Information Communication Technology

Year 1

SECTION

3

INTERNET EVOLUTION, ISPs AND THEIR FUNCTIONS

ICTs IN THE SOCIETY

Connecting and Communicating Online

INTRODUCTION

Welcome, learner. In this section, you will be introduced to the concept of the internet and its numerous advantages as well as some disadvantages associated with the usage of the internet. You will explore internet services, the evolution of the internet and how the internet works. In addition, you will learn about and explore Internet Service Providers (ISPs) and their functions.

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

- Describe the evolution of the Internet and identify the Internet Service Providers (ISPs) and their functions.

Key Ideas

- The internet is a global or worldwide interconnection of computer networks for communication and data services using protocols which allows users to:
- Connect easily through personal computers.
- Exchange electronic mail (email) with friends and colleagues.
- Post information for others to access and update.
- Access multimedia information that includes sound, photographic images and video.
- Access diverse perspectives from around the world
- The internet provides services such as the World Wide Web (WWW), email, social networking, search engines, online shopping and many more.
- The internet comes with a lot of advantages and some disadvantages.
- There are two groups of computers on the internet, namely servers or host and client computers.
- The host or server computers house the information that users need on the internet.
- Servers are created and managed by companies called Internet Service Providers (ISPs).
- ISPs play a major role in sustenance of the functioning of the internet.

WHAT IS THE INTERNET?

What comes to your mind when you hear the term internet?

The Internet

The internet is a global interconnection of computer networks for communication and data services using protocols.

Protocols are rules and standards that govern communication on a network.

The internet involves an interconnection of networks such as private, public, academic, business and government networks.

Transmission Control Protocol/Internet Protocol (TCP/IP) are used in the transmission of data to the right destination. The internet is a network of networks linked by a broad array of electronic, wireless and optical networking technologies.

The Internet Provides a Vast Range of Services, these Services include

1. The World Wide Web (WWW)

The World Wide Web (WWW), often referred to as the internet's backbone, is a system of interconnected public webpages.

It is made up of all the public websites that users can access on their computers through the internet.

Hyperlinks are used to interconnect Web pages and documents on these sites. When a user clicks on a hyperlink, she/he is redirected to a different location for the information.

Users access and navigate websites through programs called web browsers.

A web browser is a software application used to access information on the World Wide Web.

Figure 3.1: Some popular internet browsers

2. Email Services

Email, short for electronic mail, is a message distributed by electronic means from one computer user to one or more recipients via a network.

Email is convenient, fast, and economic means of exchanging messages. These messages can include text, pictures and animations, and can have file attachments. Email has become an essential tool for personal and professional communication.

Examples of web-based email providers are Gmail, Outlook, and AOL.

Figure 3.2: Examples of web-based email providers

3. Social Networking Services

Social networking is the use of internet-based social media platforms to connect with friends, family, or peers.

Marketers use social networking to increase brand recognition and encourage brand loyalty.

Popular social networking sites include Facebook, Instagram, TikTok, WhatsApp, and X.

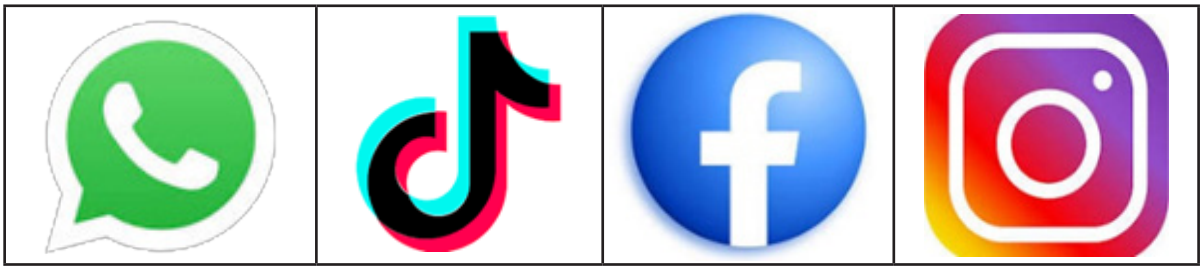

Figure 3.3: Popular social networking sites

4. Search Engines Services

Search engines are web-based application software or programs that enables users to locate information on the World Wide Web.

Search engines help people find the information they are looking for online using keywords or phrases. They employ complex algorithms to provide relevant search results based on user queries, enabling efficient information retrieval. Examples of search engines are Google, Yahoo, Yandex, AOL

Figure 3.4 Some popular search engines

As illustrated in the statistics in Figure 3.5, Google currently has the highest share of the search engine market worldwide by a long way, with over 90%.

Figure 3.5: Search engine statistics. *Source: www.statcounter.com, April 2024*

5. Online Shopping Services

Online shopping, also known as e-commerce, is the activity of buying and selling goods or services over the internet.

Online shopping has changed the way many people buy products and services. It provides a wide variety of items that users can buy from the comfort of their homes through websites and apps. Online shopping comes with some advantages such as:

a. It provides convenience for users
b. It provides extensive product choices for users, and
c. It provides competitive pricing for users.

Online shopping has reshaped the retail industry and consumer habits. Amazon leads the global e-commerce market. Its inventory (April 2024) included 12 million items and 350 million third-party sellers list items.

Examples of online shopping sites in Ghana include Jumia Ghana, Shopwice, Afrikart, KiKUU, and Superprice.

Figure 3.6: Some online shopping sites in Ghana

6. File Transfer Services

File Transfer Services enable the seamless transfer files over the internet. File Transfer services help individuals and businesses share documents, media and data with others digitally through platforms like File Transfer Protocol (FTP).

7. Streaming Services

Streaming services are online platforms providing on-demand access to movies, TV shows, music, and more which allow users to enjoy entertainment at their convenience.

The rise of streaming has led to changes in how many people watch and listen to media, with many traditional cable and radio services adapting to the digital streaming trend. Examples of streaming platforms include Netflix, Apple TV, Amazon Prime Video, and Spotify

Figure 3.7: Some streaming platforms

8. Cloud Storage Services

Cloud storage is a mode of computer data storage in which data is stored on servers in remote locations. Users can store files and data in the cloud, making them accessible from anywhere with an internet connection.

Cloud storage is cheaper in cost compared to the acquisition of a storage device. It can easily be used as a back-up system. Cloud storage cannot be accessed without network connectivity which means, one will need a network connection to access files from cloud storage.

The servers are maintained by a third-party provider who is responsible for hosting, managing, and securing data and stored on its infrastructure.

Examples of cloud storage services are Google Drive, Dropbox and iCloud.

