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| | | |
|--|---|-----------|
| Unit V | UBIQUITOUS CLOUDS AND THE INTERNET Of THINGS | (06 hrs) |
| <p>Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking.</p> | | |

Q5) a) Explain the architecture of Internet of Things? List down the enabling technologies used in IoT. [9]

b) Explain important features of ZigBee Technology. [9]

OR

Q6) a) Explain any one innovative Applications of the Internet of Things. [9]

b) Draw an architecture of RFID along with an application. [9]

- Q5)** a) Explain Cloud Mashups for Agility & Scalability in detail. [6]
b) Explain Data-Intensive Scalable Computing. Differentiate between Conventional Supercomputer and Data Intensive Scalable Computing. [6]
c) Write a short note on Wireless Sensor Networks (WSN). [6]

OR

- Q6)** a) Explain Social Networking site Twitter. [6]
b) Explain the different Technologies to build IOT infrastructure. [6]
c) Explain the Applications of the Internet of Things. [6]
i) Inventory Management
ii) Route Generation & Scheduling

- Q5) a) Explain Social Networking site Facebook. [6]
- b) Explain in detail the Cyber-Physical System. [6]
- c) Explain Benefits & Graph Properties of Social Network. [6]

OR

- Q6) a) Explain cloudlet. Differentiate between cloud & cloudlet. [6]
- b) Write a short note on RFID. [6]
- c) Write a short note on ZigBee Technology. [6]

- Q5)** a) List down the enabling technologies used in IoT. Explain any one application of using sensor networks in Internet of things. [9]
- b) Differentiate between active and passive tags used in RFID. [8]

OR

- Q6)** a) Write short note on Smart Power Grid. Explain with neat diagram. [9]
- b) What are different components of ZigBee. Explain the significance of each. [8]

- Q5)** a) Explain in detail NASA's Nebula Cloud. [6]
- ~~b)~~ Explain Supply Chain Management. [6]
- c) Explain the concept of FutureGrid. [6]

OR

- Q6)** a) Explain Social Networking site Twitter. [6]
- b) Explain the different Technologies to build IOT infrastructure. [6]
- c) Explain the Applications of the Internet of Things [6]
- i) Inventory Management
 - ii) Route Generation & Scheduling

Q5) a) What are different enabling technologies used in IoT. Explain any one application of Internet of things? [9]

b) What is ZigBee Technology. Explain different layers of the ZigBee protocol stack? [8]

OR

Q6) a) Explain applications of the Internet of Things used in Retailing and Supply-Chain Management. [9]

b) Draw an architecture of RFID along with an application. [8]

Cloud Trends in Supporting Ubiquitous Computing

💡 Ubiquitous Computing kya hota hai?

"Ubiquitous Computing" ka matlab hai – har jagah computer systems ka hona, bina dikhai diye kaam karte rehna. Jaise smart watches, smart TVs, Alexa, fitness bands – ye sab aapke aas-paas hote hain aur smartly kaam karte hain.

☁️ Cloud Computing ka kya role hai?

Cloud computing matlab – data aur applications ko internet ke zariye access karna, bina kisi heavy hardware ke. Jaise Google Drive, iCloud, AWS, etc.

↑ TOP Top Cloud Trends jo Ubiquitous Computing ko support kar rahe hain

| 📌 No. | 🔍 Cloud Trend | 📖 Description | 💡 Example / Use Case |
|-------|-----------------------------|---|---|
| 1 | Edge Computing | Data ko device ke paas hi process karna, cloud tak bhejne ki zarurat nahi | Smart cameras, self-driving cars |
| 2 | Hybrid Cloud | Public + Private cloud ka mix, flexible aur secure | Banks, hospitals, large organizations |
| 3 | Serverless Computing | Code chale bina servers manage kiye, auto-scaling support | Chatbots, background tasks, APIs |
| 4 | Cloud Security Enhancements | Cloud me advanced security tools (AI/ML) se protection | Secure IoT devices, access control |
| 5 | AI + Cloud Integration | Cloud pe AI models run karna, smart features add karna | Voice assistants, healthcare apps |
| 6 | Cloud-Native Applications | Apps jo specially cloud ke liye bani ho, easily scalable | Netflix, Zoom, online games |
| 7 | IoT + Cloud Connectivity | IoT devices ka real-time cloud se connect hona | Smart homes, smart cities, industrial IoT |

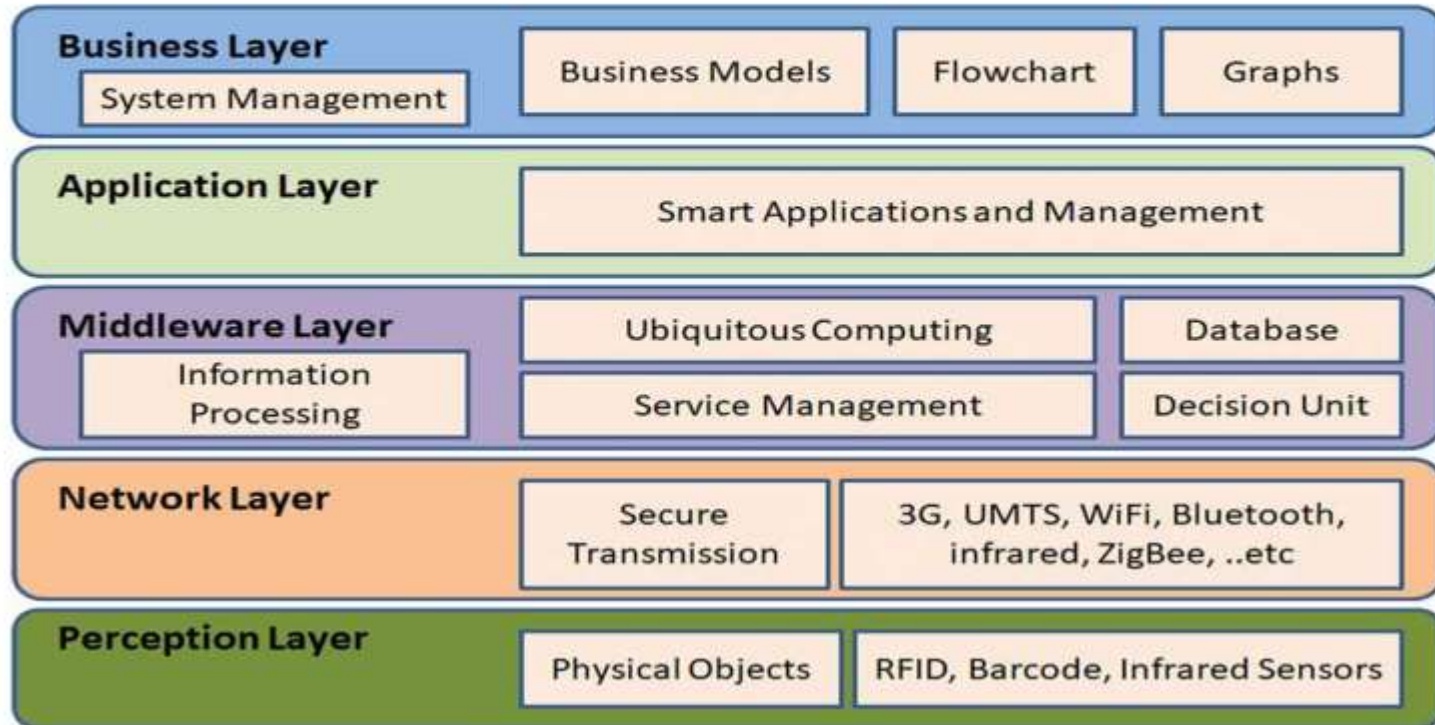
Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS)

Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking.

