Module 2, 7

M2M to IoT., IoT & protocols.

→ Intro. to M2M.
  ↳ Background.
  ↳ A typical

Intro. to IoT :-

Internet of Things is a concept which enables the communication between internetworking devices and applications.

The physical objects or things communicate through internet.

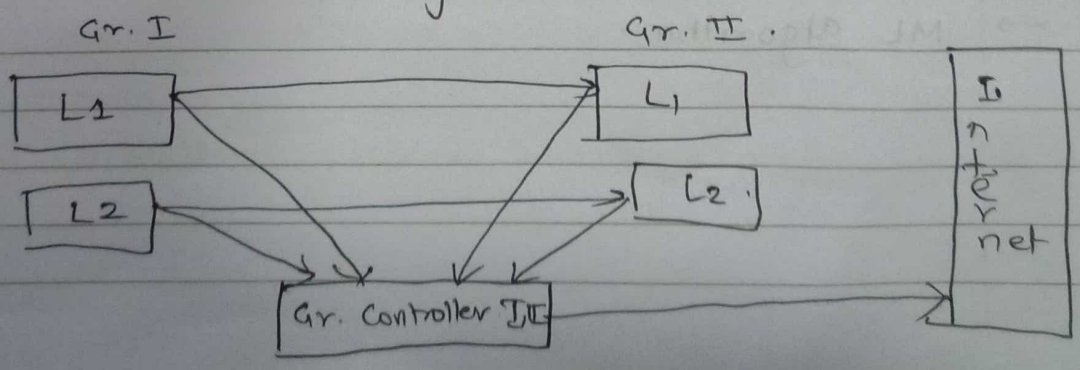
The concept of IoT begins with things which can be classified as Identity comm^n devices.
e.g. RFID.

Def^n :- IoT means a n/w of physical objects sending, receiving or communicating the info^n using internet or other communication technologies.

Hyper connected devices :-

Hyper connectivity means use of multiple sys. and devices that can be constantly connected to a n/w with the help of internet.

e.g. n/w of city lights connected to main station using sensors and IoT. The whole city lights can be controlled through main station.



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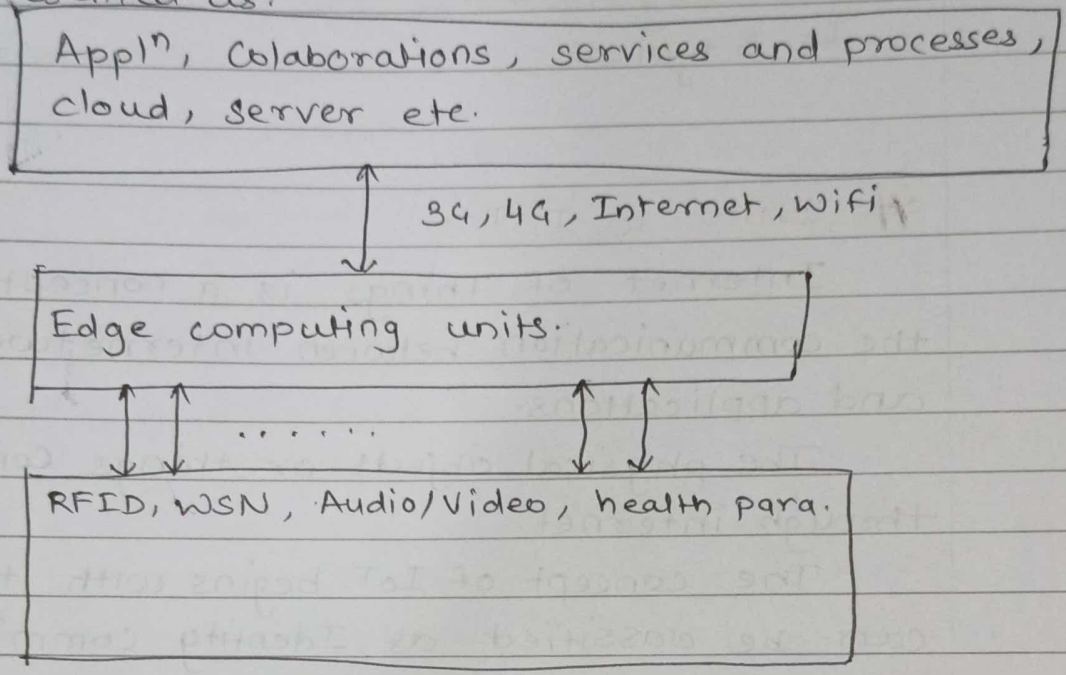
A general framework for IoT using smart connected device, edge computing appl^n can be represented as:



- A smart connected device is the dev. at the edge of internet.
- Various dev. can be connected with various IP add., data transfer rate.
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Technology behind IoT:-

