

Unit-3

Introduction to Internet

The Internet is a global network that connects millions of computers and devices, enabling people to communicate, share information, and access digital resources worldwide. It works like a vast highway system, where data travels in small packets between connected devices.

- Facilitates instant communication and information exchange across the world.
- Connects computers, smartphones, and servers through various wired and wireless networks.
- Powers daily activities such as emailing, online learning, shopping, and entertainment.

Architecture & functioning of the Internet

- **Layered model:**

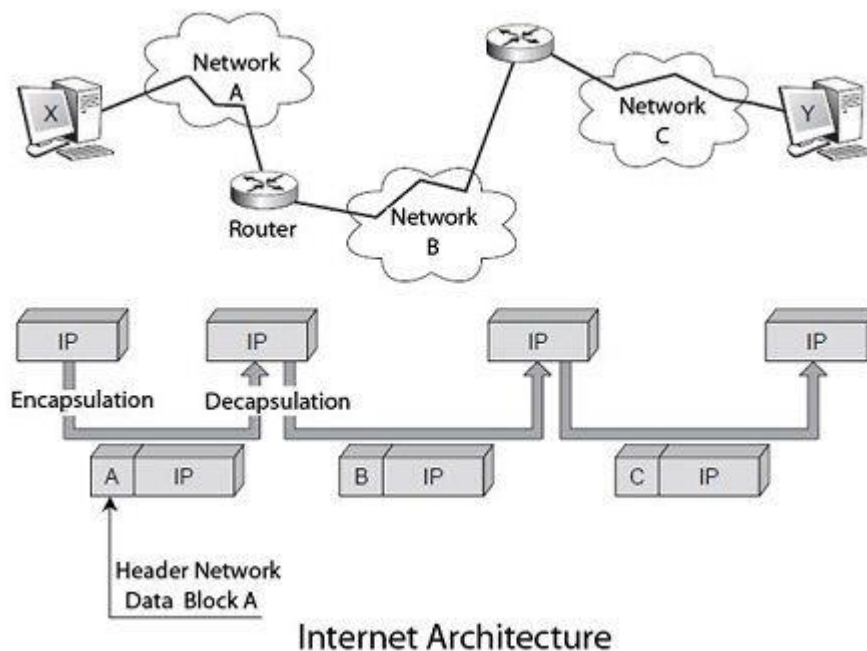
The internet operates on a layered architecture, with the most common model having five layers: physical, link, network, transport, and application.

- **Protocols:**

Each layer has its own set of protocols, which are rules that govern communication. The [Transmission Control Protocol/Internet Protocol \(TCP/IP\)](#) is the foundational suite that enables devices on different networks to communicate.

- **Data packets:**

Data is broken down into small packets for transmission. These packets are routed independently across the network and are reassembled at the destination.



World Wide Web (WWW):-

The World Wide Web (WWW), often called the Web, is a system of interconnected webpages and information that you can access using the Internet. It was created to help people share and find information easily, using links that connect different pages together. The Web allows us to browse websites, watch videos, shop online, and connect with others around the world through our computers and phones.

All public websites or web pages that people may access on their local computers and other devices through the internet are collectively known as the World Wide Web or W3. Users can get further information by navigating to links interconnecting these pages and documents. This data may be presented in text, picture, audio, or video formats on the internet.

Key Parts of the Web

The Web has three main building blocks that make it work:

- **URL (Uniform Resource Locator):** This is the address of a webpage, like <https://www.example.com/>. It tells your browser exactly where to find the page.
- **HTTP (Hypertext Transfer Protocol):** This is the set of rules that lets your browser and the server talk to each other to send and receive webpages.
- **HTML (Hypertext Markup Language):** This is the code that tells browsers how to display a webpage, including where to put text, pictures, and links.

World Wide Web (WWW) Vs Internet:-

It's easy to mix up the Web and the Internet, but they're different:

Aspect	World Wide Web	Internet
What It Is	A collection of webpages and websites you access with a browser.	A global network connecting computers.
Started	1989 by Tim Berners-Lee at CERN.	1960s as <u>ARPANET</u> .
Purpose	To share and explore information like text, images, and videos.	To connect devices and share data.
How You Use It	Through browsers like Chrome or Firefox.	Through any connected device for email, apps, etc.
Example	Visiting a website like Wikipedia.	Sending an email or streaming a video.