◆ Performance of Distributed Systems and the Cloud

| Sl. No. | Topic | Simple Explanation (Hinglish) |
|---------|---------------------|---|
| 1 | Scalability | System easily grow ya shrink ho sakta hai as per load |
| 2 | Load Balancing | Kaam ko multiple servers me equally baantna for better speed |
| 3 | Fault Tolerance | Agar ek part fail ho jaye, to system fir bhi kaam karta rahe |
| 4 | Latency | Data bhejne aur receive karne me lagne wala time (jitna kam ho utna better) |
| 5 | Resource Management | CPU, memory, storage ko efficiently use karna |
| 6 | Virtualization | Ek hi hardware pe multiple virtual systems run karwana |

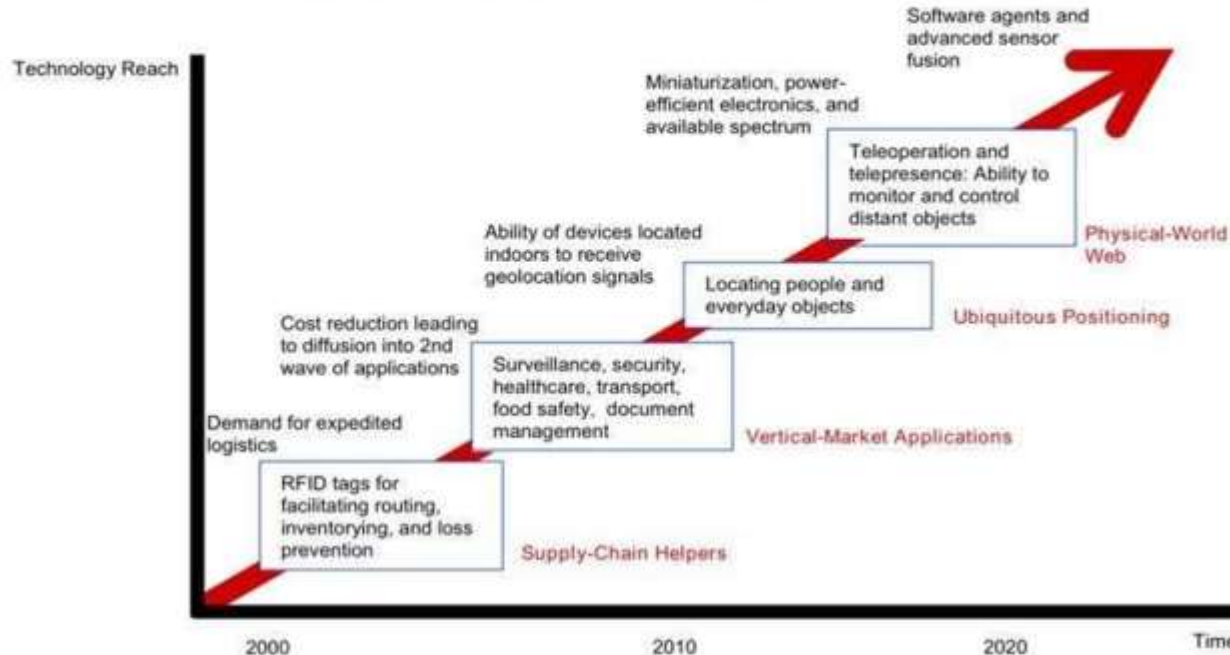
IoT Architecture



| 12 34 Layer Name | 📖 Explanation (Hinglish) | 🔍 Examples / Tech Used |
|---------------------|--|--------------------------------------|
| 1 Perception Layer | Ye layer real world se data collect karti hai sensors ya RFID ke through. | Sensors (Temp, Motion), RFID Tags |
| 2 Network Layer | Ye data ko perception layer se lekar Internet ya cloud tak bhejne ka kaam karti hai. | Wi-Fi, ZigBee, Bluetooth, 4G/5G |
| 3 Middleware Layer | Yahan data process, store aur analyze hota hai AI/ML ya cloud systems ke through. | Cloud Server, Big Data, AI, Database |
| 4 Application Layer | User ko final service ya output milta hai – app, dashboard ya system notifications ke form me. | Mobile App, Web Dashboard, Alerts |
| 5 Business Layer | Business logic apply hoti hai – jaise billing, reporting, profit analysis, alerts, etc. | Billing Systems, Analytics, CRM |

The Internet of Things : Enabling Technologies

TECHNOLOGY ROADMAP: THE INTERNET OF THINGS





Source: SRI Consulting Business Intelligence

| Enabling Technology | Description (Hinglish) |
|---|---|
| RFID | Object tracking ke liye radio waves use karta hai. |
| Sensor Networks | Multiple sensors se data collect karna aur share karna. |
| ZigBee | Low-power wireless communication standard for IoT devices. |
| GPS | Location tracking ke liye satellite-based system. |
| Connectivity (Wi-Fi, 5G, Bluetooth, etc.) | Devices ko network se connect karna. |
| Cloud Computing | Data store aur process karne ke liye online servers. |
| Edge Computing | Data processing device ke paas karna for faster response. |
| Big Data Analytics | Collected data ka analysis karke insights nikalna. |
| Artificial Intelligence (AI) & Machine Learning | Smart decision making ke liye data se seekhna. |
| Security | IoT systems ko protect karne ke liye encryption aur authentication. |

◆ Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS)

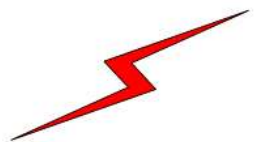
◆ RFID Kya Hota Hai?

RFID (Radio Frequency Identification) ek wireless technology hai jo **radio waves** ka use karke objects, animals, ya logon ko identify karne ke kaam aati hai.

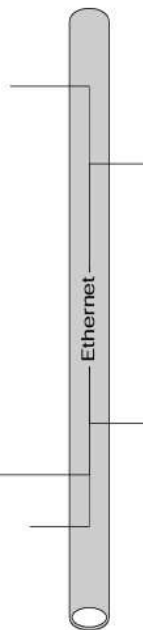
-  Aapka college ID card, toll plaza tag, ya product barcode RFID ka example ho sakta hai.
-  RFID se contactless identification hota hai – **scan karne ki zarurat nahi**, bas paas lana padta hai.



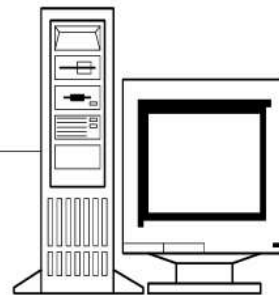
RFID Tag



RF Antenna

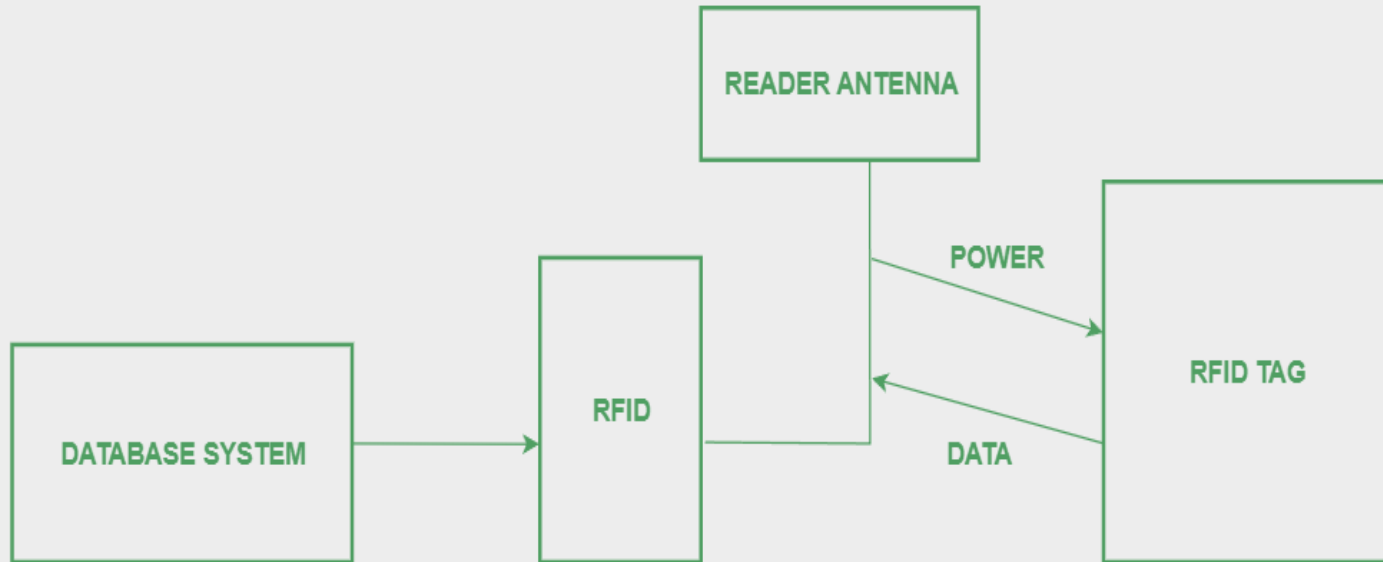


Network



Workstation

| Component | Description (Hinglish) |
|-------------|--|
| RFID Tag | Ek chhota transponder (radio receiver aur transmitter) jo uss object ke saath chipka hota hai jise track karna hota hai. |
| RFID Reader | Ek device jo radio waves emit karta hai taaki tag ko energize kar sake aur wapas data receive kar sake. |
| Antenna | Reader aur tag dono radio waves bhejne aur receive karne ke liye antenna ka use karte hain. |
| Data | RFID tags mein simple serial number se lekar complex inventory information tak ka data store ho sakta hai. |