- Following entities provide a large and diverse tech. environment which are :-

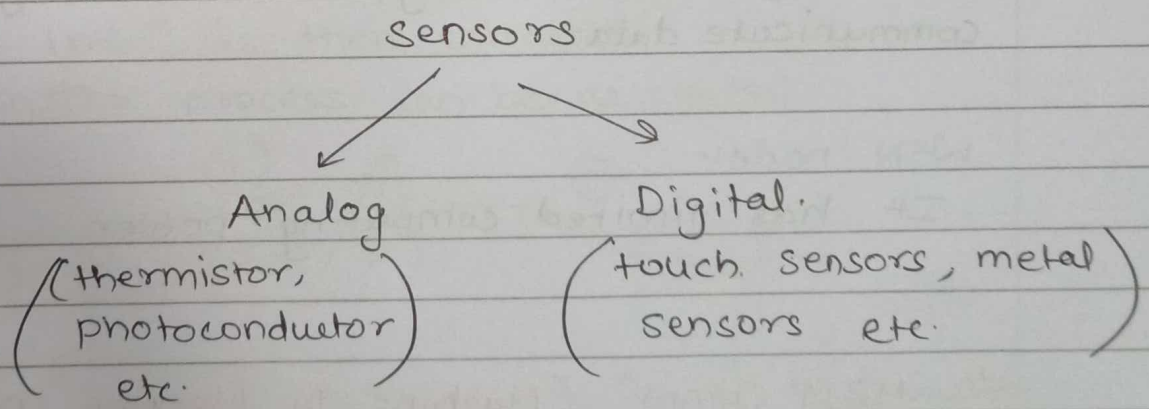
→ H/w
→ IDE (Integrated Development Environment)
→ N/w connection.
→ S/w
→ ML algorithm.

Various levels in IoT are:-

A device Platform(μC)
↓
Network.
↓
server.
↓
cloud platfor.
↓
Online platform.

Components of IoT sys:-

1) Sensors and control units:-

- Sensors are electronic components used for sensing physical para. (temp, pressure, audio etc.)
- Each street light has sensors for measuring light intensity and sending that data over a fixed period.
- 

- Most commonly used control unit is microcontroller.

2) Communication Module:-

- It consists of protocol handles, message queue

3) Software :- → device software
→ Server software.

4) Middleware :- Open IoT is an open source middleware. It enables comm^{n} with sensor and cloud.

5) Firmware :- It is an open source technology. It enables the wireless mesh connectivity.

Platforms for Integration :-
Things speak, Nimbits.

Sources for IoT :-
Arduino Uno, Microduino, Intel Galileo, Intel Edison, Beagle Board, Rasp-Pi.

WSN :- (Wireless Sensor Network) :-
It is a n/w in which each sensor node connects wirelessly with ability to compute, aggregate and communicate data.

WSN node :-
It has limited computing power.