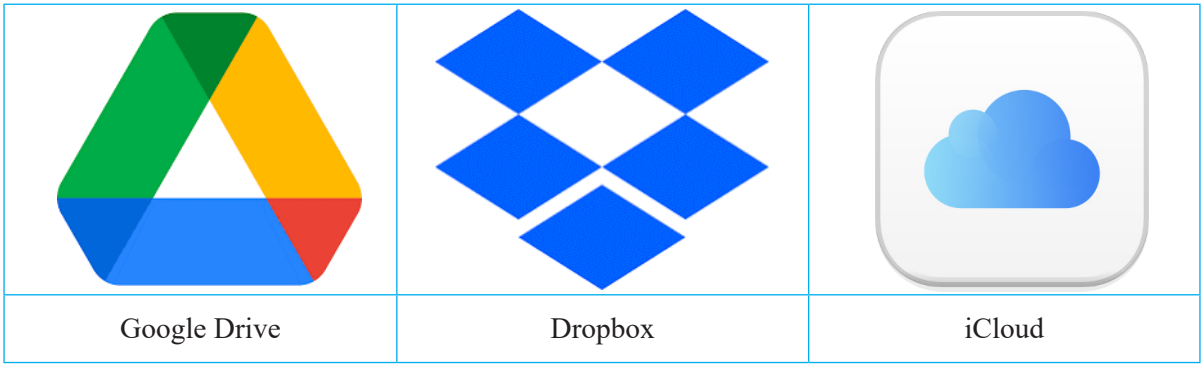

Figure 3.8: Examples of cloud storage services

9. Online Gaming Services

Online gaming is the playing of a video game over the internet or any computer network. Examples of online game services are: Steam, Xbox Live, PlayStation Network, and the Epic Games Store.

Online games bring a lot of people across the world together to form digital communities. It creates competition among players at the same time serving as a source of entertainment. Online gaming has become one of the most popular and fastest-growing sports in the world.

Figure 3.9: Online gaming platforms

Difference between Internet and World Wide Web

Some people incorrectly interchange the terms 'internet' and 'world wide web'. They are not the same thing. The table below highlights the differences between them.

Internet	World Wide Web
• The internet is a global interconnection of computer networks. • The internet is infrastructure.	• The World Wide Web is a collection of information accessed via the internet. • The WWW is a service on top of the infrastructure provided by the internet.

Activity 3.1

Instructions:

In this activity, you are going to match the images in Group A with their corresponding names (descriptions) in Group B. Write your answers in your notebook and compare with your colleagues. This activity can be done in groups or individually.

Materials needed: Notebook or a jotter, pen, ruler.

Match the images(icons) in Group A with their correct names and descriptions in Group B.

Group A (Image)	Group B (Name)
	**Instagram** A free photo and video sharing app available on iPhone and Android.
	**Facebook** A social networking site that makes it easy for you to connect and share with family and friends online
	**Google Chrome** Is a free internet browser developed by google that is used for accessing the information available on the World Wide Web
	**WhatsApp** A free, multiplatform messaging app that lets you make video and voice calls, send text messages, and more
	**Microsoft Edge** Is a cross-platform browser developed by Microsoft that's installed by default on all new Windows devices
	**Tiktok** Is a social media platform for creating, sharing and discovering short videos

Follow the steps below:

Step 1

Draw a two-column table with the headings in the table above (Group A (Images) and Group B (Description).

Step 2

Write the numbers representing the images in the first column (1, 2, 3, 4, 5, 6, 7)

Step 3

Carefully observe the images and write one of the descriptions against each image's number in the second column.

Step 4

Compare your work with what your classmates did and finally submit it to your class teacher for a whole class discussion.

EVOLUTION OF THE INTERNET

The number of internet users has increased so much from the time internet started. It is expected that the number of internet users will reach 6.54 billion by 2025. Sharing information and knowledge has become extremely easy for those that have access to the internet. As a result, the number of computer networks that are connected to the internet also increased significantly.

Let us Take a Look at How the Internet Started

1. The internet started in the USA in the late 1960s for government researches to share information. The academic, military and government agencies' computers across USA interacted and shared information on a single network via telephone lines. This network was called Advanced Research Projects Agency Network (ARPANET).

   This project was funded by the U.S. Department of Defense. Computer files were broken into smaller segments called packets before being transmitted over the network and then reordered back into a single file at their destination, known as packet switching.
2. A lot of computer networks joined ARPANET which led to an agreed set of rules for data handling and transmission over the network. In the 1970's, TCP/IP (Transmission Control Protocol/Internet Protocol). TCP made it possible for computers to speak the same language which helped ARPANET to grow into a global interconnected network of networks (internetworking – internet for short).

   IP when combined with TCP, helps internet traffic find its destination. Every device connected to the internet is given a unique IP number. Known as an IP address, the number can be used to find the location of any internet-connected device in the world.
3. The growth of ARPANET resulted in email though it was not intentionally planned to be so.

   As the network increased in popularity and scope, users quickly realised the potential of the network as a tool for sending messages between different ARPANET computers. The first email was sent in 1971.
4. As time went on, the number of computers on the network increased making it difficult to keep track of all the different IP addresses. This problem was solved by the introduction of the Domain Name System (DNS) in 1983. The DNS is the internet's equivalent of a phone book and converts hard-to-remember IP addresses into simple names.

5. A British computer scientist by name Tim Berners-Lee invented the World Wide Web (WWW) at CERN (the European Organisation for Nuclear Research) in Switzerland in the year 1989 which was opened to the public in 1991. Tim Berners-Lee wrote three technologies; URL, HTML and HTTP. This enabled a user-friendly interface for the internet that allowed it to enter everyday use.
6. Some of the other milestones in the evolution of the internet are shown in Figure **3.10**.

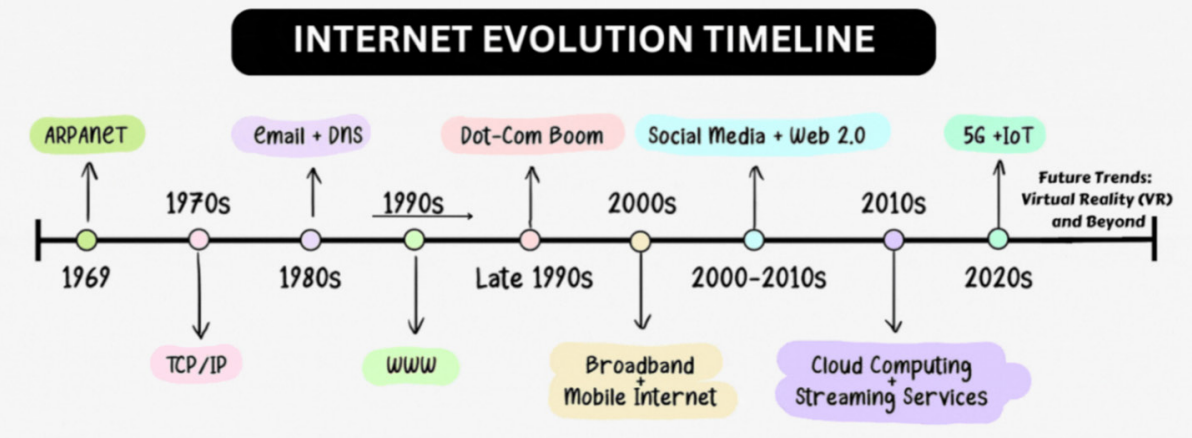

Figure 3.10: Evolution of the internet

In brief, the internet stated in the United States in the 1960s but did not become visible to the public until the early 1990s.

Internet usage has steadily and rapidly increased since then. By 2020, approximately 4.5 billion people, or more than half of the world's population, were estimated to have had access to the internet.

According to Statista (www. Statisa.com), 5.35 billion people use the internet worldwide as of 2024, accounting for 66.04% of the global population. With over 1.05 billion users, China has the highest number of internet users.

India and the United States follow with 729 million and 692 million internet users, respectively.