🔄 Working of RFID System – Simple Steps

1. RFID Reader radio signals bhejta hai.
2. Paas mein rakha **Tag** us signal ko receive karke apna ID bhejta hai.
3. Reader ye ID **Backend System** ko bhejta hai.
4. Backend system us ID ko identify karke info display karta hai.

| Area | Use Case (Hinglish) |
|---------------------------|--|
| 🏪 Retail | Products ke upar RFID lagake fast billing aur inventory tracking |
| 🏭 Manufacturing | Machines aur parts ka real-time monitoring |
| 🚗 Transportation | Toll collection (FASTag), vehicle tracking |
| 📖 Libraries | Books ko auto-track karna aur easy check-in/out |
| 🏥 Healthcare | Patients aur equipment ka tracking aur safety |
| 🏢 Office/College Security | Access control using RFID-enabled ID cards |
| 🐄 Animal Tracking | Cattle/farm animals ki health aur location monitor karna |

| Tag Type | Description (Hinglish) |
|--------------|--|
| Passive Tags | Reader ke radio waves se power lete hain, inme battery nahi hoti. |
| Active Tags | Inme battery hoti hai, jo data zyada frequently aur lambi distance tak transmit kar sakti hai. |

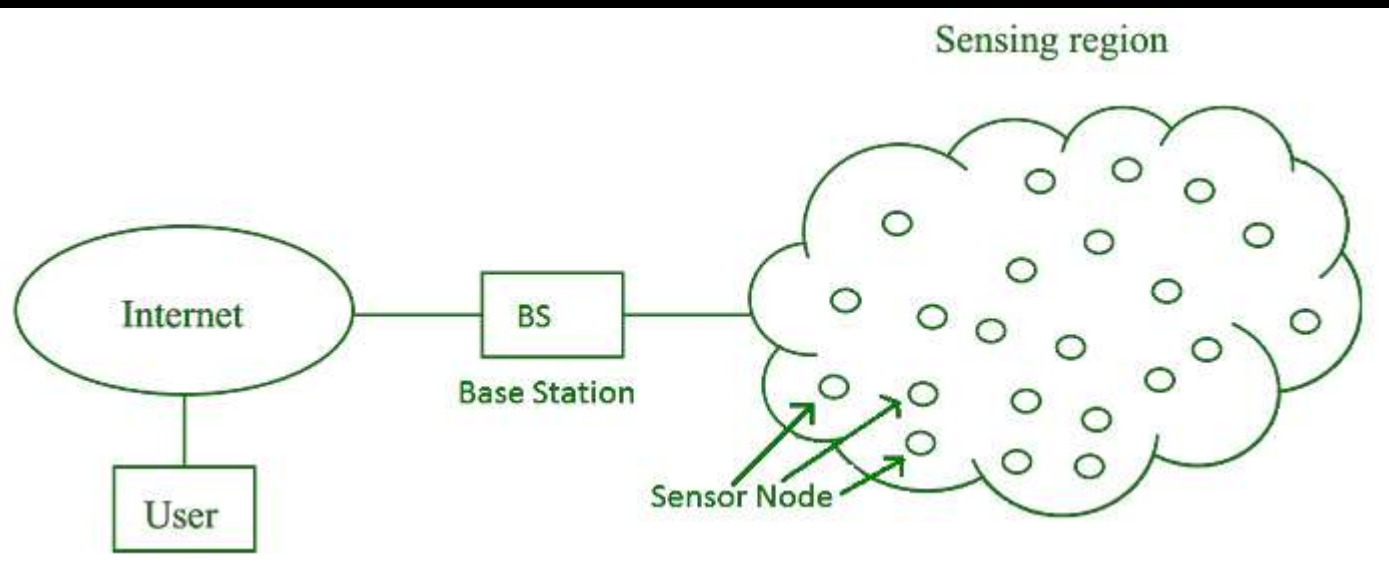
b) Differentiate between active and passive tags used in RFID.

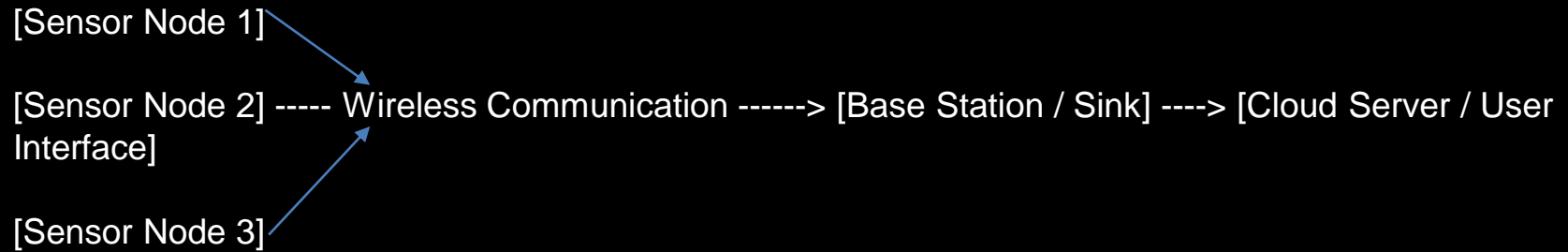
| Feature | Active Tags | Passive Tags |
|-----------------|---|--|
| Power Source | Inke paas apni battery hoti hai. | Reader ke signal se power milti hai (no battery). |
| Range | Long range (up to 100 meters ya zyada) | Short range (typically 1-5 meters) |
| Signal Strength | Strong signal bhej sakte hain due to battery power. | Weak signal — sirf jab reader pass ho. |
| Lifespan | Battery khatam hone tak kaam karte hain (2-5 years approx.) | Zyada life – kyunki koi battery nahi hoti. |
| Size & Cost | Thode bade aur mehange hote hain. | Chhote aur saste hote hain. |
| Data Storage | Zyada data store kar sakte hain. | Limited data storage capacity hoti hai. |
| Usage Example | Vehicle tracking, high-value asset tracking. | Library books, retail inventory, access cards. |

| Application | Description (Hinglish) |
|-------------------------|--|
| Inventory Management | Retail, warehouse, aur logistics mein maal ka tracking aur management. |
| Supply Chain Management | Production se lekar delivery tak goods ki tracking. |
| Access Control | Buildings aur facilities mein entry aur access control karna. |
| Pet Tracking | Pets ki pehchaan aur tracking. |
| Healthcare | Patients aur medical equipment ka tracking. |
| Manufacturing | Factory floor par parts aur tools ki tracking. |
| Logistics | Shipments aur packages ka tracking. |

What is WSN?

WSN (Wireless Sensor Network) sensors ka ek group hota hai jo wireless network ke through data collect karta hai aur ek central point (base station) ko bhejta hai. Ye mainly environment monitoring aur real-time data gathering ke liye use hota hai.