Note: In short, the Web is just one part of the Internet, like a library is one part of a

File Transfer Protocol (FTP):-

FTP is a standard communication protocol. There are various other protocols like HTTP which are used to transfer files between computers, but they lack clarity and focus as compared to FTP. Moreover, the systems involved in connection are heterogeneous, i.e. they differ in operating systems, directories, structures, character sets, etc the FTP shields the user from these differences and transfers data efficiently and reliably.

The **File Transfer Protocol (FTP)** is widely used in the application layer of networking. It works at the application layer, ensuring that files are sent and received securely.

Types of Connection in FTP

- Control Connection
- Data Connection

Control Connection

For sending control information like user identification, password, commands to change the remote directory, commands to retrieve and store files, etc., FTP makes use of a control connection. The control connection is initiated on port number 21.

Data connection

For sending the actual file, FTP makes use of a data connection. A data connection is initiated on port number 20.

FTP sends the control information out-of-band as it uses a separate control connection. Some protocols send their request and response header lines and the data in the same TCP connection. For this reason, they are said to send their control information in-band. HTTP and [SMTP](#) are such examples.

TELNET:-

TELNET stands for Teletype Network. It is a **client/server application protocol** that provides access to virtual terminals of remote systems on local area networks or the Internet. The local computer uses a telnet client program and the remote computers use a telnet server program. In this article, we will discuss every point about TELNET.

TELNET is a type of protocol that enables one computer to connect to the local computer. It is used as a standard [TCP/IP protocol](#) for virtual terminal service which is provided by [ISO](#). The computer which starts the connection is known as the **local computer**. The computer which is being connected to i.e. which accepts the connection known as the **remote computer**. During telnet operation, whatever is being performed on the remote computer will be displayed by the local computer. Telnet operates on a client/server principle.

Uses of TELNET

- Remote Administration and Management
- Network Diagnostics
- Understanding [Command-Line Interfaces](#)
- Accessing Bulletin Board Systems (BBS)
- Automation and Scripting

Advantages of TELNET

- It provides remote access to someone's computer system.

- Telnet allows the user for more access with fewer problems in [data transmission](#).
- Telnet saves a lot of time.
- The oldest system can be connected to a newer system with telnet having different operating systems.

Gopher:-

Gopher is the fastest way to find and get text files from different computers on the internet. It came before the World Wide Web that we use today. Gopher lets you see a list of files and folders, almost like looking at files and folders on your own computer. You could click on the items in the list to read text files from other computers connected to the internet.

Gopher used very simple text without any pictures or formatting, unlike websites today. It made it easy for beginners to access information online without needing complex programs or skills.

Key Features of Gopher-

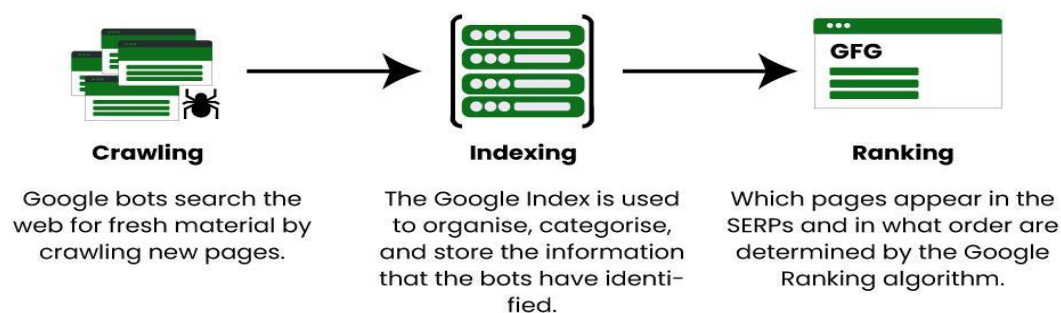
1. **Simple Text:** Gopher uses just plain text to show information, without any pictures or fancy formatting. This makes it easy and fast to use.
2. **Organized Menus:** The files and folders on Gopher servers are organized like a tree, with main folders and sub-folders. You can easily move through these folders by selecting them from a menu.
3. **Flexibility:** While Gopher was mostly used for text files, it could also handle other types of files like images or videos. It could even connect to other systems that had different types of information.

Search Engines:-

Search engines are programs that allow users to search and retrieve information from the vast amount of content available on the internet. **They use algorithms to index and rank web pages based on relevance to a user's query, providing a list of results for users to explore. Popular search engines include Google, Bing, and Yahoo.**

How do Search Engines Work?