The percentage of the population using the internet in Ghana has also been growing rapidly. As of January 2023, Ghana registered approximately 24.06 million internet users, growing from the 23 million reported in 2022.

Several factors drive the continued growth of internet users in Ghana and elsewhere.

These factors include the increasing affordability of smartphones and mobile data, and the growing popularity of online services such as online shopping/e-commerce, streaming video, and social media.

Activity 3.2

Materials: Notebook or jotter or a piece of paper, pen, ruler.

Instructions: In your group, create a timeline of the evolution of the internet. The table below, provides some key dates. Use these dates as a guide to research and add their corresponding activities. Surf the internet with the dates given for more information.

Dates	Activities
1960	The establishment of the Advanced Research Projects Agency Network (ARPANET)
1970	
1971	
1983	
1989	
1991	
2000s	Broadband mobile internet
2010s	
2020s	5G and Internet of Things (IoTs)

Follow the steps below:

Step 1

Draw a two-column table with the headings: Dates and Activities

Step 2

Write the dates shown in the table above in the first columns of your table

Step 3

Search for the corresponding activities to the dates you copied (You can search for it online)

Step 4

Compare your work with your colleagues and submit it to your teacher for a class discussion.

ADVANTAGES AND DISADVANTAGES OF THE INTERNET

Advantages of the use of the internet

1. The internet helps in getting information faster with the help of search engines.
2. The internet makes it easy to connect with others through email, social media, and video conferencing applications.
3. It enables many more people to be able to work from home or have a virtual office.
4. The internet makes it easier for people to buy goods and services with e-commerce websites from the comfort of their own home. Examples include; groceries, clothes, household items, and much more.
5. The Internet of Things makes our lives easier and more efficient. Everyday objects like lights, heating and security systems can be connected to the internet. This means you can control them remotely without having to do everything manually. For example, you can turn on the lights in your house before you even get home using an app on your smartphone.
6. The internet provides a diverse array of options for leisure and amusement. From streaming movies and TV shows on platforms like Netflix to gaming communities and social media platforms, the internet offers endless opportunities to keep people entertained.
7. The internet provides a range of education resources and tools such as online courses, videos, tutorials, and FAQs. There are also websites where you can ask questions and get answers from experts. It is like having a whole library at your fingertips! This ready access to information and training has empowered learners across the world.
8. The internet provides a source of income for many people. There are many e-commerce businesses which employ people with a range of skills, from web designers to delivery drivers. The internet enables freelancers to find work globally, entrepreneurs to start new e-commerce businesses, and content creators to monetise their blogs, videos, and social media.
9. The internet provides online banking services that allows users to manage their financial affairs. For example, paying someone by a bank transfer from the comfort of your own home.

Disadvantages of the use of the internet

1. Time wastage, addiction and distractions:
   - Most internet users waste a lot of time on social networking and other websites while doing nothing productive.
   - Users can become addicted to these online services which diverts users from other productive pursuits in their lives.

- It can also negatively impact workplace productivity. Students can get disconnected from their studies, which can negatively impact their education.

2. Lack of content control:
   - The vastness of the WWW means there is an abundance of content, both good and bad.
   - Users may accidentally encounter violent or pornographic material they did not intend to see.
   - Many unethical and pornographic websites harm the younger generation.
3. Trolls, bullying, and stalkers:
   - Trolls: These are individuals who intentionally provoke or harass others online. The anonymity of the internet often makes them more confident.
   - Cyberbullying: Especially affecting young people, cyberbullying occurs when someone uses technology (often via the internet) to intimidate others.
   - Stalking: With personal information readily available online, stalkers can easily find details about individuals.
4. Never disconnecting from work:
   - While remote working from home is convenient, it blurs the boundaries between work and personal life.
   - Notifications can disrupt leisure time, leading to fatigue and burnout.
5. Wrong information

   Although the WWW is regarded as a primary source of information, some websites include inaccurate and worthless information. Sometimes, users can have trouble distinguishing between what is correct and what is incorrect.
6. Hacking, identity theft, and crime:
   - To hack means to illegally break into someone's computer. The internet can be used for hacking.
   - Hackers exploit people to steal personal information (identity theft).
   - Internet fraud continues to grow. This involves the internet being used to offer scam advertisements that request advance payments via email, websites, chat rooms, or message boards.
   - Hidden corners of the internet facilitate criminal activities.
   - Malware is harmful software that damages your data or slows down your computer's performance. It can infect your computer using various means such as email and downloading infected files from the internet.
7. Health and social impacts:
   - Excessive internet use can lead to loneliness and social isolation.
   - Sitting for too long can contribute to health issues like obesity.

Activity 3.3

1. Create a mind map for:
   a. The advantages of the internet
   b. The disadvantages of the internet
   c. An internet service (your teacher will assign your group with an internet service)

which is the use of diagrams to represent information visually. The central idea would be placed in the middle while the associated ideas arranged around it. You will create a mind map for 'the advantages of the Internet'' the disadvantages of the internet' and 'an internet service'. This activity should be done in groups or individually.

2. Let's start with the mind map for 'the advantages of the internet'.

Materials needed: plain sheet of paper, pencil, pen, ruler.

Steps:

Step 1

Pick one of the sheets of paper.

Step 2

Sketch a circle in the middle of the paper using a pencil and write 'Advantages of the Internet' in the circle.

Step 3

Draw an arrow from any part of the circumference of the circle outward and draw an oval at the end of the arrow. Write one advantage of the internet in the oval.

Step 4

Repeat step 3 until you have at least four advantages of the internet.

Note: What you just did is called a mind map. Compare your mind map with other groups and submit it to your teacher for a whole class discussion.

3. Instruction:

Follow the steps in Question 2 to create a mind map for the 'disadvantages of the internet'.

4. Follow the steps in Question 2 to create a mind map for your assigned 'internet service'.

HOW THE INTERNET WORKS

The internet is essentially a vast network of computers connected to one other, allowing them to send and receive data. Here is a simplified explanation:

1. **Data Transmission**: Information is broken down into smaller units called packets. Each packet is transferred across the internet. Each packet contains a portion of the data and a header with information about its origins and destination.
2. **Networking Hardware**: Network devices like routers and switches direct the packets to their destination by using protocols. The transmission control protocol (TCP) and the internet protocol (IP) are responsible for the transmission and routing of the packets. The hypertext transfer protocol (HTTP) is what we use to view web sites through a browser.

   HTTPS is the secure version of HTTP. HTTPS ensures that any data transferred between a website and a user cannot be tampered with or modified by a hacker. HTTPS also ensures that the user accesses the actual website and not a fake version.
3. **Distributed Network**: The internet is a distributed network, meaning it is not dependent on any individual device/computer. This makes it resilient and scalable, as the network can still function even if parts of it go down.
4. **Connection Types**: Digital devices can connect to the internet via various methods, including fibre optic cables, Wi-Fi, and cellular networks. These connections translate data into electrical signals or light pulses that travel at high speeds.
5. **IP Addresses and DNS**: Every device on the internet has a unique IP address. The Domain Name System (DNS) translates human-friendly domain names (like www.example.com) into IP addresses that computers use to connect to each other.

Figure 3.11:

For example, if you type the web address, also called the URL (Uniform Resource Locator), *www.heightslibrary.org* into your browser, your browser would ask DNS for the corresponding IP address.