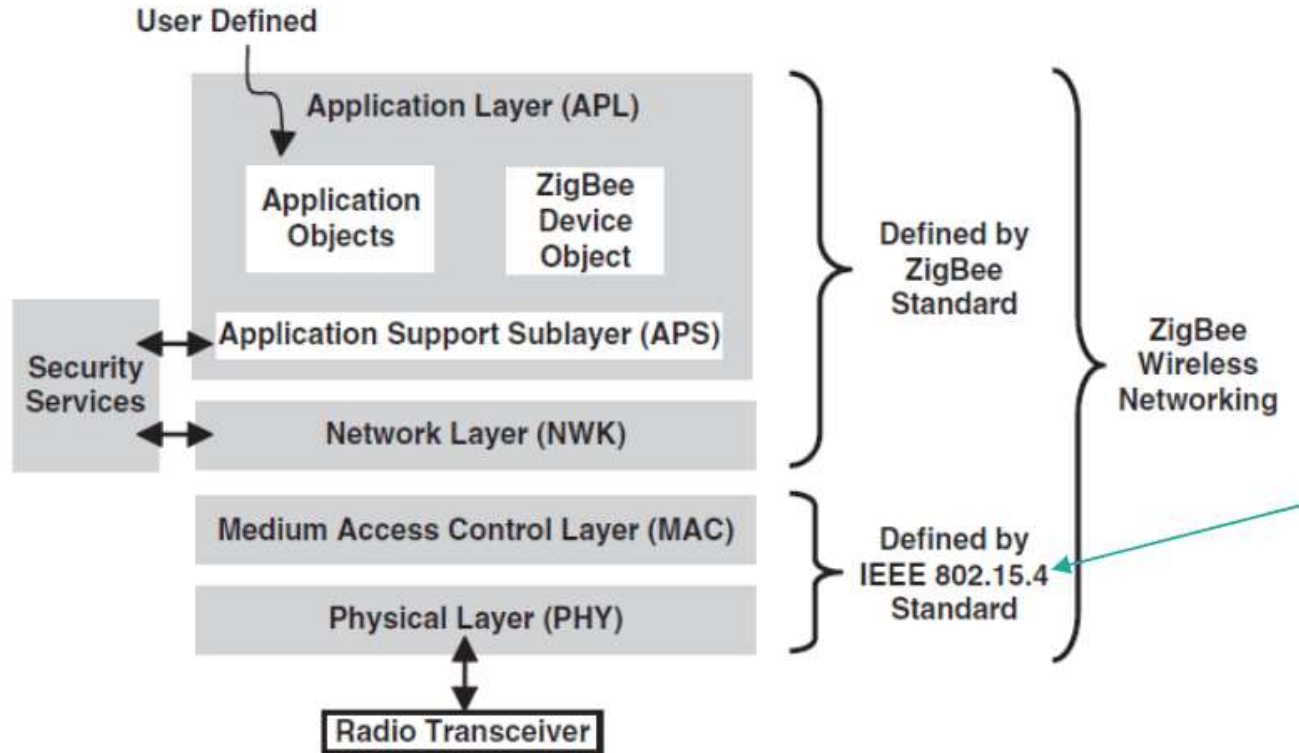
WSN Architecture

| Component | Description (Hinglish) |
|---------------------|---|
| Sensor Nodes | Chhote devices jo environment se data sense karte hain (jaise temperature, light, motion). |
| Transceiver Module | Wireless communication ke liye responsible (Wi-Fi, ZigBee, Bluetooth). |
| Microcontroller | Sensor data process karta hai aur communication control karta hai. |
| Power Source | Battery ya energy harvesting device jo sensor ko power deta hai. |
| Base Station (Sink) | Sabse central point jahan saara data collect hota hai aur user ya cloud system ko bheja jata hai. |

| Application Area | Description (Hinglish) |
|--------------------------|--|
| Environmental Monitoring | Temperature, humidity, pollution, forest fire detection jaise natural environment ka monitoring. |
| Healthcare | Patients ki health monitoring, body sensors se vital signs collect karna. |
| Industrial Automation | Factory machines ki condition monitoring aur fault detection. |
| Agriculture | Soil moisture, temperature monitoring for better crop management. |
| Military | Battlefield surveillance, enemy movement detection. |
| Smart Homes / Buildings | Energy management, security systems, lighting control using sensor data. |

ZigBee Technology

- **ZigBee** ek low-power, low-data-rate wireless communication protocol hai, jo mainly short-range IoT devices aur sensor networks ke liye design kiya gaya hai.
- Ye IEEE 802.15.4 standard par based hai, aur smart homes, automation, aur industrial control mein bahut popular hai.



ZigBee Wireless Networking Protocol Layers

| Layer | Description (Hinglish) |
|---|---|
| Physical Layer (PHY) | Radio frequency transmission ke liye hardware layer, jo 2.4 GHz, 900 MHz ya 868 MHz bands use karti hai. |
| MAC Layer | Medium Access Control, data transmission ko manage karta hai aur collision avoid karta hai. |
| Network Layer (NWK) | Devices ko network mein join karna, routing, aur data packet forwarding ka kaam karta hai. |
| Application Layer | Application profiles define karta hai jise smart lighting, home automation, etc. ke liye use kiya jata hai. |
| Application Support Sublayer (APS) | Application data ko manage karta hai aur devices ke beech communication ko control karta hai. |

| Feature | Explanation (Hinglish) |
|-----------------------|--|
| Low Power Consumption | ZigBee devices kam power use karte hain, battery lambi chalti hai. |
| Short Range | Typically 10-100 meters tak communication hota hai. |
| Low Data Rate | Data rate 20-250 kbps tak hota hai, jo sensors ke liye kaafi hai. |
| Mesh Networking | Devices ek dusre se connect hokar network banate hain, range badhta hai. |
| Security | AES-128 encryption use hoti hai secure communication ke liye. |
| Cost Effective | Low cost hardware aur implementation easy hai. |
| Scalability | Hundreds tak devices ek network mein easily connect ho sakte hain. |
| Reliability | Mesh network ki wajah se data delivery zyada reliable hoti hai. |

□ **Example Samjho:**

Agar ek ZigBee sensor temperature data bhej raha hai:

- 1.Application Layer** – Sensor application data generate karega (jaise 30°C).
- 2.APS Layer** – Ye data ko organize karega aur send karne ke liye ready karega.
- 3.Network Layer** – Decide karega ki data kis path se router/coordinator tak jayega.
- 4.MAC Layer** – Timing decide karega kab data bhejna hai aur collision avoid karega.
- 5.Physical Layer** – Radio signal ke form mein data wireless bhejega.

ZigBee Device Types

| Device Type | Description (Hinglish) |
|-------------|---|
| Coordinator | Network ka central device, jo network banata hai aur devices ko manage karta hai. |
| Router | Data packets ko forward karta hai aur network coverage extend karta hai. |
| End Device | Simple device jo sirf data send/receive karta hai, network routing mein involved nahi hota. |

| Application Area | Description (Hinglish) |
|------------------------------|---|
| Home Automation | Smart lighting, HVAC control, security systems. |
| Industrial Automation | Machine monitoring, control systems. |
| Smart Metering | Electricity, water, gas metering with remote data collection. |
| Healthcare | Patient monitoring devices with low power consumption. |
| Remote Controls | Wireless remote controls for various devices. |

GPS (Global Positioning System)

🌐 What is GPS?

GPS ek satellite-based navigation system hai jo kisi bhi object, vehicle, ya person ki exact **location (latitude, longitude, altitude)** provide karta hai – anywhere on Earth, 24/7.