M2M comm^{n} (Machine to Machine comm^{n})
- imp. basic block in IoT.
- conn^{n} between two machines without human interference.
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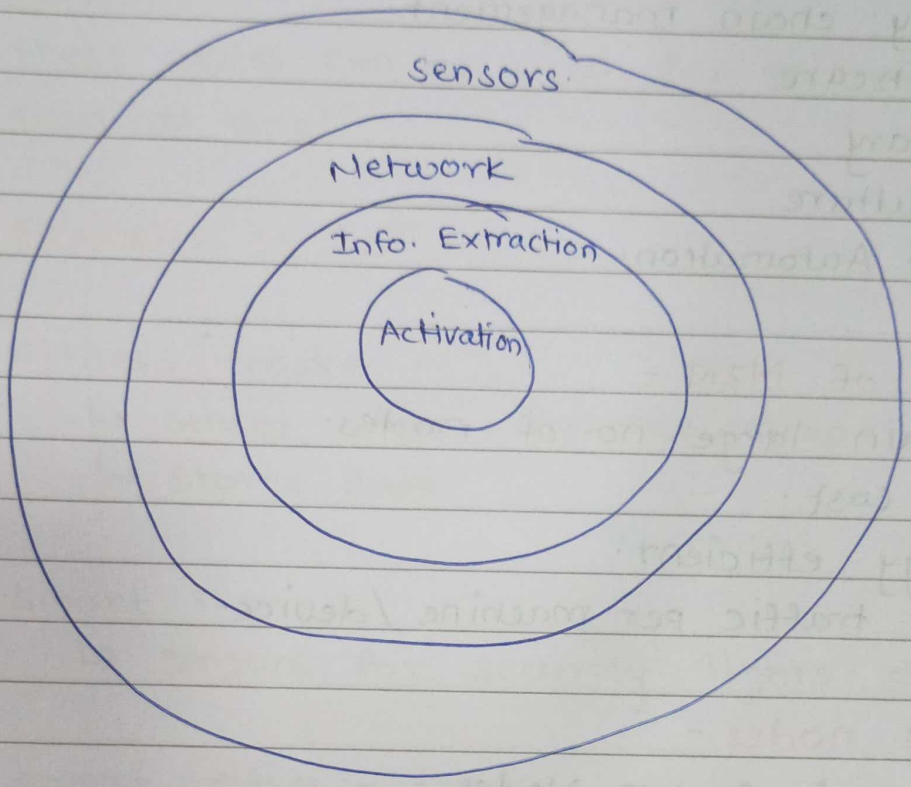
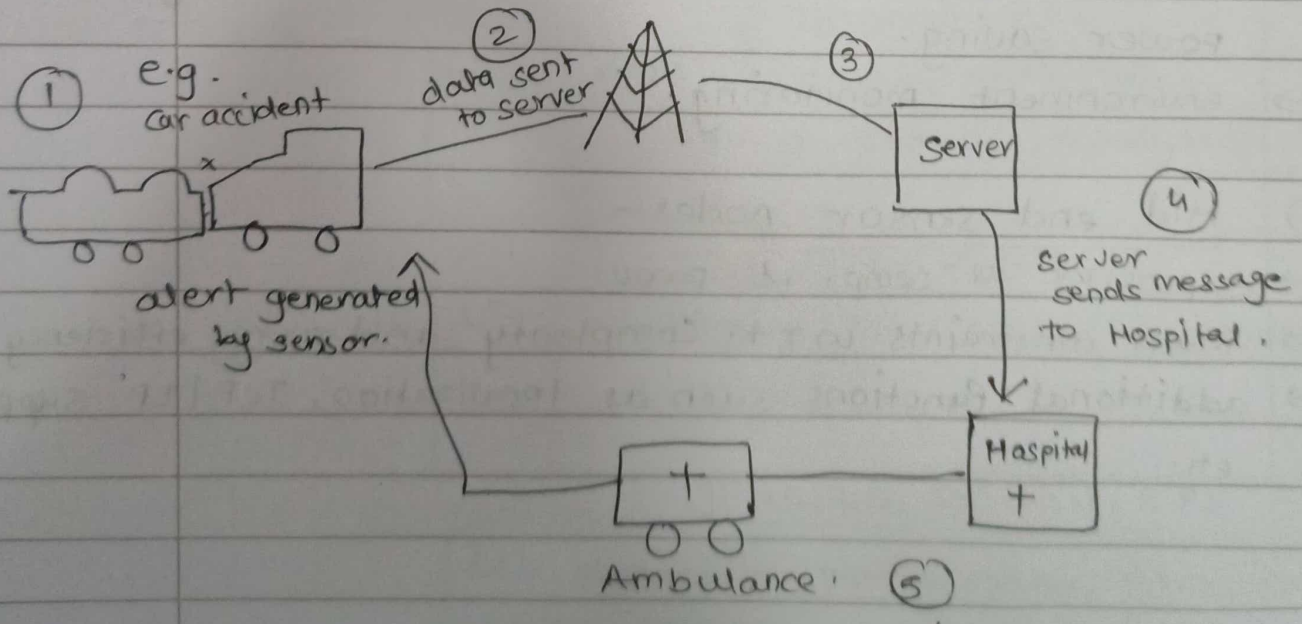
Overview of M2M commⁿ:



→ sensors collect data from remote areas.
→ Networks are responsible for transportation of data.
→ The infoⁿ is then extracted.
→ Then the process can be activated.



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M2M applications :-

1) Environmental Monitoring
2) Civil protection & public safety
3) supply chain management.
4) Healthcare.
5) Military
6) Agriculture
7) Home Automation.

Adv. of M2M :-

→ contain large no. of nodes.
→ low cost.
→ energy efficient.
→ small traffic per machine / device.

M2M nodes :-

1) Low end Sensor Nodes :-

→ cheaper.
→ low range data transfer capabilities.
→ basic functions like data collection, Auto configuration, power saving.
→ environment monitoring.

2) Mid end sensor nodes :-

→ expensive as comp. to prev.
→ fewer constraints w.r.t. Complexity and energy efficiency.
→ additional functions such as localization, TCP/IP support etc.