DNS would return the IP address assigned to the Heights Library's domain name (*151.101.2.159*). This IP address gives an accurate location of the webs server where the website files reside.

Your browser then connects to that IP address.

The browser sends a request to the server, asking it to send a copy of the website to the user/client – see Figure **3.12** below.

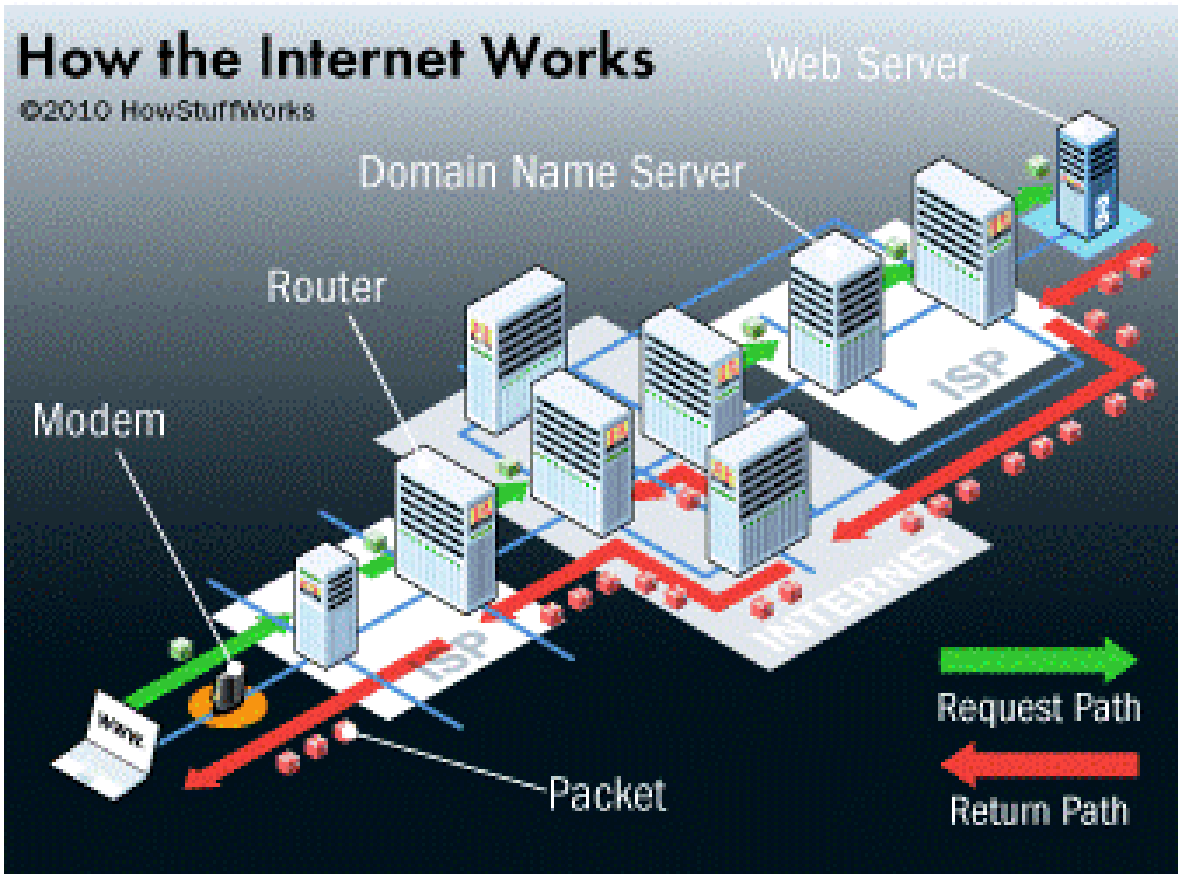

Figure 3.12: How the internet works

Activity 3.4

In this activity, you will research a topic relating to the evolution of the internet such as internet protocols, virtual reality, artificial intelligence, Internet of Things and report your findings to the whole class.

Materials needed: Notebook, pen, smartphone or laptop or desktop computer or tablet.

Instructions:

1. Connect your computing device (example; mobile phone, computer) to the internet

2. Launch any browser on the device (example; Google Chrome, Firefox, Internet Explorer)
3. Type the topic (keywords: internet protocols, artificial intelligence) in the search box of the search engine.
4. Press the enter key on the keyboard or search.
5. Copy the relevant information about the topic and create a word file for it or write in your notebook.
6. Print a copy of your findings and show it to your teacher and the whole class as well. (If yours is written in your notebook, submit that one to your teacher).

Activity 3.5

In your group, create a glossary of terms relating to the internet using the Tables tools in Word (or similar word processing software).

Materials needed: Computer internet access and with installed MS Word (or similar).

Instructions:

1. Launch or Open MS Word app on your computer.
2. Create a new file.
3. Save the file as 'Glossary'.
4. Add a heading to your document.
5. Navigate to where you want to create the glossary.
6. Click on the "Insert" tab in the ribbon.
7. Select "Table" and then choose the number of rows (11) and columns (2).
8. In the first column of the table, enter your terms (e.g., Artificial Intelligence, Robotics etc).
9. In the second column, enter the corresponding definitions or descriptions of each term as shown below.

Glossary term names	Descriptions
Artificial Intelligence (AI)	Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think and learn like humans. It encompasses a wide range of technologies and techniques that enable machines to perform tasks that typically require human intelligence. AI systems can analyse data, recognise patterns, make decisions, and solve problems autonomously, often with a level of accuracy and efficiency that exceeds human capabilities in certain domains. The key aspects of artificial intelligence include: Machine Learning, Natural Language Processing (NLP), Computer Vision and Robotics. Artificial Intelligence (AI) can be grouped as Narrow AI and General AI. Narrow AI (Weak AI): AI designed and trained for a specific task or set of tasks, such as voice recognition or playing chess. Narrow AI operates within a limited context and cannot perform tasks beyond its programmed capabilities. General AI (Strong AI): AI that exhibits human-like intelligence and can perform any intellectual task that a human can. General AI remains theoretical and is the subject of ongoing research and debate.
Robotics	Combining AI with physical machines to create robots that can perform tasks autonomously or semi-autonomously
Computer vision	AI applications that enable machines to interpret and understand visual information from the world, such as images and videos.

10. Add at least 8 more Glossary term names and their descriptions to your table.
11. Show your work to your teacher in a printed or soft copy form.

Activity 3.6 (Project work)

1. Research about a person who has made a significant contribution to the development of the internet such as Tim Berners-Lee and create a slideshow about this person and their contribution(s).
2. Create a poster which illustrates the difference between two internet-related terms, for example, the difference between the WWW and the internet, a search engine and a browser, or a web address and an IP address.

Use the space below to reflect on the Activities above. How did you find the activities? Include any notes that will help you to complete the tasks in the future.

WHAT ARE INTERNET SERVICE PROVIDERS

The evolution of the Internet has brought about a whole lot of opportunities as well as challenges. We learnt that the Internet is a global network of networks of computers. The interconnections were made possible through telecommunication links. Interestingly, it is believed that no one owns the internet. The generally accepted fact however is that there are certain companies that are said to own portions of the internet. These companies are called Internet Service Providers (ISPs). ISPs specialise in creating servers that house the information users need on the internet and provide accessibility to users. ISPs play crucial roles in the workings of the Internet.