📶 GPS Architecture

| Component | Description (Hinglish) |
|-----------------|--|
| Space Segment | 24+ satellites jo Earth ke around ghoomte hain aur signals broadcast karte hain. |
| Control Segment | Ground stations jo satellites ko monitor aur control karte hain. |
| User Segment | GPS receivers (mobile phones, vehicles, IoT devices) jo satellite signals ko receive karte hain aur location calculate karte hain. |

❑ **How GPS Works (Basic Flow):**

1. GPS receiver (jaise phone ya tracker) kam se kam **4 satellites** ka signal receive karta hai.
2. Signal mein timing info hoti hai — isse receiver tak signal aane mein lagne wala time calculate hota hai.
3. Is time difference se receiver aur satellite ke beech ki distance nikalta hai.
4. 3 satellites se distance se 2D location (lat, long) aur 4th satellite se accurate time ya altitude milta hai.

| Application Area | Description (Hinglish) |
|---------------------|--|
| Navigation Systems | Vehicles, ships, aircrafts ke liye real-time location tracking and route planning. |
| Smartphones | Maps, ride-booking apps (Ola, Uber), food delivery, etc. mein location services. |
| Logistics & Fleet | Goods aur delivery vehicles ki real-time tracking. |
| Agriculture | Precision farming — correct location pe seeds, fertilizers apply karna. |
| Disaster Management | Rescue operations mein location trace karna, affected areas ka mapping. |
| Military | Missile guidance, troop movement, and enemy tracking. |

Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System)

| Application Area | Description (Hinglish) | Example |
|--|--|--|
| Smart Buildings | Sensors aur IoT devices se building ka automation hota hai (lighting, AC, security, etc). | Smart offices jahan lights automatic on/off hote hain based on presence. |
| Smart Power Grid | Electricity grid mein IoT use karke real-time monitoring aur energy efficiency improve hoti hai. | Smart meters jo real-time usage track karte hain aur remote billing bhejte hain. |
| Retailing and Supply-Chain Management | Goods ka tracking, inventory control aur customer behavior analysis IoT ke through hota hai. | Amazon warehouses mein RFID & sensors se real-time inventory management. |
| Cyber-Physical Systems (CPS) | Physical devices + digital systems milke intelligent control systems banate hain. | Self-driving cars ya smart manufacturing robots jo real-time react karte hain. |

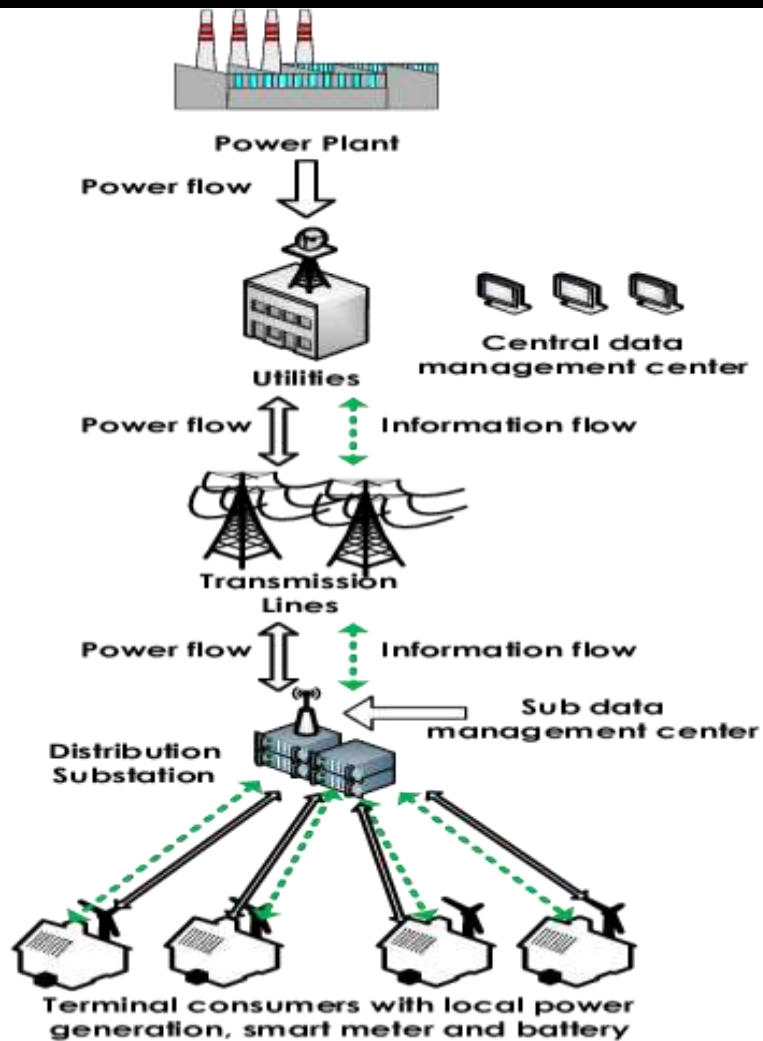
IoT in Smart Buildings

| Feature / Area | Description (Hinglish) | Example |
|--------------------------|--|---|
| Smart Lighting | Motion sensors detect presence aur lights automatic on/off ho jaate hain. | Office ya home mein light tabhi jalti hai jab koi room mein hota hai. |
| HVAC Control | Temperature aur humidity sensors se AC/fan auto adjust hota hai for comfort. | Smart thermostats like Nest jo temp ko auto maintain karte hain. |
| Security & Surveillance | IoT-enabled cameras aur smart locks se building ka security automate hota hai. | Smart CCTV cameras jo mobile app se access kiye ja sakte hain. |
| Energy Management | Sensors aur data analysis se electricity ka usage track karke wastage reduce hota hai. | Smart meters jo usage report karte hain aur alerts bhejte hain. |
| Access Control | RFID, biometric ya mobile app se authorized log hi entry le sakte hain. | Smart locks jisme fingerprint ya RFID card se access milta hai. |
| Fire & Safety Monitoring | Smoke detectors, gas leak sensors emergency detect karke alert bhejte hain. | Building mein smoke detector automatically fire alarm on kar deta hai. |
| Water Management | IoT sensors water usage aur leakage detect karte hain. | Smart taps ya water leak detector jo alert dete hain leakage par. |

Write short note on Smart Power Grid. Explain with neat diagram

Definition:

A **Smart Power Grid** is a modern electricity network that uses **IoT sensors**, **automation**, and **communication technology** to efficiently generate, transmit, distribute, and monitor electricity.



**Smart Power
Grid Architecture
Diagram:**

| Component | Description (Hinglish) |
|-----------------------|---|
| Power Generation | Electricity produce hoti hai using sources like coal, hydro, solar, wind, etc. |
| Transmission Network | High-voltage lines jo electricity ko long distances tak bhejte hain. |
| Distribution Network | Low-voltage lines jo electricity ko consumers tak pahunchate hain. |
| Smart Meters | Devices jo real-time energy usage monitor karte hain aur data utility ko bhejte hain. |
| Control Centers | Central hubs jo grid operations monitor aur control karte hain. |
| Renewable Integration | Solar panels aur wind turbines jo grid mein energy feed karte hain. |
| Consumers | End-users jo electricity consume karte hain; ab prosumers bhi ban sakte hain (produce + consume). |

⚡ Smart Power Grid

| Feature / Area | Description (Hinglish) | Example |
|--|---|---|
| Real-Time Monitoring | Grid sensors real-time data detect karte hain (voltage, load, fault, etc.). | Agar kahin overload ho raha hai to system turant detect kar leta hai. |
| Smart Metering | Users ke electricity usage ka data real-time mein collect hota hai aur remote se accessible hota hai. | Smart meter jo app pe electricity bill aur usage dikhata hai. |
| Two-Way Communication | Consumers aur utility dono ek dusre ko data bhej sakte hain (demand-response system). | Consumer bhi feedback de sakta hai power company ko via app. |
| Fault Detection & Isolation | Fault location detect kar ke us part ko isolate kar diya jaata hai to prevent blackout. | Ek area mein short circuit hua to sirf wahi area ka power cut hota hai. |
| Load Balancing | Demand ke hisaab se electricity distribute ki jaati hai to prevent overload. | Zyada load hone par kuch loads ko auto shift kar diya jaata hai. |
| Renewable Integration | Solar, wind energy jaise sources ko grid ke saath integrate kiya jaata hai. | Ghar ke solar panels se extra power grid mein bheji ja sakti hai. |
| Remote Control | Grid operations remotely manage kiye ja sakte hain using IoT and software. | Engineer bina site jaaye remotely transformer on/off kar sakta hai. |

