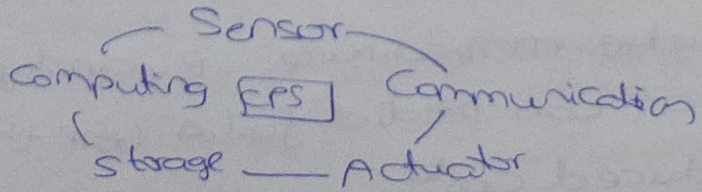
Unit-5

IOT	IIOT
1) Internet of Things	1) Industrial Internet of Things
2) It supports customer oriented applications	2) It supports industry oriented applications
3) Wireless communication	3) Wired, wireless
4) Data quality is medium to high	4) Data quality is high to very high
5) Ex: Smart lighting, Smart parking, Smart home	5) Ex: Predictive maintainence, Quality control, Equipment management

IIOT is a subset of IOT,
IIOT is linked to Industry 4.0, which aims to digitize & optimize manufacturing process using automation & advanced technologies.

Cyber Physical Systems: (CPS):
CPS monitor, coordinate, control & integrate physical operations using software

CPS architecture Combines physical components (actuators and sensors) with cyber components (networking, computing, data storage).
Physical systems are monitored & controlled by embedded computers.



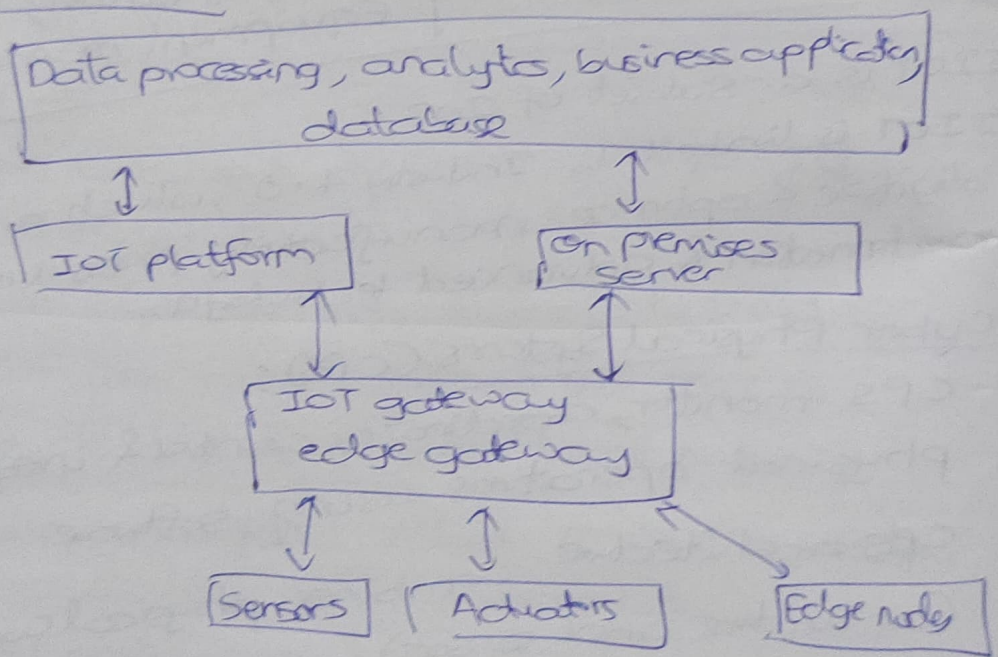
Working of IIOT:

It runs on internet & embedded systems. IIOT is a network of intelligent devices connected to systems that monitor, collect, exchange, analyze data.