Since we know "What are Search Engine?" Now let's have a closer look at the elements involved in its working:



Email:-

Email stands for [Electronic Mail](#). It is a method to send messages from one computer to another computer through the Internet. It is mostly used in business, education, technical communication, and document interactions. It allows communicating with people all over the world without bothering them. In 1971, a test email was sent Ray Tomlinson to himself containing text.

It is the information sent electronically between two or more people over a network. It involves a sender and receiver/s.

Why use E-Mail?

An email is a communication that happens in real time and can get important data across to people in various geographies. An email is a record of the communications that have happened and is stored on the server of the organization. One has to be very cautious while typing out a mail.

Advantages of Email Services-

These are the following advantages of email services:

Easy and Fast:

Composing an email is very simple and one of the fast ways to communicate. We can send an email within a minute just by clicking the mouse. It contains a minimum lag time and can be exchanged quickly.

Secure:

Email services are a secure and reliable method to receive and send information. The feature of spam provides more security because a user can easily eliminate malicious content.

Web Browser:-

The web browser is an application software used to explore the World Wide Web ([WWW](#)). It acts as a platform that allows users to access information from the Internet by serving as an interface between the client (user) and the server. The browser sends requests to servers for web documents and services, then renders the received [HTML](#) content, including text, [images](#), [links](#), styles, and scripts.

Simply being connected to the Internet isn't enough; a browser is essential to search and view content online. Popular web browsers include [Google Chrome](#), [Microsoft Edge](#), [Mozilla Firefox](#), and [Safari](#).

Website Cookies

When we visited any website over the internet our web browser stores information about us in small files called cookies. Cookies are designed to remember stateful information about our browsing history. Some more cookies are used to remember about us like our interests, our browsing patterns, etc. Websites show us ads based on our interests using cookies.

Here is a list of 5 popular web browsers:

1. **[Google Chrome](#)**: Developed by Google, Chrome is one of the most widely-used web browsers in the world, known for its speed and simplicity.

2. **Firefox:** Developed by the Mozilla Foundation, Firefox is an open-source browser that is known for its privacy features and customization options.
3. **Apple Safari:** Developed by Apple, Safari is the default browser on Mac and iOS devices and is known for its speed and integration with other Apple products.
4. **Microsoft Edge:** Developed by Microsoft, Edge is the default browser on Windows 10 and is known for its integration with other Microsoft products and services.
5. **Tor Browser:** Developed by The Tor Project, Tor Browser is a web browser that is designed for anonymous web browsing and is based on Mozilla Firefox.

Internet of Things (IoT):-

The Internet of Things (IoT) refers to a network of interconnected physical objects such as devices, machines, vehicles, or people embedded with sensors, software, and unique identifiers that enable them to collect, exchange, and process data over a network without requiring direct human-to-human or human-to-computer interaction.

Sensors:

Sensors collect data and send it via the network to edge or cloud systems where the data is processed and analyzed. Results are delivered to users through apps or used to automatically drive actuators and systems.

Different types of Sensors

- **Temperature Sensors:** Measure heat or temperature changes in the environment or objects.
- **Image Sensors:** Capture visual data for cameras and computer vision applications.
- **Gyro Sensors (Gyroscope):** Detect angular velocity and orientation of objects.
- **Obstacle Sensors:** Identify the presence of obstacles to avoid collisions.
- **RF Sensors:** Use radio frequency signals for detection, tracking, and communication.
- **IR Sensors (Infrared):** Detect heat signatures or motion using infrared light.
- **MQ-02/05 Gas Sensors:** Sense the presence and concentration of gases like CO, methane, or smoke.
- **LDR Sensor (Light Dependent Resistor):** Measure light intensity and brightness levels.
- **Ultrasonic Distance Sensor:** Calculate distance by using ultrasonic sound waves.

Working of IoT Devices

- **Collect and Transmit Data :** For this purpose sensors are widely used they are used as per requirements in different application areas.
- **Actuate device based on triggers produced by sensors or processing devices:** If certain conditions are satisfied or according to user's requirements if certain trigger is activated then which action to perform that is shown by Actuator devices.
- **Receive Information:** From network devices, users or devices can take certain information also for their analysis and processing purposes.
- **Communication Assistance:** Communication assistance is the phenomenon of communication between 2 networks or communication between 2 or more IoT devices of same or different networks.

Characteristics of IoT

- **Always Connected :** IoT devices love to stay connected, but to save energy they sometimes take small naps (sleep mode) and wake up only when needed.