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3) High end sensor node:-

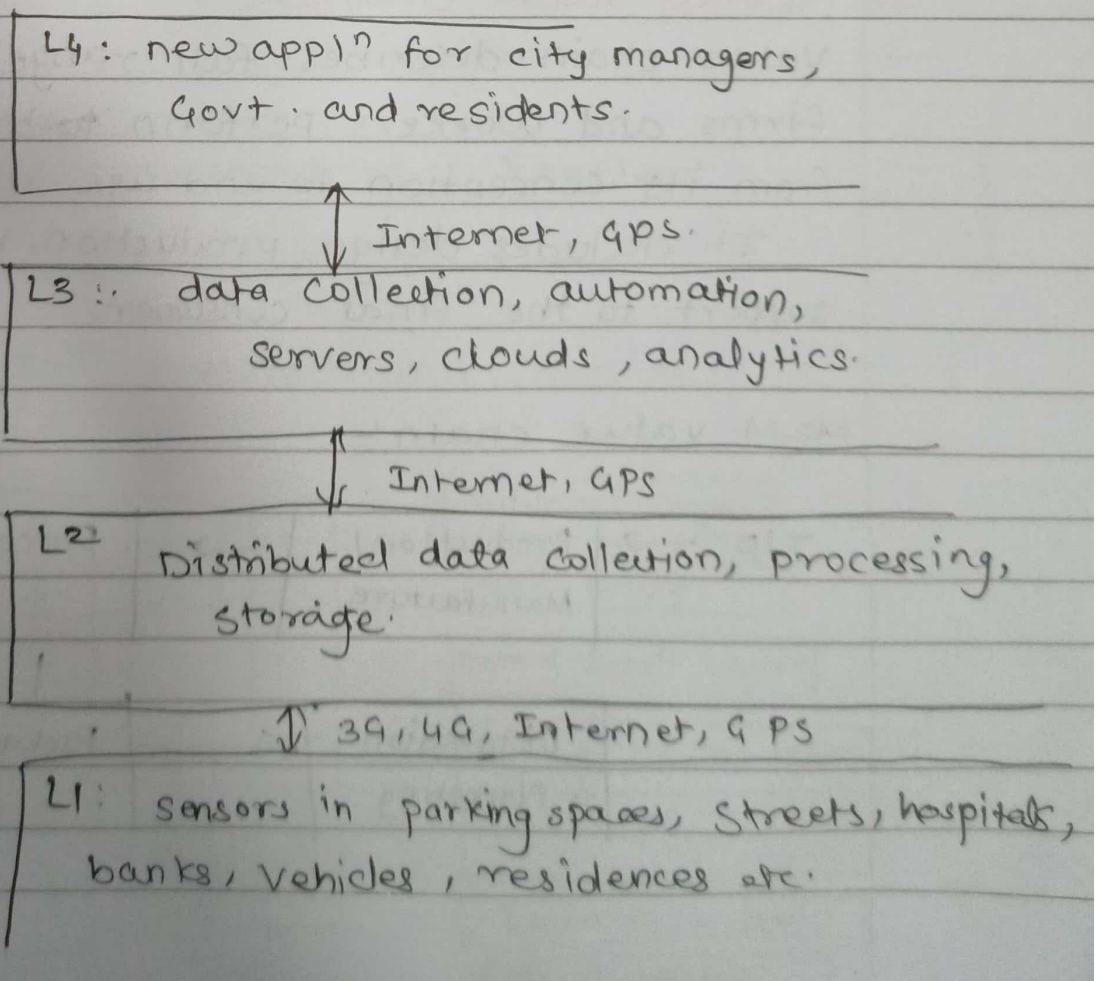
- can handle multimedia data with quality of services.
- these nodes can be used for military and bio-medical appl^{n}.

Examples of IoT:-

1) Fitness tracker:-
   ↳ Senses steps, distance, sleep.
   ↳ Stores data.

2) Smart Home:-
   ↳ sensors for security, lights, smoke detector etc.

3) smart cities:-



M2M System Layers and design standards:

i) IETF (Internet Engineering Task Force)
- for addressing IoT standards.

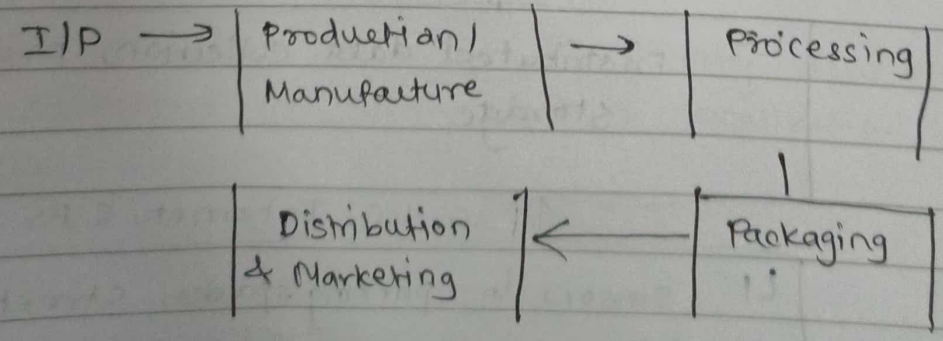
Modified OSI model for IoT:-
- OSI model contains 7 layers.