Each IIOT consists:

1) Intelligent devices that sense, communicate store info
2) Public, private data communicators infrastructure
3) Analytics, applications which generate business information from raw data
4) People

Infrastructure:



Advantages:

1) Increased efficiency through real time monitoring
2) Increased productivity through automation
3) Predictive maintainance: By analyzing data IIOT can predict failure before they occur.
4) Reduced costs

vendors in IIOT: GE Digital, Siemens, IBM Watson, Cisco, Bosch, AWS IoT

Components of IIOT implementation:

1) Smart factories:
   i) cyber physical system (CPS): Integrates physical process with computational control to create smart manufacturing. Smart manufacturing improves efficiency

2) Industry 4.0 strategy: Initiated in Germany. Motive is to get high quality, low cost products.
   Evolution: Industry 1.0 → Steam Engine
   Industry 2.0 → Electricity
   Industry 3.0 → Computers, automation
   Industry 4.0 → Advanced processors, Smart technologies

3) Industrial Internet:
   Utilizies IPV6, LPWAN for communication.
   Used for machine to machine communication.
   Focuses on continuous, safe, real-time operations

4) Factories of the Future:
   Types:
   i) Smart Factories: Can be acheived by CPS
   ii) Connected factories: All devices are interconnected
   iii) Virtual Factories: Advanced decision support, real world simulations provided.

→ Cisco Connected Factory is designed for industrial applications with IT integration.

Derelopment of IIOT Architecture:

1) ITU → International Telecommunication Union
2) IIC → Industrial Internet consortium.

Communication Methods of IOT devices:

ITU categorizes IOT devices based on their functionalities & types of communication they use.

Categories are

1) Data carrying devices: They store data & communicate with other devices
2) Data capturing devices: They read data using readers & write using writers
   Ex: RFID, barcode scanner
3) Sensing & Actuating devices: They sense ~~on~~ from environment and act accordingly
4) Gereral purpose devices: Machines, Consumer electronics.

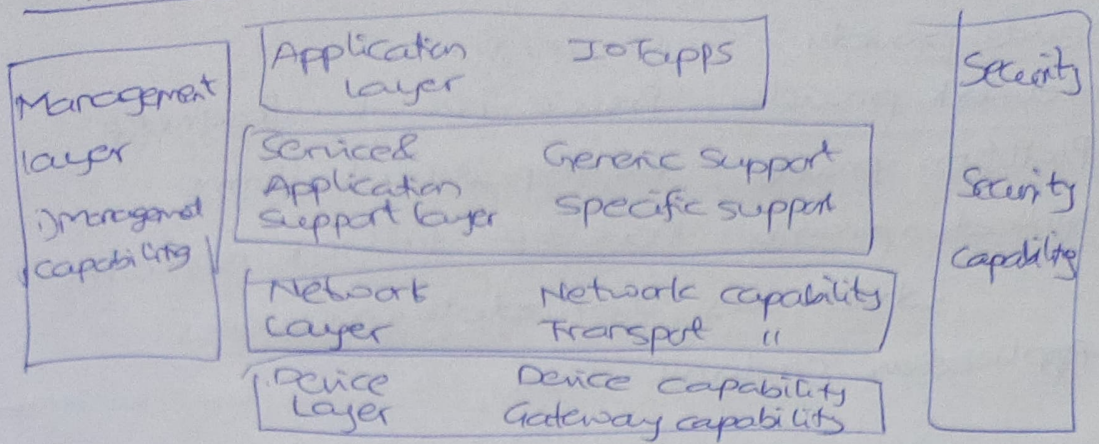
Gereral Architecture requirements of ITU:

1) Intereoperability
2) Each device must have unique ID for communication
3) Devices should operate independantly
4) Protect the data
5) Easily able to add/remove devices

ITU architecture of IOT, IIOT:

1) Interconnectivity
2) Scalable 3) Support variety of devices
4) Provide services to all IOT
5) The architecture must adapt to Constantly changing network

IIOT reference model by ITU:



1) Device Layer:

a) Direct communication devices: Talk to network directly

b) Gateway communicatiandvices: Device communicate through gateway

c) Local Network devices: Devices which communicate locally, they form a small network

d) Power saving devices: Devices which turn off to save power

2) Network Layer:

Converts data into some protocol.
Manages network connectivity

3) Service & Application Support Layer:

Provides data processing & storage.
Special features are provided to meet the requirements of ~~specific~~ applications

4) Application Layer: User interacts with IoT services and applications. Also can send data to devices.

