Unit 3

Internet : The internet is a global network of interconnected computers that communicate and share data using standard communication protocols like TCP/IP.

In simple words, the internet is a worldwide system that connects millions of computers and allows users to exchange information, share resources, and communicate easily.

Key Features :
(i) Global Connectivity
(ii) Information sharing
(iii) Communication
(iv) Resource Access
(v) Standard Protocols

Uses of Internet :
- Email and Instant messaging
- Web browsing
- Online shopping and banking
- Education and Research
- Social Networking
- Entertainment

Q) Architecture of the Internet

The internet architecture refers to the structure and organization of how computers, networks, and devices are connected and communicate using standard protocols (mainly TCP/IP)

It is a layered architecture that makes data transmission efficient, secure, and reliable.

- Layers of Internet Architecture (TCP/IP Model)

The internet is commonly described using four layers:

(1.) Application layer : This is the top layer where users interact with internet services.

Function-

Provides network services like website, email, file transfer

Ex: HTTP / HTTPS, FTP, SMTP/POP3

(2.) Transport layer : Responsible for end-to-end communication between devices.

Functions -

- Breaks data into packets
- Ensures reliable delivery
- Reassembles packets at the receiver end.

Protocols: TCP (Transmission Control Protocol)
UDP (User Datagram Protocol)

3.) Internet layer : This layer defines how packets travels across networks.

Functions :-

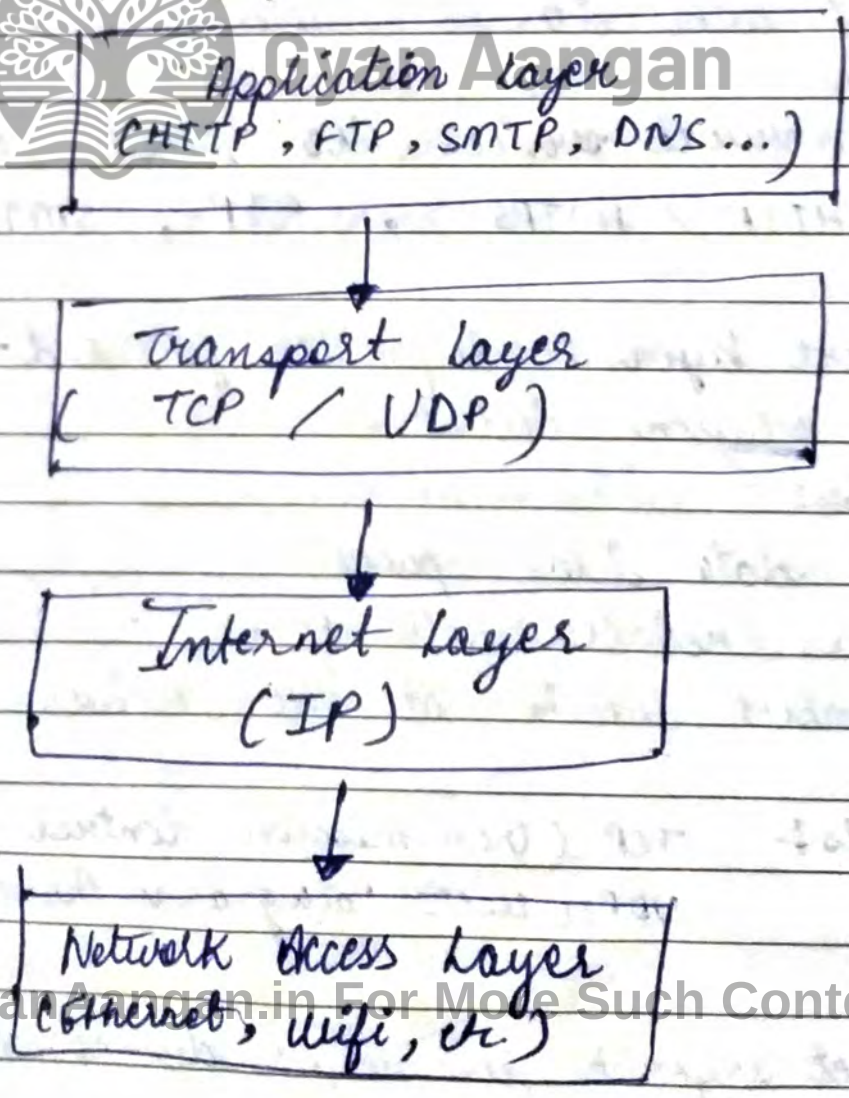
- Logical addressing using IP address
- Routing packets between networks

Protocol used :- IP (Internet Protocol)

(4.) Network Access layer :- This layer deals with physical transmission of data.