L7 → Appln
L6 → Presentation
L5 → Session
L4 → Transport
L3 → Network
L2 → Data link
L1 → Physical.

} Classical OSI.

Global Value chains:-
- Value chain describes full range of activities that firms and workers perform to bring a product from its conception to end use and beyond.
  It includes design, production, marketing, distribution, support to the final consumer.

M2M value chain:-



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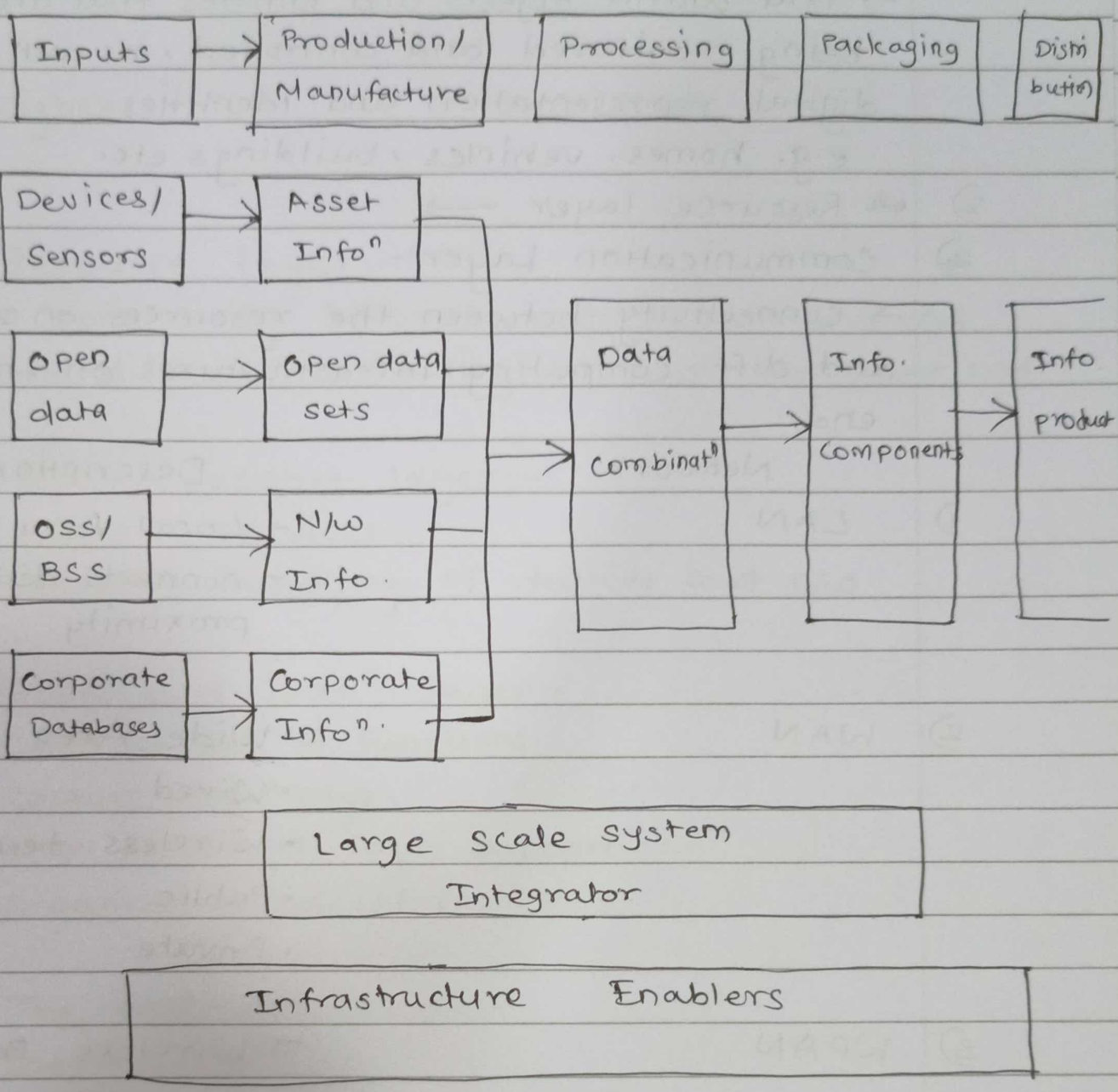
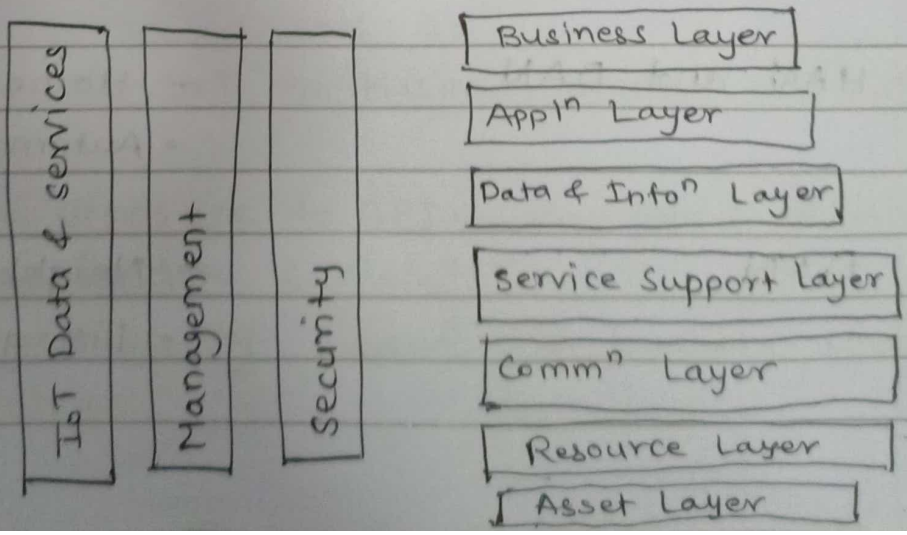
IoT value chains:-