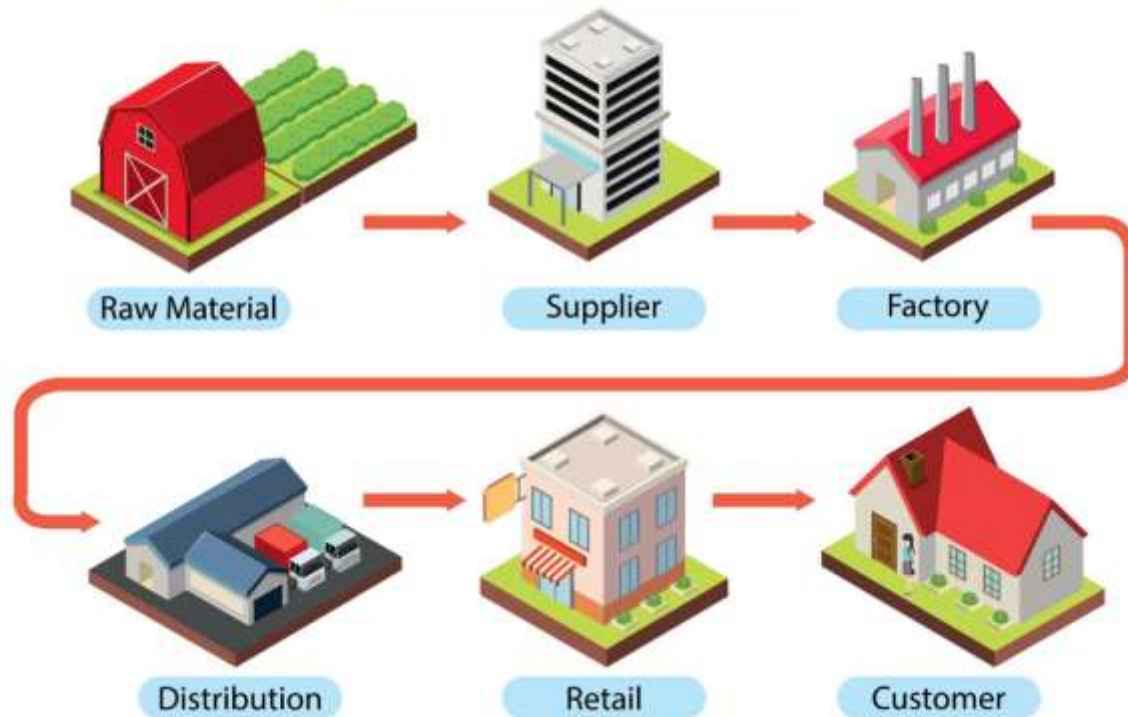
✓ **Advantages:**

- Improved **reliability** and **efficiency**.
- Reduced **power outages**.
- Better **energy management**.
- Support for **green energy**.
- Enhanced **consumer control** over energy usage.

Retailing and Supply-Chain Management (SCM)

| Topic | Explanation |
|-------------------------|---|
| Retailing | Products ko customer tak pohunchane ka process — shop se lekar online tak sab include hota hai. |
| Supply-Chain Management | Raw materials se lekar final product delivery tak ka poora process manage karna. |
| Goal | Inventory optimize karna, delivery fast aur accurate karna, aur cost kam karna. |

Supply Chain



📦 Supply Chain Management (SCM) kya hai?

Supply Chain Management ka matlab hai poore process ko manage karna jisme raw materials lekar final product customer tak pohchaya jata hai. Is process mein kai stages hoti hain jaise sourcing, production, inventory management, transportation, aur delivery.

SCM ka main goal hota hai ki products sahi time pe, sahi quantity mein, sahi condition mein, aur cost-effective tareeke se customer tak pohche.

🔑 Supply Chain Management ke Important Parts:

- **Sourcing:** Raw materials ko suppliers se lena.
- **Production:** Raw materials ko final product mein convert karna.
- **Inventory Management:** Stock ka control aur management.
- **Warehousing:** Products ko safely store karna.
- **Transportation:** Goods ko ek jagah se dusri jagah bhejna.
- **Distribution:** Products ko customers tak deliver karna.
- **Returns Management:** Defective ya unwanted products ko wapas lena.

Supply Chain Management ke Benefits:

- Cost kam hoti hai.
- Delivery faster aur reliable hoti hai.
- Customer satisfaction badhta hai.
- Inventory management improve hota hai.
- Business operations efficient hote hain.

- Suppliers:** Provide raw materials needed for production.
- Manufacturers:** Convert raw materials into finished products.
- Distributors:** Handle the storage and transportation of products.
- Retailers:** Sell the products to end consumers.
- Consumers:** The final users of the products.

💡 Applications of IoT in Retailing and Supply Chain

| Application | Description (Hinglish) | Example |
|------------------------------|--|---|
| 1. Inventory Management | Real-time stock tracking aur automatic reorder system. | Walmart stores mein smart shelves jo stock khatam hone par alert bhejte hain. |
| 2. Asset Tracking | Goods ki location aur condition track karna during transport. | DHL ke delivery trucks GPS se track hote hain. |
| 3. Cold Chain Monitoring | Temperature-sensitive products ke liye temperature monitor karna. | Nestlé dairy products ko refrigerated trucks mein monitor karna. |
| 4. Supply Chain Visibility | End-to-end goods ka transparent tracking. | Amazon supply chain mein live shipment tracking. |
| 5. Predictive Maintenance | Machines aur equipment failures predict karna to avoid downtime. | Conveyor belt sensors factories mein maintenance alerts bhejte hain. |
| 6. Automated Warehousing | Robots aur automated guided vehicles (AGVs) se warehouse operations. | Flipkart ke warehouses mein automated picking and packing. |
| 7. Smart Customer Experience | Personalized offers aur smart checkout systems. | Stores mein RFID-based automatic billing jaise Amazon Go. |
| 8. Demand Forecasting | Real-time data se demand prediction aur stock optimization. | Retailers like Big Bazaar apne sales trends analyze karte hain. |

□ Cyber-Physical System (CPS)

| Term | Explanation |
|------------------------------------|---|
| Cyber-Physical System (CPS) | A system jisme physical components (machines, sensors) aur cyber components (software, networks) tightly connected hote hain real-time data exchange ke liye. Yeh system physical world ko monitor aur control karta hai using computer-based algorithms. |

| Layer | Description (Hinglish) |
|-------------------|---|
| Perception Layer | Physical world se data collect karta hai through sensors, actuators, GPS, etc. |
| Network Layer | Data ko transmit karta hai from perception layer to processing units using communication protocols. |
| Processing Layer | Collected data ko process karta hai using computing devices aur cloud platforms. |
| Application Layer | Processed data ko use karke decisions leta hai for controlling physical processes. |
| Business Layer | IoT data ko business strategies aur operations mein integrate karta hai. |

Q Key Features of CPS

- Real-time monitoring aur control.
- Integration of hardware (sensors, actuators) aur software.
- Feedback loops jisme physical system se data cyber system ko milta hai aur control signals bheje jaate hain.
- Used in complex systems jaha automation aur reliability zaroori hai.

| Application | Description (Hinglish) | Example |
|------------------------|---|---|
| Smart Grid | Power grid jisme electricity supply real-time monitor aur control hota hai. | Smart meters aur grid automation systems. |
| Autonomous Vehicles | Self-driving cars jo sensors aur AI se control hote hain. | Tesla ka autopilot system. |
| Industrial Automation | Factories mein machines aur robots ka automated control. | Smart manufacturing plants with robotic arms. |
| Healthcare Systems | Remote patient monitoring aur medical devices ka integration. | Wearable health monitors jo doctor ko data bhejte hain. |
| Smart Buildings | Buildings jisme lighting, temperature, security systems automated hain. | Automated HVAC aur smart lighting systems. |
| Aerospace Systems | Aircraft ke control aur monitoring systems real-time work karte hain. | Flight control systems in modern airplanes. |
| Agriculture Automation | Farm machines aur irrigation systems automated aur monitored hote hain. | Drones for crop monitoring, automated irrigation systems. |
| Transportation Systems | Traffic signals, public transport systems real-time control mein hote hain. | Intelligent traffic management systems. |

Online Social and Professional Networking.

a) Explain Social Networking site Twitter.

[6]

Explain Social Networking site Facebook.