5) Management & Security Layer: Ensures authorization, authentication across all layers. Provides specific security measures in applications like smart meter monitoring.

Business roles in IIOT:

1) Device provider: Gives sensors
2) Network provider: Provide network infrastructure
3) Platform provider: Develop IOT platforms
4) Application provider: Develop software applications which uses IoT data in business
5) Application customer: User

IIOT architecture by IIC:

→ It focuses on integrating interests & concerns of all stakeholders in IIOT.

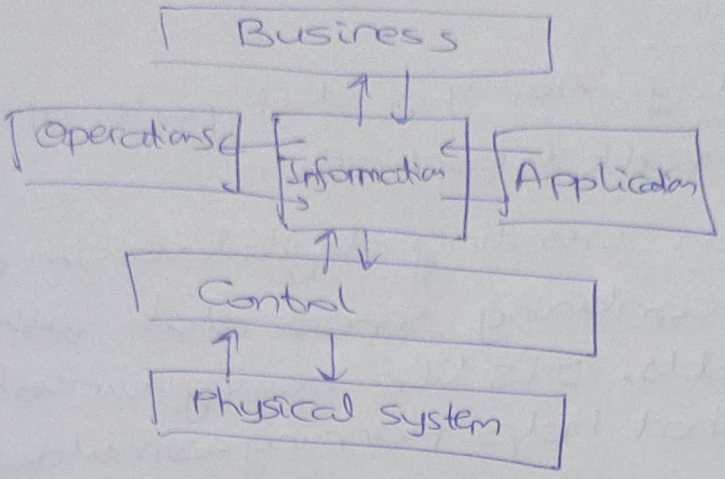
It addresses 4 viewpoints

1) Business viewpoint: How IIOT impacts business
2) Usage " " : Focuses how it is used
3) Functional " " : " on what it implements
4) Implementation " " : " on software, hardware used.

Operational technology (OT) system in IIOT:

→ It is a part of Industrial control system (ICS).
→ OT is managed by control & operational engineers.
→ OT interfaces with environment through sensors, actuators
→ OT systems are independently managed by their owners
→ Integration of IT and OT in IIOT follows unified model & divides IIOT into 5 domains. They are Control, Operations, Information, Application Business.

IIC architecture:



1) Control domain: Contains actuators, sensors. Manages industrial process

2) Operations: Deals with system monitoring, management & optimization. To improve system performance

3) Information: Collects info from all domains.

4) Applications: Contains all API's & user interface to make it usable by consumers

5) Business: Helps in managerial decisions.

Applications of IIOT:

Power distribution networks
Water " "
Management networks
Oil, gas distribution networks

IIOT challenges: Interoperability, scalability, flexibility, security, energy usage, adaptability

IIOT data characteristics:

1) Polymorphism - Diff sensors diff data
2) Relationships in data
3) Real time data fetch.

Industry 4.0

Design Principles:

1) Interoperability: Ability of diff parts of factory to talk to eachother
2) virtualization: Creating digital version of factory by combining sensor data with computer models. It's like having virtual copy of factory that helps planning & simulation
3) Decentralization: Give machines the ability to make decision on their own.
4) Real time Capability: Getting data immediately & analyzing it fastly
5) Service orientation: Provide maintainance support to machines
6) Modularity: Make the factory flexible so that it can be changed when needed.

Characteristics:

1) IT-OT convergence
2) Interoperability
3) Data driven decision making
4) Decentralization
5) Flexibility or Modulaility
6) Providing Digital Customer Experience
7) Providing predictive insights so that it helps in predicting the machines which will not work before only
8) CPS
9) Advanced manufacturing technologies