You will now be introduced to ISPs, their functions, and what they have to offer in the digital space, alongside examples. You will also get to familiarise yourself with some of the challenges ISPs encounter, their impact on customers, and more.

Scenario

Before you proceed to move on, read the following scenario carefully and see if you can answer the questions that follow:

While at home, John Mensah was able to access the internet with his mother's smartphone, he chatted on Facebook with friends, watched how cake is prepared on YouTube, downloaded some games from the Google Play store and installed them on the smartphone. The next day, John's younger sister Abena also tried but she could no longer access the internet. She then switched to a desktop computer thinking that may work for her, yet to no avail because the desktop PC was not connected to the internet.

What answer do you have for these statements based on the given scenario:

a. Why was John able to access the internet from his mother's smartphone that day and do all that he expected (chats, watching video, downloads)?
b. Why was John able to chat on Facebook, watch YouTube videos and downloaded games when the smartphone had internet access, yet Abena couldn't do same when she tried the next day.
c. What can be changed relating to the desktop PC that will allow the same activities John carried out using the smartphone to be carried out using the desktop PC?

Definition of an ISP and Examples

An Internet Service Provider (ISP) is a company that provides internet access for homes and businesses, typically for a fee. There are thousands of these companies throughout the world, the most popular in the U.S.A. and China being AT&T and China Telecom respectively. Popular ISPs in Ghana include:

Activity 3.7

Research and create a list of different ISPs available in Ghana. Include information such as the services offered, pricing plans, customer reviews, and any unique features of each ISP.

You can complete this activity alone or in a small group with your colleagues.

NOTE: Wikipedia (April, 2024), reported Ghana has over 15 commercial internet service providers and the majority of their customers access the internet from mobile devices).

FUNCTIONS OF ISPs

Internet Service Providers (ISPs) perform variety of functions including the following:

1. Provide access to the internet

This is the primary function of an ISP. Connecting directly to the internet would require owning and managing the infrastructure and technology necessary for an internet connection, which is not feasible for the average user due to the high cost, complexity, and expertise required. For a monthly fee, ISPs will provide and maintain this infrastructure and technology.

ISPs offer different connection speeds to cater for the diverse need of society. The connection speed and cost of the ISP service are determined by the type of connection. Connection types include:

a. Dial-up
b. DSL
c. Cable
d. Wireless
e. Fibre-optic.

Your location may restrict your choice of ISP access. For example, despite significant advancements in telecommunications technology, there are still many regions in the world where geographical challenges and the high cost of infrastructure development make it difficult for service providers to offer broadband or wireless services. In these areas, dial-up internet connection, even though it is slow and now considered 'old technology', becomes the only feasible option for connecting to the digital world.

2. Email services

Many ISPs provide an email account with a unique address linked to your internet service account. See *Figure* **3.13** below for the benefits of MTN email service advertised with the MTN email service (April 2024).

With My MTN Mail's email service you can have your very own My MTN Mail email address and also benefit from the following features:

- SMS notification of new email messages.
- Access to your email via the web site, from cell phones with built in email facilities or from your PC email program.
- 2GB of email storage space.
- Built in Calendar and Contacts List.
- Built in Spam and Virus checking.
- Up to 4 additional email aliases.

Figure 3.13: Email service advertisement

3. Web hosting

Every website is typically made of many files, including images, videos, audio, text, and code, that are stored on special computers called web servers. Web hosting is a service that maintains, configures, and runs physical servers to store files that constitute your website, and make it accessible on the internet. Web hosting services also provide additional support, such as security and website backup. Website hosting fees can vary from one ISP to another, from free (though often limited) space, to charges based upon the size and functionality desired on the website.

4. Proxy server

A proxy server is a server (host computer) that sits between you (client computer) and the rest of the internet, acting as a 'proxy' (intermediary) for your traffic. It is also known as *application-level gateway* – see Figure **3.14**.

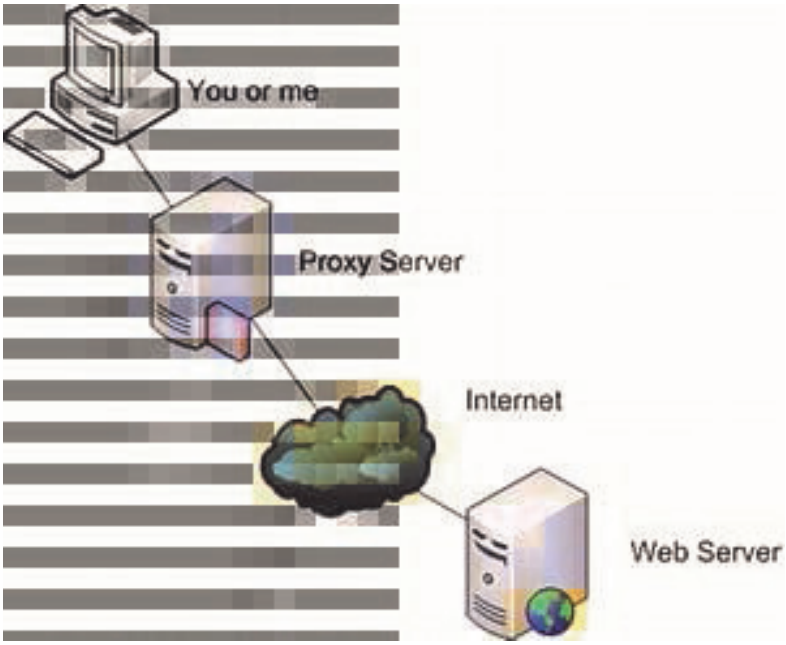

Figure 3.14: A proxy server

For example, consider a situation where you want to search for something on Amazon. Without a proxy server, your computer would make a data request directly to Amazon's servers which would send the data back to your computer. When connecting via a proxy server, that request is passed through an external server and sent to Amazon. From there, the requested information is sent back through the proxy and finally to your computer. Your IP is replaced (concealed) with the proxy server's IP, making every online system 'think' as though you are connecting from the proxy server, not your computer. In other words, the proxy server makes it appear to every online system as if you are accessing the internet directly from it, rather than your computer or device.

There are many reasons why a proxy server is used; two popular reasons include:

a. Enhancement of privacy in a network
b. Ensuring of anonymity while browsing the internet.

5. Technical support

The ISP's technical support staff (human) or chatbots are responsible for troubleshooting of customer problems, diagnosing of faults related to internet access and resolution of issues over the phone. When you sign up with an internet service provider (ISP), they usually send you a modem and a router (nowadays usually a modem/router combo). They usually replace this equipment at no extra cost if it stops working.

Figure 3.15 A Modem/Router combo

A *modem* is an essential piece of hardware that allows internet-enabled devices to connect to the Internet. It works by converting signals (analogue) from a telephone line (wire or cable) into a form (digital) that your computer can understand and vice versa (converts digital signal from computer to analogue for transmission). A *router* allows you to connect multiple devices (i.e., laptop, desktop, smart TV, printer, etc.) directly or through a switch or hub to your home or office internet. A router also acts as a bridge to allow the devices interconnected (wirelessly or with cables) on the local network(s) to communicate with each other or one another.