Explain Benefits & Graph Properties of Social Network.



| Feature/Aspect | Explanation (Hinglish) |
|-----------------------|--|
| Purpose | Short messages (tweets) share karna, news aur updates ke liye. |
| Character Limit | Tweets mein max 280 characters hote hain. |
| Followers & Following | Users ko follow kar sakte ho aur apne followers hote hain. |
| Real-time Updates | Latest news, trends, aur live events pe focus. |
| Hashtags | Topics ko categorize karne ke liye hashtags (#) use hote hain. |
| Retweet | Kisi aur ke tweet ko apne followers ke saath share karna. |
| Trending Topics | Popular aur current topics dikhata hai. |
| Direct Messaging (DM) | Private messages send karne ka option. |

Facebook

| Feature/Aspect | Explanation (Hinglish) |
|---------------------|---|
| Purpose | Friends aur family ke saath connect hona, photos aur updates share karna. |
| Profile & Timeline | User ka personal profile aur timeline jahan posts dikha sakte hain. |
| Friends System | Users ko friend request bhejne aur accept karne ka system. |
| Groups & Pages | Communities aur business pages create karna. |
| Events | Events create aur attend karne ke liye feature. |
| Messenger | Facebook ka built-in chat system for private messaging. |
| Photo/Video Sharing | Photos aur videos upload karna. |
| News Feed | Friends aur pages ke updates ka feed. |

Benefits of Social Media

| Benefit | Explanation (Hinglish) |
|-----------------------|--|
| Connectivity | Log duniya ke kisi bhi kone se connect ho sakte hain. |
| Information Sharing | Jaldi aur easily news, updates, aur knowledge share kar sakte hain. |
| Community Building | Similar interests wale log groups ya communities bana sakte hain. |
| Marketing & Promotion | Businesses apne products/services ko promote kar sakte hain. |
| Customer Engagement | Direct feedback aur communication customers ke saath possible hota hai. |
| Education & Awareness | Awareness campaigns aur educational content spread karna asaan hai. |
| Entertainment | Videos, memes, games, aur other entertainment forms available hain. |
| Career Opportunities | Job search, professional networking (LinkedIn jaise platforms) hota hai. |

🔍 Graph Properties of Social Media Networks

| Property | Explanation (Hinglish) |
|-------------------------------|---|
| Nodes (Vertices) | Har user ya profile ek node hota hai network mein. |
| Edges (Links) | Connections (friendship, following) ko edges kehte hain. |
| Degree | Ek node ke connections ki sankhya (kitne friends ya followers hain). |
| Directed vs Undirected | Twitter jaise networks mein edges directed hote hain (follow karna), Facebook mein undirected (friendship). |
| Weighted Edges | Kuch connections zyada important ya active ho sakte hain (weight assign hota hai). |
| Clusters / Communities | Nodes groups mein organize hote hain jinka common interest hota hai. |
| Path Length | Do nodes ke beech sabse chhota connection route ka distance. |
| Centrality | Important nodes jinse zyada connections ya influence hota hai. |

Explain Cloud Mashups for Agility & Scalability in detail.

Cloud Mashups kya hote hain?

Cloud Mashups ek tarah ke web applications hote hain jo multiple cloud services ya APIs ko combine karke banaye jaate hain. Matlab, alag-alag sources se data aur functionalities ko integrate karke ek naya useful application create karna. Ye mashups cloud environment mein bante hain jisme resources dynamically allocate hote hain.

Agility ka matlab kya hai?

Agility ka matlab hai system ka tez aur flexible hona — matlab ki jaldi se naye features add karna, naye services integrate karna, aur market ke changes ke hisaab se turant adapt karna.

Scalability ka matlab kya hai?

Scalability ka matlab hai system ka apne resources ko badha ya ghata sakna, jaise ki user load badhne par server capacity badha dena, ya kam hone par reduce kar dena, bina performance degrade kiye.

☁️⚡ Cloud Mashups for Agility & Scalability kaise kaam karte hain?

| Aspect | Explanation (Hinglish) |
|-----------------------------|--|
| Modular Integration | Cloud mashups alag-alag services ko modules ki tarah integrate karte hain. Isse jaldi development hota hai. |
| Reuse of Services | Existing cloud services (jaise Google Maps, payment gateways) reuse kiye jaate hain, time aur cost bachta hai. |
| Dynamic Resource Allocation | Cloud platforms automatically resources (CPU, memory) allocate karte hain jab demand badhti hai, scalability achieve hoti hai. |
| On-Demand Computing | Mashups cloud par run karte hain, isliye users ko apne hardware ka tension nahi, aur load ke hisaab se scale hota hai. |
| Fast Deployment | Cloud mashups ko quickly deploy kar sakte hain without complex infrastructure setup. |
| Flexible Architecture | Mashups easily naye APIs ya services add ya remove kar sakte hain, jis se agility banti hai. |
| Cost Efficiency | Pay-as-you-use model ki wajah se sirf jitna use kiya uska hi charge aata hai, unnecessary resources waste nahi hote. |
| Real-Time Updates | Services ke beech data aur functionalities real-time mein share hote hain, jo decision making ko improve karta hai. |



Example:

Maan lo ek e-commerce website ko chahiye:

- User location ke liye **Google Maps API** integrate karna,
 - Payment ke liye **PayPal API** use karna,
 - Product reviews ke liye ek alag review service.
- Ye sab cloud mashup se easily integrate ho jata hai, aur user demand ke hisaab se backend cloud servers apne aap scale kar lete hain.

Explain Data-Intensive Scalable Computing. Differentiate between Conventional Supercomputer and Data Intensive Scalable Computing

📄 What is Data-Intensive Scalable Computing (DISC)?

DISC ek computing model hai jo **bahut zyada data (Big Data)** ke saath deal karta hai. Isme data ko **distribute** karke **parallel processing** hoti hai taaki system easily **scale** kar sake — yani demand ke hisaab se expand ho sake.

Example: Google, Facebook, Amazon — ye sab DISC use karte hain to handle tera-bytes ya peta-bytes of data.

🔄 Key Features of DISC (Hinglish mein):

| Feature | Explanation (Hinglish) |
|------------------------------|---|
| Distributed Systems | Data ko multiple servers mein tod tod ke process kiya jata hai. |
| Parallel Computing | Ek saath multiple tasks process hote hain, time bachaate hain. |
| Scalable Architecture | Easily servers add/remove karke system expand ho sakta hai. |
| Fault Tolerance | Agar ek node fail ho jaye, system fir bhi chal sakta hai. |
| Data-Driven | Focus hota hai large-scale data processing par. |

❌❑ DISC vs Conventional Supercomputers (Comparison in Table – Simple Hinglish)

| Feature | Conventional Supercomputer | Data-Intensive Scalable Computing (DISC) |
|------------------------|---|--|
| Purpose | Complex scientific calculations (physics, weather simulation) | Large data ko process aur analyze karna (Big Data) |
| Focus | High processing power | High data volume handling |
| Architecture | Centralized, tightly coupled system | Distributed, loosely coupled system |
| Hardware | Expensive, custom-built machines | Commodity (normal) hardware with cloud or cluster setup |
| Scalability | Limited scalability | Highly scalable (nodes easily add/remove kar sakte hain) |
| Fault Tolerance | Kam (agar ek component fail ho jaye toh system ruk sakta hai) | Zyada (data replicate hota hai alag nodes pe) |
| Examples | IBM Summit, Cray Supercomputer | Hadoop, Spark, Google File System, Amazon EC2 |
| Cost | Bahut mehnga | Comparatively sasta (scale karne par bhi cost-efficient) |

Explain the different Technologies to build IOT infrastructure.






| Technology | Explanation (Hinglish) |
|----------------------|--|
| RFID | Wireless tags aur readers ka use karke objects ko track aur identify karte hain. |
| WSN (Sensor Network) | Multiple sensors environment se data collect karke ek central system tak bhejte hain. |
| ZigBee | Low-power wireless protocol jo smart home devices aur automation ke liye use hota hai. |
| Wi-Fi | High-speed internet se devices ko connect karke data transfer karta hai. |
| Cloud Computing | IoT devices se aayi data ko store aur process karta hai — accessible from anywhere. |
| Edge Computing | Data ko device ke paas hi process karta hai taaki speed fast ho aur bandwidth save ho. |

Explain the Applications of the Internet of Things.