M2M to IoT Architechtural Overview:



1) Asset Layer:-
→ real world objects and entities that are subject to being monitored and controlled, as well as having digital representation and identities.
e.g. homes, vehicles, buildings etc.

2) Resource layer →

3) Communication Layer:-
→ connectivity between the resources on one end and diff. computing infrastructures on the other end.

	Network	Description.
1)	LAN	- Local Area N/w. - connects dev. in close proximity.
2)	WAN	- Wide Area N/w. • Wired • Wireless technologies. • Public • Private.
3)	WPAN	- Wireless Personal Area N/w. • Fitness • Healthcare.
4)	HAN and BAN	- Home & Building Area N/w • Automation & control Appln.
5)	NAN	- Neighbourhood Area N/w. • Dist. grid.

6) V2V — Vehicle to Vehicle.
- Collision Avoidance.

7) Zigbee — Protocol Stack

2) Resource layer:-
connectivity between resources on one end and different computing infra. on the other end.

4) service support layer:-
- support services.
- uniform handling of devices and n/w

5) Data and Info^n layer:-
- abstract set of functions.
- capture knowledge.
- provide control logic support.
- organization of info.

6) The Application Layer:-
- Specific IoT appl^n.
- open ended array of appl^n.

7) Business Layer:-
- support core business op^n.
- integration of IoT in business process and enterprise systems.
- provides exposure to APIs for third parties to get access to data and info^n.
- ~~retrieve~~ necessary support for business process workflow.

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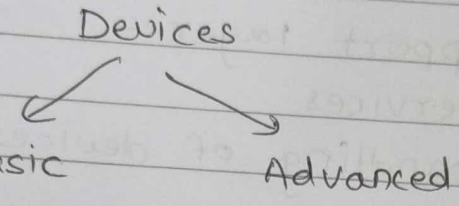
Technology fundamentals:-

→ Devices and getaways.
→ LAN & WAN.
→ Data Management.
→ M2M to IoT analytics.
→ Knowledge Management.

Devices in IoT systems:

classification of devices in IoT system is:



→ Basic Devices:-

- uc class devices.
- can perform simple opⁿ
- can't comm. without gateways.
- good for alarms, metering etc.

→ Adv: Devices:-

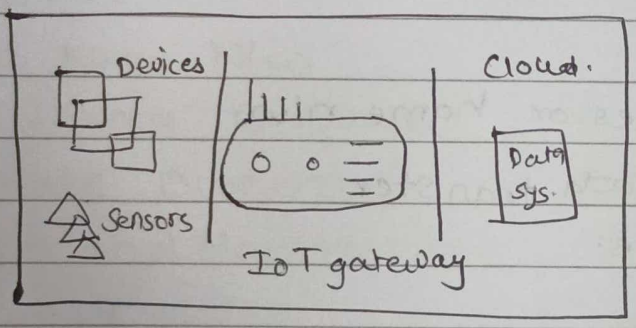
- Gen. purpose class devices are performing applⁿ level logic and support commⁿ protocols.
- used for automated units, processing multiple actions at the same time.