ISPs in More Detail

Here is additional information about what ISPs do and how they go about it:

1. Connecting users to the internet

a. When you subscribe to an ISP, you can establish a link between your devices (such as computers, smartphones, or tablets) and the internet.

b. ISPs facilitate this connection by providing access through various technologies, including:

Broadband: High-speed connections via cable modems, fibre-optic lines, or DSL.

Wireless: Utilising cellular networks or Wi-Fi.

Dial-up: Using the public telephone network to provide last-mile connections.

c. The maximum amount of data transmitted over an internet connection in a given amount of time is known as *bandwidth*. This varies depending on the type of internet connection.

2. Data transmission

a. Once connected, ISPs act as intermediaries between end users and the internet.

b. When you send a request to access a website, download content, or perform any online activity, your ISP is responsible for transmitting that request to the relevant servers.

c. Similarly, when data (such as web pages, emails, or files) is sent in return for your request, the ISP delivers it to you.

3. Services provided by ISPs (some explained in more detail earlier)

a. ***Internet access:*** The primary service of ISPs is to connect users to the Internet.

b. ***Internet transit:*** Allows network traffic to cross or transit network of computers through access points, thereby connecting smaller ISPs to the larger Internet or the internet backbone, which allows data to flow globally.

c. ***Domain name registration:*** Manage domain names (e.g., www.example.com) for websites.

d. ***Web hosting:*** Lease out computing capacity or resources to host websites.

e. ***Colocation:*** Provide physical space for servers in data centres.

f. ***Data storage:*** Allows storage of files and documents on ISPs servers remotely.

g. ***Offsite backups:*** Offer capability to backup data on the servers of an ISP for system recovery purposes

Note that the list above is not exhaustive. You can read from the internet or other sources for more on the services or functions of ISPs.

4. Historical Context

a. The internet (originally ARPANET) began as a network between government research labs and universities.

b. ARPANET is derivative of the name of the agency that pioneered the design and construction of the Internet. The agency was called, Advanced Research Project Agency (ARPA)

c. In the late 1980s, commercial use of the internet started, and ISPs emerged.

d. Dial-up ISPs were common initially, but cable TV companies and telephone carriers later emerged and offered faster broadband connections.

e. In 1989, the first commercial ISP was founded. It was called 'The World', a slow dial-up. Since then, the number of commercial ISPs has increased exponentially.

5. Net Neutrality

a. Net neutrality is the principle that ISPs should enable access to all content and applications regardless of the source, and without favouring or blocking particular products or websites.

b. Municipal broadband (i.e., broadband provided by public entities instead of private companies) has been suggested as a solution to net neutrality issues.

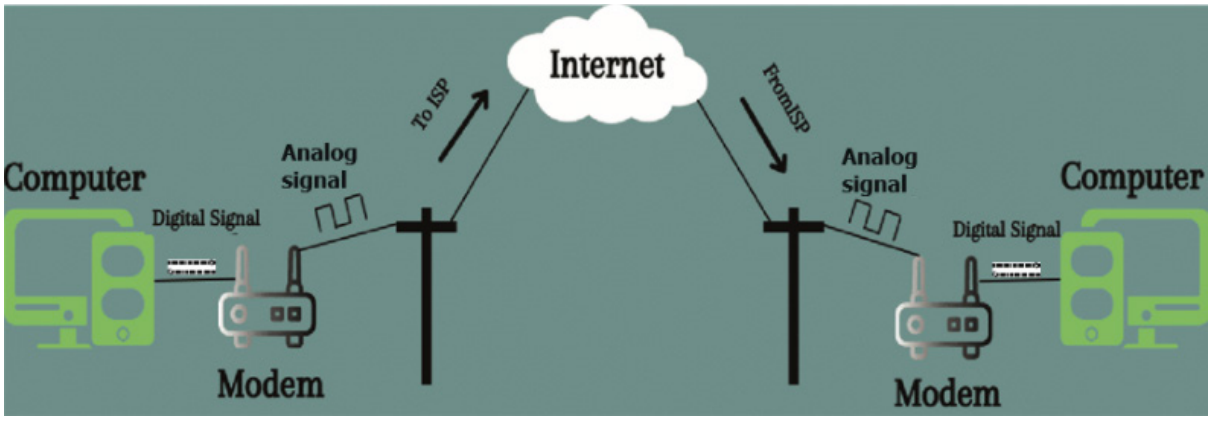

Figure 3.16: Data transmission

Conclusion

As shown in Figure 3.16 above, ISPs provide the infrastructure and technology outside homes and buildings that will enable its customers to access the internet. Within the home a modem and router are required for internet access, and an ISP will usually supply its customers with this equipment. The ISPs also maintain the infrastructure and deal with customer queries and problems. Other functions of the ISPs include providing email, web hosting services, and a proxy server. Without ISPs, you would be unable to connect to the internet. These companies therefore make it possible for their customers to surf the web, shop online, conduct business, do research, and connect with family and friends, at a fee.

Activity 3.8

With the knowledge gained so far regarding what an ISP is, its functions and other related aspects, conduct research and develop a business plan for your own ISP firm, taking into consideration the following parameters:

a. Services you want to offer
b. Your target customers
c. Type of servers
d. Type of transmission media and connection method
e. Security features
f. Ethical considerations
g. Location
h. Pricing plan

Share your plan with your teacher.

LINKING TO THE INTERNET FROM HOME

There are instances where individual may want to establish internet connections personally and directly from the comfort of their homes. The figure below (Figure **3.17**) illustrates the steps and digital devices used to access the internet at home.

