Is Cloud Networking? Definition, Types & Benefits: https://www.forbes.com/advisor/business/software/what-is-cloud-networking/
14. Kev Z. What is cloud computing? An overview of the cloud: https://www.atlassian.com/microservices/cloud-computing

Glossary

1. **Amazon Web Services (AWS) and Microsoft Azure:** Amazon Web Services (AWS) and Microsoft Azure are two of the leading cloud-based infrastructure as a service (IaaS) providers.
2. **Architecture:** Network architecture is the plan for how devices are connected and communicate with each other on a network. It is essential for creating efficient and reliable networks.
3. **Bandwidth:** is the maximum rate at which data can be transferred across a given path. In simpler terms, it's like the size of a pipe through which information flows.
4. **Bluetooth:** is a short-range wireless technology that allows devices to connect and communicate with each other without using wires. It uses radio waves to transmit data over a short distance.
5. **Client:** A computer that request for a service or resources from a host (server) computer in a network or the Internet.
6. **Cloud Computing:** A broader term for overall centralised computing resources that are shared by numerous customers. It can also be described as the delivery of computing resources over the Internet.
7. **Cloud Networking:** An IT infrastructure where an organization's network and resources are hosted in a public or private cloud platform and are available on demand using only an Internet connection.

8. **Coaxial cable:** is a type of electrical cable used to transmit high-frequency signals with minimal interference.
9. **Connectivity:** refers to the ability of different devices, systems, or components to connect and communicate with each other. It's the state or extent of being connected or interconnected.
10. **DDoS Attack:** A type of cyber-attack where multiple attackers distribute malicious activities across different locations to overwhelm a system or infrastructure, causing it to become inaccessible to legitimate users.
11. **Encryption:** The act of crumbling data or information using algorithms in order to prevent it from being read or used by an unauthorised person
12. **Ethernet:** A widely used technology for local area networks (LANs) that enables devices to communicate over a wired connection.
13. **Hotspot:** Refers to a physical location or a technology that provides internet access, typically through a wireless network.
14. **Hub:** A device that links multiple computers and devices together.
15. **Loop:** Instructions that is continually repeated until a certain condition is reached.
16. **Malware Attack:** A malware attack is a common cyberattack whereby malware (normally malicious software) designed to gain unauthorized access and cause harm or damage to a computer, server, client or computer network and/or infrastructure. The malicious software encompasses many specific types of attacks such as ransomware, spyware, command and control, and more.
17. **Network Architecture:** The physical or the logical design or structure of a computer network
18. **Network Infrastructure:** The hardware and software that enable network connectivity and communication between users, devices.
19. **Node:** A node is any physical device within a network of other tools that is able to send, receive, or forward information. Also referred to as the computer node or internet node, a personal computer is the most common node in a network. Modems, switches, hubs, bridges, servers, and printers are also nodes, as are other devices that connect over Wi-Fi or Ethernet.
20. **Pairing:** The process of establishing a connection or linking two entities so they can work together or communicate with each other.
21. **Privacy:** It involves protecting personal data, communications, and activities from being accessed, shared, or observed by others without consent.
22. **Redundancy:** The process of providing multiple paths for traffic so that data can keep flowing.
23. **Server:** Also known as a host computer, a server refers to a computer that houses resources (information, device, applications) that users or client computers access on the Inter
24. **SSID (Service Set Identifier):** The unique name of a wireless network (Wi-Fi) that identifies it from other networks.
25. **Topology:** the physical or logical arrangement of devices and connections in a network.
26. **Twisted pair cable:** is a type of communication cable that consists of two insulated conductors (usually copper) twisted together.

Acknowledgements

Ghana Education Service (GES)

List of Contributors

Name	Institution
Felix Tenkorang Opare	Accra Academy
Kwadjo Adjei	SDA SHS Asokore Koforidua
Millicent Heduvor	Awaso STEM SHS
Abdul Rahim Mahmud	Yeji SHS