- **Good at Teamwork:** They can talk to all kinds of other devices big or small, old or new without complaining about differences in hardware or software.
- **Adaptive in Nature:** Like a quick learner, an IoT device can adjust itself when situations change for example, a smart light getting brighter when the room gets dark.
- **Quietly Smart:** They don't just collect data; they process it to give meaningful insights like a fitness tracker telling you not just how many steps you walked, but how healthy your activity level is.
- **Scalable:** Whether you add one device or thousands, IoT systems are designed to grow without losing efficiency.
- **Energy Conscious:** They know how to save battery, turning off when not in use and waking up only when needed, just like an energy-efficient roommate.

Modern Applications

- Smart Grids and energy saving
- Smart cities
- Smart homes/Home automation
- Healthcare
- Earthquake detection
- Radiation detection/hazardous gas detection
- Smartphone detection

Advantages of IoT

- Improved efficiency and automation of tasks.
- Increased convenience and accessibility of information.
- Better monitoring and control of devices and systems.

Disadvantages of IoT

- Potential for hacking and data breaches.
- Collection and misuse of personal data.
- Significant initial investment required.

Smart cities:-

A smart city uses digital technologies and data to improve city functions, making them more efficient, sustainable, and livable for residents.

These cities leverage technologies like the [Internet of Things \(IoT\)](#), data analytics, and communication networks to enhance urban infrastructure and services, from traffic management and waste disposal to energy use and public safety.

The goal is to optimize city operations, promote economic development, and improve the overall quality of life for citizens.

Key components and characteristics

- **Digital infrastructure:** Smart cities are built on a foundation of high-speed internet, communication networks, and the Internet of Things (IoT) devices, which collect data in real-time.

- **Data-driven decision-making:** The data collected from sensors and other sources is analyzed to help city managers make informed decisions about how to operate services efficiently.
- **Enhanced efficiency:** Services like waste collection (e.g., a bin signaling when it's full), traffic flow, and energy distribution are optimized to reduce waste and cost.
- **Sustainability:** Smart cities focus on environmental sustainability through efficient resource management, such as smart grids and water systems.
- **Improved quality of life:** The use of technology aims to make cities safer, more accessible, and more responsive to the needs of their residents, including an aging population.
- **Citizen engagement:** Technology can be used to improve citizen services and encourage greater participation in city governance.

Examples of smart city initiatives

- [Intelligent traffic management systems](#) that adjust signals based on real-time traffic flow.
- [Smart waste management](#) systems that optimize collection routes.
- [Smart energy grids](#) that reduce consumption and improve distribution.
- [Sensor-based systems](#) that monitor air and water quality.

Industrial Internet of Things (IIoT) :-

The Industrial Internet of Things (IIoT) connects industrial machinery and sensors to the internet, using deep analytics to turn data into insights that improve efficiency, reliability, and safety. It focuses on machine-to-machine communication to optimize operations in industries like manufacturing, energy, and logistics. Key benefits include increased efficiency, smarter inventory management, and predictive maintenance, which help lower costs.

What it is

- **Interconnected systems:** IIoT involves networking industrial devices, sensors, and machines with analytics platforms.
- **Data-driven insights:** The system gathers and analyzes massive amounts of data to provide valuable insights that were previously unavailable.

- **Focus on operations:** Unlike the consumer-focused IoT, IIoT specifically aims to improve production and operational efficiency in industrial settings.

Key benefits

- **Increased efficiency:** Industries can optimize production processes, leading to lower capital and operating expenses.
- **Predictive maintenance:** IIoT can predict equipment failure before it happens, allowing for maintenance to be scheduled proactively, reducing downtime.
- **Improved safety:** Real-time data and connected systems can lead to a safer working environment for employees.
- **Smarter logistics:** Companies can track products in real-time throughout the supply chain, monitoring condition and location to prevent damage and improve delivery.
- **Enhanced asset management:** IIoT enables better tracking and monitoring of assets, from small sensors to complex machinery.

How it works

- **Data collection:** Sensors and devices collect data from the physical world, such as temperature, vibration, or location.
- **Data transmission:** This data is transmitted through a network to a central system or cloud platform.
- **Data analysis:** Analytics platforms process the data using technologies like machine learning to identify trends, anomalies, and opportunities for improvement.
- **Action and optimization:** Insights from the analysis are used to make real-time adjustments to industrial processes, improve decision-making, and optimize performance