Functions :- • Sending data over actual hardware
• Frames, MAC address, NIC.

Diggram :-



Q ▶ Functioning of the Internet

The Internet works by transmitting data from one device to another across a global network using standard communication protocols (TCP/IP).

Step 1 : You send a request

When you open google or type a URL in a browser

- Your device creates a request for that webpage.

Step 2 : DNS Converts URL to IP Address

Computers understands IP addresses, not names.

- DNS (Domain Name System) converts www.google.com → 142.250.190.78
- This IP address identifies Google's server.

Step 3 : Data Packets are Created

Your request is broken into small pieces of data called packets.

Each packet contains :

- Sender address
- Receiver address
- Part of the message

Step 4 : Packets Travel Through Internet

Packets move through :-

- Routers
- Switches
- Gateways
- Undersea cable
- Wireless networks

Routers decide the best path for each packet.

Step 5: Server Processes the Request
Google's server recieves all packets and:
- Understands your request
- Fetches the webpage.
- Prepares a response
- Breaks it again into packets

Step 6: Packets Return to Your Device
Packets travel back through the internet using the best and fastest route.

Step 7: Your Browser Reassembles the Packets
Your device collect the packets and rebuilds the webpage.

Basic Internet Services

1. WWW (World Wide Web)
WWW is a system of interlinked hypertext documents (webpages) accessed through the Internet using a browser.
Features:
- Uses HTTP/HTTPS protocol
- Displays text, images, audio, video.
- Allows hyperlink navigation

2. FTP (File Transfer Protocol)
FTP is a standard protocol used to upload and dowload files between computers on the Internet.

Features:
- Supports two-way file transfer
- Faster than e-mail attachments
- Used for website maintenance and file sharing.

3. Telnet

Telnet is a protocol that allows remote login to another computer over the Internet.

Features :
- Text-based remote communication.
- Users can control another computer as if they are physically present
- Mostly replaced by SSH due to better security.

Used for :- Remote server management, testing, and network control.

4. Gopher

Gopher is an older Internet service that provides text-based menus to access documents and files.

Features :-
- Predecessor of the WWW
- Uses a menu system instead of hyperlink
- Mostly outdated today.

5. Search Engines

search engines are programs that help users find information on the Internet by typing keywords.

Functions :-
- Index web pages

- Display relevant results
- Provide filters for better searching

Examples: Google, Yahoo, Bing etc.

6. E-mail

E-mail is a service used to send and recieve electronic messages over the Internet.

Features:
- Fast and reliable
- Can attach files
- Uses SMTP, POP3, or IMAP

7. Web Browsers

A web browser is a software application used to acess and view webpages on the WWW.

Functions:
- Displays web content
- Allows navigation via hyperlinks
- Supports bookmarks, tabs, extensions

Q ▶ Internet of Things (IoT)

The internet of things (IoT) is a network of physical devices embedded with sensors, software and connectivity that enables them to collect and exchange data over the internet without human involvement.

IoT = Devices + Sensors + Internet + Smart Automation

Components of IoT system :

1.) Devices & sensors :

- A 'sensor' is an electronic device that detects changes in the environment (motion, temperature, light etc.) and converts them into data that the IoT system can understand.

- Sensors act like the eyes, ears and nose of IoT devices.

- Physical objects embedded with sensors or actuators collect data from the environment.

2.) Connectivity : Networks such as Wi-Fi, Bluetooth, Zigbee, LoRaWAN, or 5G that transmit data between devices, gateways, and cloud platforms

3.) Data Processing :

- Edge devices, gateways, or cloud platforms process and analyze collected data, often using AI or Big data technologies.

- This step transforms raw data into meaningful insights.

4.) User Interface (UI)

- Applications, dashboards, or mobile apps through which users interact with IoT systems.

- Interfaces can also trigger actuators to perform automated actions.

5.) Actuators

- These are components that perform physical actions based on the data or commands received.

Ex:- Motors, smart locks, alarms etc.

Function :- Convert digital signals into real-world actions.