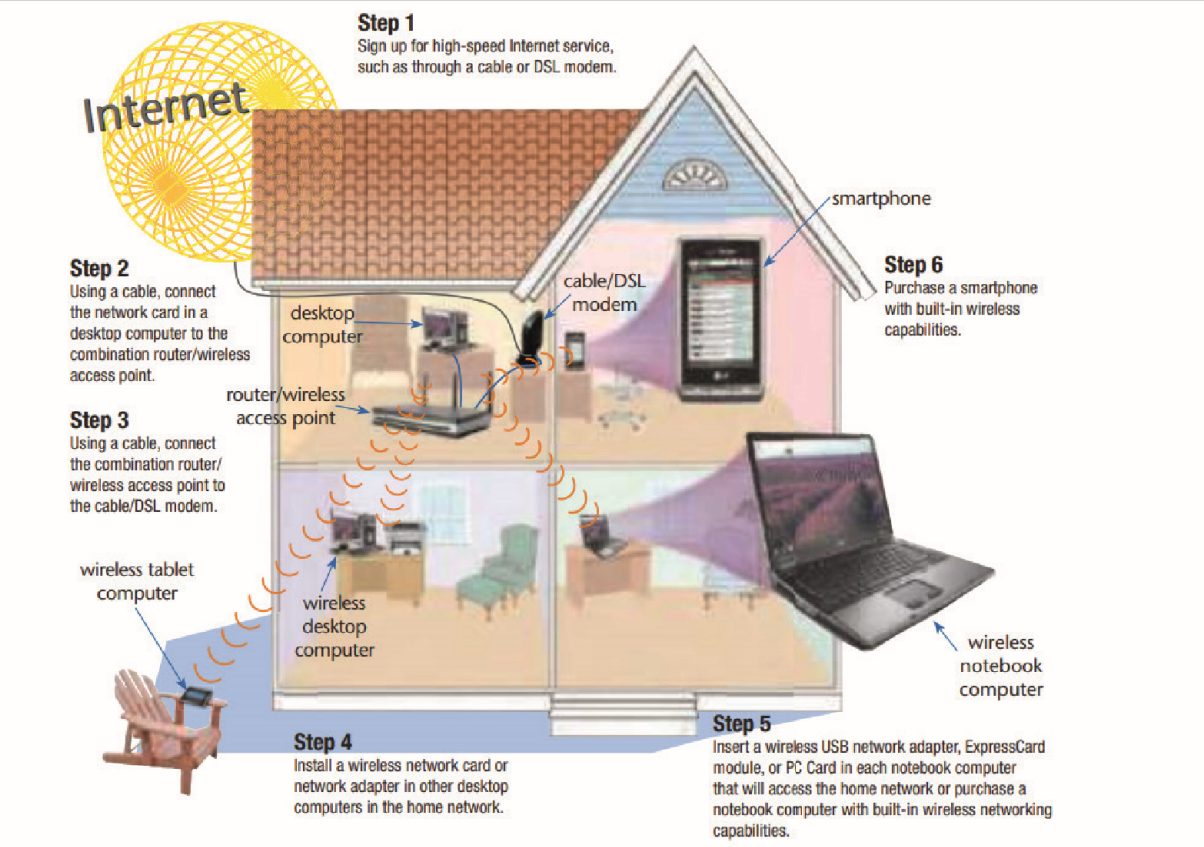

Figure 3.17: Linking to the internet from home

How you connect your digital device to the internet will vary a little depending on your connection type, but the steps are generally similar and straightforward as follows:

1. **Wi-Fi connection** (quick to set up and flexible positioning)

   Step 1: Ensure your Wi-Fi is turned on. Look for the Wi-Fi icon in your taskbar.

   Step 2: Access your device's settings (the path varies by operating system).

   Step 3: Find your Wi-Fi network name (Service Set Identifier or SSID) from the available list and click on it.

   Step 4: Enter the network password (if requested).

   Step 5: Wait for your computer to connect to the Wi-Fi network.

   Step 6: Open your browser and confirm access by visiting a given web site.

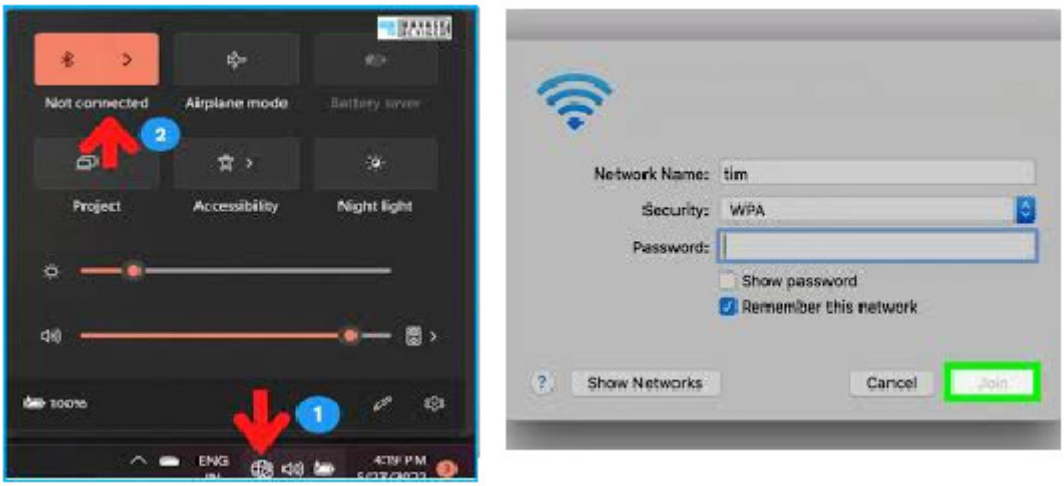

Figure 3.18: Wi-Fi Connection (Windows 10, 11)

2. **Ethernet connection** (good for stability and speed)

   Step 1: Connect the Ethernet cable to a yellow LAN port on your modem.

   Step 2: Connect the other end of the Ethernet cable to an Ethernet port on your computer or laptop.

   Step 3: Make sure that the Ethernet light is green and flashing next to the port connected to on your modem.

   Step 4: Open up your browser to confirm that you can load a webpage.

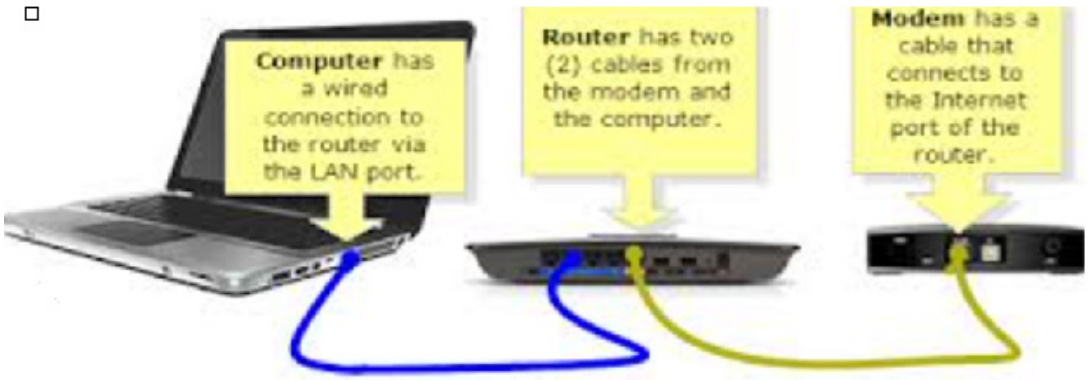

Figure 3.19: Ethernet connection

3. **Dial-up connection** (slow, an older method and less common nowadays)

   Step 1: Verify hardware requirements (Ensure modem is installed on your computer)

   Step 2: Obtain dial-up internet service.

   Step 3: Plug your modem into the phone jack.

   Step 4: Connect the modem to your computer.

   Step 5: Set up the dial-up connection.

   Step 6: Adjust settings if necessary.

   Step 7: Connect to the internet.

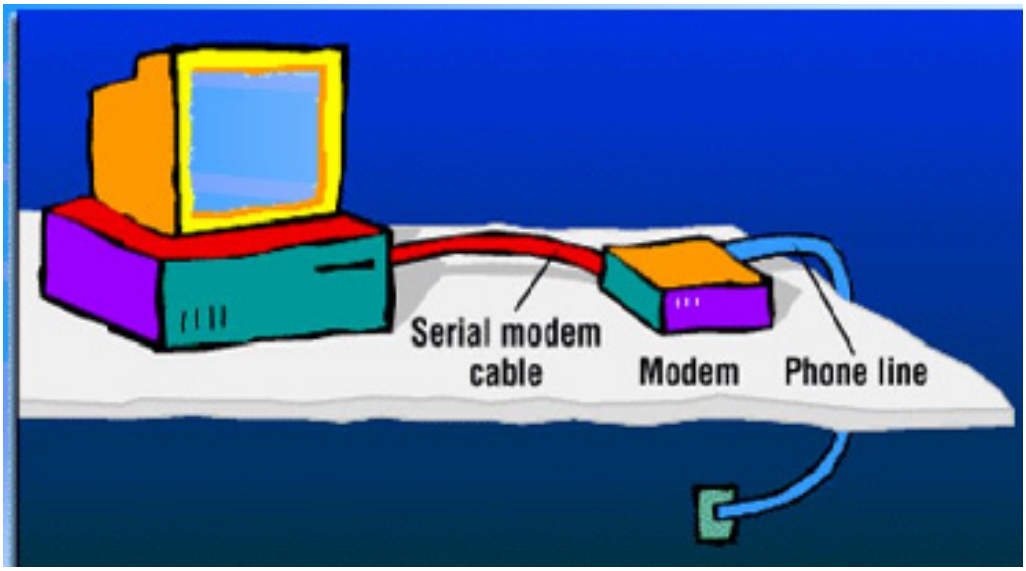

Figure 3.20: Dial-up connection

Activity 3.9

Your father wants to access the internet at home from a laptop computer or desktop PC and has asked you to do it for him.