i) Inventory Management

ii) Route Generation & Scheduling

i) Inventory Management

| Aspect | Explanation (Hinglish) |
|---|---|
|  Purpose | Store ya warehouse ke products ka accurate record maintain karna. |
|  How IoT Helps | IoT devices jaise RFID tags , smart shelves , aur sensors real-time data detect karte hain jaise: item available hai ya nahi, quantity kitni bachi hai, etc. |
|  Benefits | Stock-outs avoid hote hain, overstock ka loss nahi hota, human error kam hota hai. |
|  Automation | Automatic alerts milte hain jab kisi item ka stock low ho jata hai. |
|  Example | Amazon warehouses – robots and sensors manage inventory automatically. |

ii) Route Generation & Scheduling

| Aspect | Explanation (Hinglish) |
|--|--|
|  Purpose | Goods, buses, ya delivery ke liye best route aur time planning karna. |
|  How IoT Helps | GPS trackers aur traffic sensors real-time location aur road condition monitor karte hain. |
|  Smart Scheduling | System automatically best route suggest karta hai — time aur fuel dono save hote hain. |
|  Real-Time Updates | Delay hone par notifications milti hain aur alternate route suggest hota hai. |
|  Example | Ola/Uber ya Swiggy Zomato delivery system — fastest delivery planning using IoT. |

Explain cloudlet. Differentiate between cloud & cloudlet

☁️ Cloudlet

Cloudlet ek **mini-cloud** hota hai jo user ke device ke **nearby** hota hai (edge pe). Ye basically ek **small-scale data center** hota hai jo **low latency** aur **fast processing** ke liye banaya gaya hota hai — especially for mobile and IoT applications.

🔧 Simple Example:

Agar tum ek AR/VR ya face recognition app use kar rahe ho jo fast response chahiye, toh instead of sending data to a big far-away cloud, wo data pehle **cloudlet** tak jata hai jo nearby hi hota hai (jaise kisi college lab ya telecom tower pe).

| ⚡ Feature | ☁️ Cloud | 📶 Cloudlet |
|---------------------|---|--|
| Location | Bahut door data centers mein | User device ke paas (edge par) |
| Latency (Delay) | High latency (data door travel karta hai) | Low latency (fast response) |
| Size | Large-scale infrastructure | Small-scale infrastructure |
| Use Case | Big data processing, storage, AI models | Real-time apps: AR/VR, IoT, mobile apps |
| Internet Dependency | High – Internet ke bina kaam nahi karta | Kam – Local processing possible |
| Example | AWS, Google Cloud, Microsoft Azure | Edge servers in hospitals, colleges, telecom |

What are different components of ZigBee. Explain the significance of each.

| 🔗 Component | 🔍 Explanation (Hinglish) |
|----------------------------|--|
| 1. ZigBee Coordinator (ZC) | 🔗 Network ka main boss – ye pura network banata hai, devices ko add karta hai aur data routing handle karta hai. |
| 2. ZigBee Router (ZR) | 🔗 Data forward karta hai – coordinator aur end devices ke beech mein data ko relay karta hai, network ko expand karta hai. |
| 3. ZigBee End Device (ZED) | 📱 Basic device – sirf data bhejta ya receive karta hai, low power use karta hai. ZR ya ZC ke through connect hota hai. |
| 4. ZigBee Protocol Stack | 📶 Rules aur layers ka set – isme PHY layer, MAC layer, Network layer, aur Application layer hoti hai jo communication ko manage karti hain. |
| 5. PAN ID | 🆔 Personal Area Network ID – unique ID hoti hai har ZigBee network ki jisse devices identify hote hain. |
| 6. Security Module | 🔒 Data secure rakhta hai – encryption aur authentication provide karta hai to prevent hacking. |

◆ What is NASA's Nebula Cloud?

Nebula ek **cloud computing platform** tha jo **NASA (National Aeronautics and Space Administration)** ne develop kiya tha, mainly for **scientific research, big data analysis, and open-source collaboration**.

Ye cloud NASA ne specially banaya tha **internal researchers** aur **external developers** ke liye taaki wo **securely aur efficiently** data share kar saken.

□ Purpose of Nebula Cloud:

◆ Use

1. Scientific Computing

2. Open Government

3. High-Performance Research

4. Web Hosting

🔍 Explanation (Hienglish)

Space missions ke liye data ko process aur analyze karna

Public ko NASA ke data aur tools provide karna

Scientists ko fast computing power dena (climate study, astronomy, etc.)

NASA ke web applications securely host karna

🔑 Key Features of NASA's Nebula Cloud:

| ⚙️ Feature | 📖 Explanation |
|----------------------|---|
| Open Source | Nebula ko banate waqt open-source tools use kiye gaye jaise OpenStack |
| Virtualization | Multiple virtual machines ek hi physical server pe run ho sakti thi |
| Elastic Resources | On-demand CPU, storage, aur memory allocate hota tha |
| Secure & Scalable | Government-level secure tha aur easily scale bhi ho sakta tha |
| Support for Big Data | Petabytes of data handle kar sakta tha for research purposes |

◆ Future Grid kya hota hai?

Future Grid ek **next-generation smart electricity network** hai jo **advanced technologies** ka use karta hai jaise ki:

- IoT (Internet of Things)
- Artificial Intelligence (AI)
- Big Data Analytics
- Cloud Computing
- Renewable Energy Integration

Ye grid **traditional power grid** se zyada intelligent, responsive, efficient aur eco-friendly hota hai.

□ Future Grid ka Objective:

“Right electricity, at the right time, in the right amount, to the right place – automatically aur smartly.”

| 🔍 Feature | ⚙️ Traditional Grid | 🚀 Future Grid |
|-----------------|-----------------------------|---------------------------------|
| Power Flow | One-way (Generation → User) | Two-way (User ↔ Grid) |
| Monitoring | Manual | Real-time automatic monitoring |
| Fault Detection | Slow | Fast & automated |
| Energy Sources | Fossil fuels only | Renewables + Fossil (Hybrid) |
| Communication | No communication | IoT-enabled devices communicate |
| Consumer Role | Passive (just consume) | Active (can generate & monitor) |
| Efficiency | Low | High |

🌐 **Key Features of Future Grid:**

1. ✓ **Smart Meters** – Real-time electricity usage monitor karte hain
2. ⚡ **Renewable Integration** – Solar, Wind jaise sources se energy le sakta hai
3. ☐ **Self-Healing** – Faults detect karke automatically fix karta hai
4. ↻ **Two-Way Communication** – Grid aur user ke beech data sharing hoti hai
5. 📊 **Data Analytics** – Smart decisions ke liye big data ka use hota hai
6. 🛡️ **Cyber Security** – Grid ke systems secure rakhne ke liye advanced protection
7. ☁☐ **Cloud & Edge Computing** – Grid ke processing ko fast aur scalable banata hai

🏠 **Future Grid ka Example Scenario:**

Tumhare ghar ka **smart meter** dekhta hai ki solar panel se zyada energy generate ho rahi hai, toh woh automatically excess electricity grid ko bech deta hai, aur tumhe uska credit milta hai – bina kisi manual effort ke.

jayesh_kande_ ▾ ●

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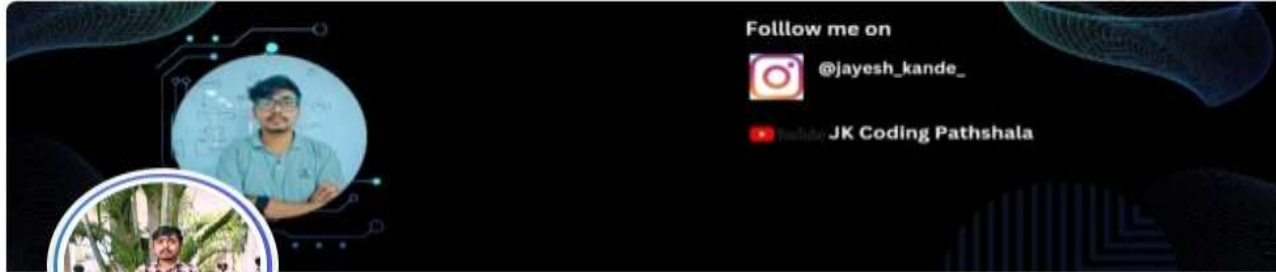
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