IoT Gateways:-

- Provides a bridge betⁿ diff. comm. technologies.
- acts as a medium to establish connⁿ betⁿ the cloud and controller in IoT.
- using IoT gateway, dev-to-dev or dev-to-cloud commⁿ can be established.

Functions of Gateway:-

→ Protocol translation.
→ data aggregation.
→ local processing.
→ data filtering.
→ local data storage.
→ autonomous dev. control.
→ provide device security.



Working:-

1) Receive data from sensor n/w.
2) Perform preprocessing, filtering and cleaning on unfiltered data.
3) Transports into std. protocols for commⁿ.
4) send data to cloud.

Adv:-

→ reliable
→ Scalable.
→ cost effective.

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Local and Wide Area Networking in IoT:

LAN:-

- grp of n/w devices that allow comm^n bet^n connected devices.
- LAN generally have private ownership.
- Crucial component of IoT.
- used for enabling comm^n bet^n devices & other components.

Adv:-

- reliable & secure.
- no need for internet conn^n.

types:-

1) Ethernet:-

- Wired LAN
- used in offices or home n/w.
- high speed data transfer.
- fast & secure.

2) Wi-Fi :-

- uses radio waves to connect devices.
- homes, shops, public spaces.
- convenient, easy to use.
- flexible, mobile.

3) Zigbee:-

- low-power, low-data rate.
- home automation / sensor n/w.
- reliable, low power consumption.
- long battery life.

Wide Area N/w :-

- connected collection of telecom. n/w
- large geographic area coverage.
- Types :-

1) Switched WAN.

- multiple components of LAN connected via shared n/w infrastructure.
- best suited to distributed environments.

2) Pt. to Pt. WAN :

- Two LAN nodes are connected through a leased line.

Difference between LAN and WAN.

	LAN	WAN.
1)	Local Area N/w	1) Wide Area N/w.
2)	small area coverage	2) large area coverage.
3)	Private Ownership.	3) Private & Public Ownership.
4)	Design and Maintainance is easy.	4) Design & Maintainance is difficult.
5)	low setup cost.	5) High setup cost.
6)	High data Tx. rate	6) Low data Tx. rate.
7)	More secure	7) less secure.

Data Management:-

- Needed for data governance.
- Massive vol. of data is created.

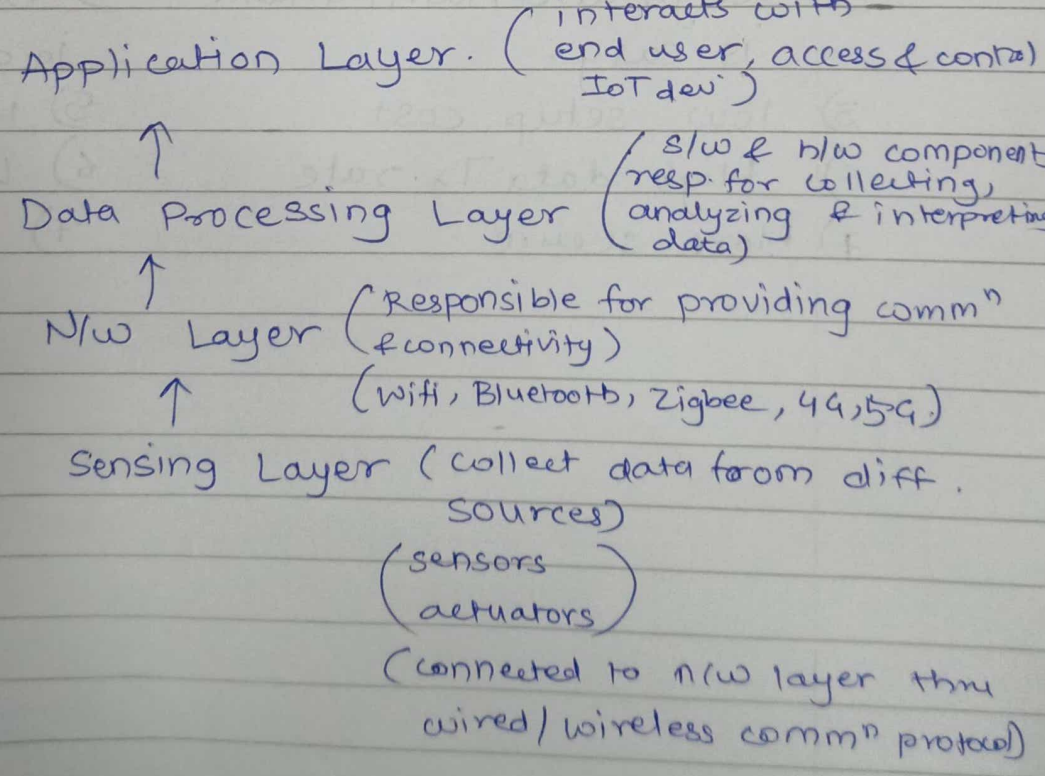
Need of data Management:-

1) Product Development:-
   - error detection
   - performance analysis.
   - offer product insights.