Ans ▶ Types of Sensors

(i) Temperature sensor :- It is used to measure temperature.

Features :- High accuracy, fast response

Ex :- Thermostats, smart AC

(ii) Motion sensors :- It detects movement

Features :- Energy efficient, highly sensitive

Ex :- Security systems, automatic lights

(iii) Light Sensor (LDR) :- Detects light intensity.

Features :- Low cost, fast reaction

Ex :- Street lights, Smart homes

(iv) Humidity sensor :- Measures moisture level

Feature :- stable readings, used in weather monitoring

Ex :- Smart agriculture.

(v) Pressure sensor :- Detects air or water pressure

Feature :- High sensitivity

Ex :- Weather apps, Industrial Machines

(vi) Proximity Sensors :- Detects nearby objects.

Features :- Touchless sensing

Ex:- Cars, mobile phones

(vii) Gas sensor :- Detects gases (CO_2, LPG)

Features :- Ensures safety

Ex:- kitchens, industries.

(viii) Accelerometer :- Detects speed and movement.

Features :- Used in tracking.

(ix) Gyroscope :- Measures rotation

Ex:- Drones, gaming devices

(x) RFID Sensor :- Detects tagged objects via radio waves.

Feature :- Long-distance reading

Ex:- Toll gates, inventory tracking

Q ▶ Smart City

A smart city is an urban area that uses Information and Communication Technology (ICT) and Internet of Things (IoT) to collect, analyze, and use data in order to improve quality of life, public services, safety, and sustainability.

In simple words:

Smart City = City + Technology + Smart Services

Technology Used in Smart Cities

- Internet of Things (IoT)
- Sensors and smart devices
- Cloud computing
- Big data analytics
- Artificial Intelligence (AI)
- Wireless communication (Wi-Fi, 4G/5G)

Major Components of a Smart City

1. Smart Transportation
   - Intelligent Traffic Lights
   - GPS-based public transport tracking
   - Smart parking systems

2. Smart Energy
   - Smart meters
   - Solar energy systems
   - Efficient power distribution

3. Smart Governance
- E-governance services
- Online bill payments
- Digital public services

4. Smart Environment
- Air & water quality monitoring
- Waste management using smart bins
- Pollution control systems

5. Smart Healthcare
- Remote health monitoring
- Smart hospitals
- Emergency response systems

6. Smart Security
- CCTV surveillance
- Emergency alert systems
- Smart street lighting.

Advantages of Smart Cities

(i) Better traffic management
(ii) Reduced pollution
(iii) Energy Efficiency
(iv) Improved safety and security
(v) Better public services
(vi) Saves time and cost.

Disadvantages of Smart City

(i) High implementation cost
(ii) Data privacy and security issues
(iii) Dependence on technology
(iv) Need for skilled manpower

* In Short :-
A Smart City uses IoT and digital technologies to manage city resources efficiently, improve public services, and enhances citizens' quality of life.

Ans ▶ Industrial Internet of Things (IIOT)
Industrial Internet of Things refers to the use of IoT Technologies, sensors, machines, and data analytics in industrial environments to improve automation, productivity, efficiency, and safety.

Components of IIOT

(i) Industrial Sensors - Collect data
(ii) Machines & Equipments - CNC machines, robots, conveyors
(iii) Connectivity - Ethernet, Wi-Fi, 5G, Industrial protocols
(iv) Data Processing / Cloud - stores and analyze machine data
(v) Control systems - PLC, SCADA, actuators
(vi) User Interface - Dashboards for monitoring and control.

Applications of IIoT

1. Smart Manufacturing
   - Automated production lines
   - Real-time monitoring of machines
2. Predictive Maintenance
   - Detects machine faults before breakdown
   - Reduces downtime
3. Asset Tracking
   - Tracks tools, equipments, and inventory
4. Energy Management
   - Monitors Energy consumptions
   - Reduces wastage
5. Quality Control
   - Detects defects automatically
   - Improves product quality.

Benefits of IIoT

- Increased productivity
- Reduced operational cost
- Improved safety
- Less downtime
- Better decision-making using data

Date
Page

Challenges of IIoT

- High initial setup cost
- Cybersecurity risks
- Complex system integration
- Skilled workforce required

* In short :-
The Industrial Internet of Things (IIoT) uses connected sensors and machines in industries to enable smart manufacturing, predictive maintainance, and efficient industrial operations.