With a partner role-play a call to your chosen ISP to enquire about their service plan, how to set up the new connection, any questions you have around potential technical issues and what upgrade options are available.

Activity 3.10

Now that you have set up your internet connection for your parent, you will want to conduct a Ping test to establish the speed of the service matches the speed indicated by the ISP.

Using your school internet connection, conduct a Ping test to check the speed of the connection. You can use the following site or similar: https://www.bandwidthplace.com/ping-test

Activity 3.11

Case Study

Transmission Media (network system) is an ISP who hosts (offers services to) four international financial institutions (banks). They were once hijacked by unknown cyber criminals. The attackers succeeded by using a script (malicious software) that tapped into the network backbone of the ISP and either diverted (redirected) or blocked incoming and outgoing traffic. This caused the services of these banks to be interrupted for a number of days. This led to what we call a denial of service (DoS) attack. This type of attack is experienced quite often in IT systems or infrastructure.

1. With this scenario as a background, research and identify at least five possible challenges that ISPs may encounter in their operations and how these challenges can be mitigated?
2. Identify at least five potential impacts on customers related to the case study above.

Activity 3.12

Pair with a friend to research and analyse current policies and regulations related to ISPs in Ghana. Explore the implications of these policies on:

a. Competition

b. Consumer rights

c. Privacy

Create a word-processed report of your findings.

Activity 3.13

Add the following terms to your Glossary created earlier in this section:

a. ISP

b. Bandwidth

c. Broadband

Use the space below to reflect on the Activities above. How did you find the activities? Include any notes that will help you to complete the tasks in the future.

REVIEW QUESTIONS

Read the scenario below and answer question 1 below.

Jason Napadam, a SHS first year learner of Accra Academy, visited his grandfather in a town called Torchedor in the Tatale Sanguli District in the Northern region of Ghana. On his third day of the visit, there was a cultural dance display called Kinachung by the Konkomba group of people.

He was so enthused by the display. He observed closely how the dancing steps were made with the rhythms from the drums and the songs sung. Special costumes were worn by both males and females. He took out his smartphone and captured some pictures and videos. Just like the picture below.

Jason decided to share these beautiful pictures and videos with his classmates, Ayitey Annan and Obed Acheampong who live in Accra and Kumasi respectively. Jason's friends, Esi Koomson and Salima Mohammed in Cape Coast requested that he also sends them these pictures and videos. They intend to post these videos on social media for monetary gains.

1.

a. What application software on the phone did Jason use to capture the pictures and videos?

b. Through which social media platforms can he share his pictures and videos with his classmates and friends? Mention four.

c. Mention two internet services (Social media platforms) that Esi can upload these videos to make money.

2. Why are internet protocols important?

3. Describe two ways that a computer could get infected with a virus from being connected to the internet.
4. Evaluate the impact of cybersecurity threats on individuals and organisations using the internet.
5. Considering the terms internet and World Wide Web, do you see them to be the same? Justify your answer.
6. Prepare a presentation on the history of ISPs, including key milestones, technological advancements, and the evolution of internet connectivity over time.
7. As individual or in group with colleagues (recommended), research how current or emerging technologies such as 5G, AI, IoT, net neutrality regulations, and the growth of fiber-optic networks impact services delivery of ISPs. Present your findings in typed form and show it to your teacher or ICT instructor for publication on your school's notice board.
8. Critique the ethical implications of ISPs collecting and monetising user data without their consent.
9. Develop a plan to improve customer service and satisfaction for an ISP facing negative feedback.

ANSWERS TO REVIEW QUESTIONS

1.
   a. Mobile phone camera
   b. WhatsApp, email, Facebook, TikTok
   c. Facebook, TikTok
2. Internet protocols provide a way to standardise the way data is sent and received, internet protocols enable the reliable, secure, and efficient communication of data across the global network.
3. Opening suspicious email attachments, accessing malicious websites, clicking malicious ads, downloading malicious and unlicensed applications.
4. Causing financial loss to individuals and organisation, reputation damage, emotional trauma.
5. The Internet is a global network of networks that connects millions of private, public, academic, business, and government networks worldwide but the World Wide Web, commonly referred to as the Web, is a system of interlinked hypertext documents accessed via the Internet. It is an application that runs on top of the Internet.
6. Clue for answer: This is a project-based question should be answered by doing some research. Your teacher will provide you guidance and feedback on your project.
7. Emerging technologies such as 5G, AI, IoT etc. would certainly raise the efficiency of ISPs depending on how they adopt or implement these technologies. Here are some clues to aid your research since this is a research-based task. You would get to discover more on how these technologies impacts the operations of ISP in your research:

   The arrival of 5G technology promises to transform our digital lives, but its success depends largely on the underlying infrastructure. Here, optical fiber emerges as an essential component, providing the necessary backbone to support the promises of this new technological era. 5G is designed to address the enormous growth in data and connectivity, the Internet of Things (IoT) with millions of connected devices, and innovations such as virtual reality (VR) and augmented reality (AR), and Artificial Intelligence (AI). It allows for a 100x increase in connection capacity and a 70% decrease in latency, making it ideal for applications involving real-time control.
8. Collecting and monetising user data without their consent is tantamount to a breach of the right of user with regards to provisions such as information privacy and copyright.
9. This answer is not an exhaustive one but a guide for you the leaner to come out with something more comprehensive: A plan to improve customer service and

satisfaction for an ISP facing negative feedback should take into consideration the following:

- Research through interviews to gather in-depth information about customer dissatisfactions
- Prepare structured questionnaires based on the feed-back obtained through interviews to gather further information
- Design solution that reflects customer needs
- Get the required resources for implementation of the proposed solution
- Implement the solutions

EXTENDED READING

- Internet Basics- What is the internet? https://edu.gcfglobal.org/en/internetbasics/what-is-the-internet/1/
- Click on the link below to watch a video on the concept internet: https://www.youtube.com/watch?v=G91s61R4qhs&pp=ygUQaW50ZXJuZXQgY29uY2VwdA%3D%3D
- Internet and its components: https://youtu.be/G91s61R4qhs
- What Broadband Costs and How to Afford It: https://www.investopedia.com/what-broadband-costs-and-how-to-afford-it-5184821
- What is an internet service provider (ISP)?: https://www.verizon.com/about/blog/isp-meaning
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Acknowledgements

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