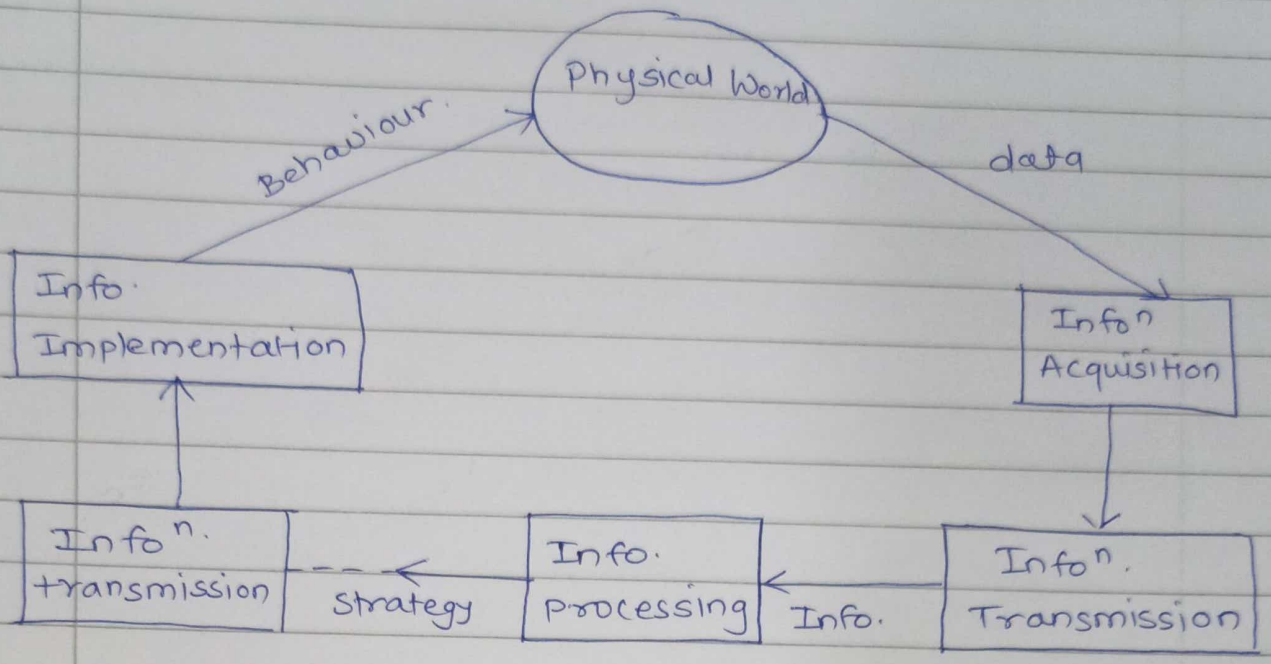
2) Prediction of Wear & Tear:-
   - equipment life cycles
   - make maintainance plans.

3) Facilitate Resouree & system efficiency:

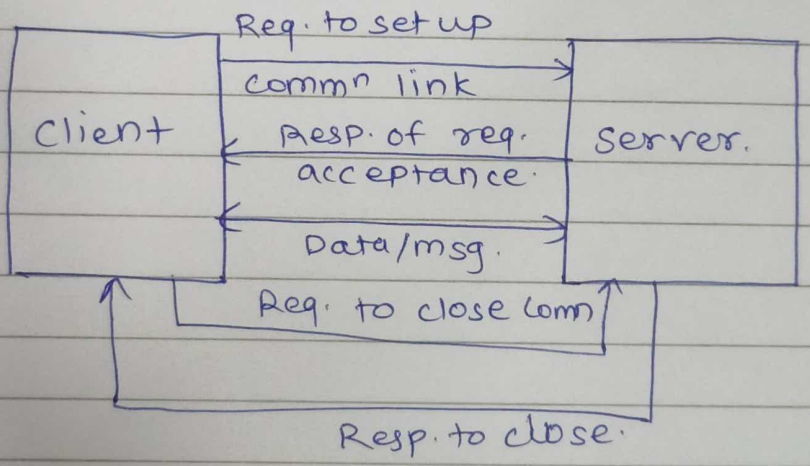
IoT reference Model:



IoT infon model:



IoT commn model:



Security & Management are Vertical layers.

1) Device Intelligence
2) Edge Processing
3) Edge initiated commn.
4) Msg. control.
5) Identification, authenticatn, encryption.
6) Remote control and updates of devices.