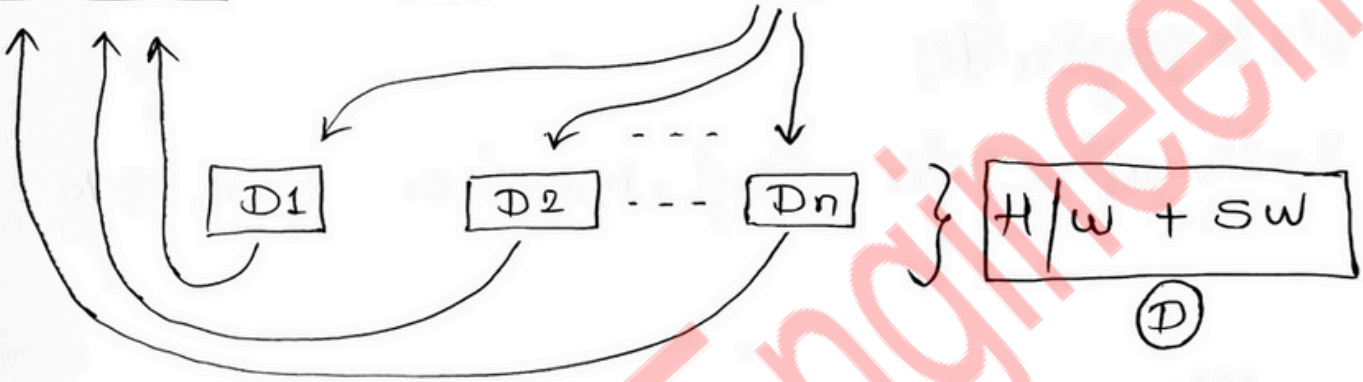
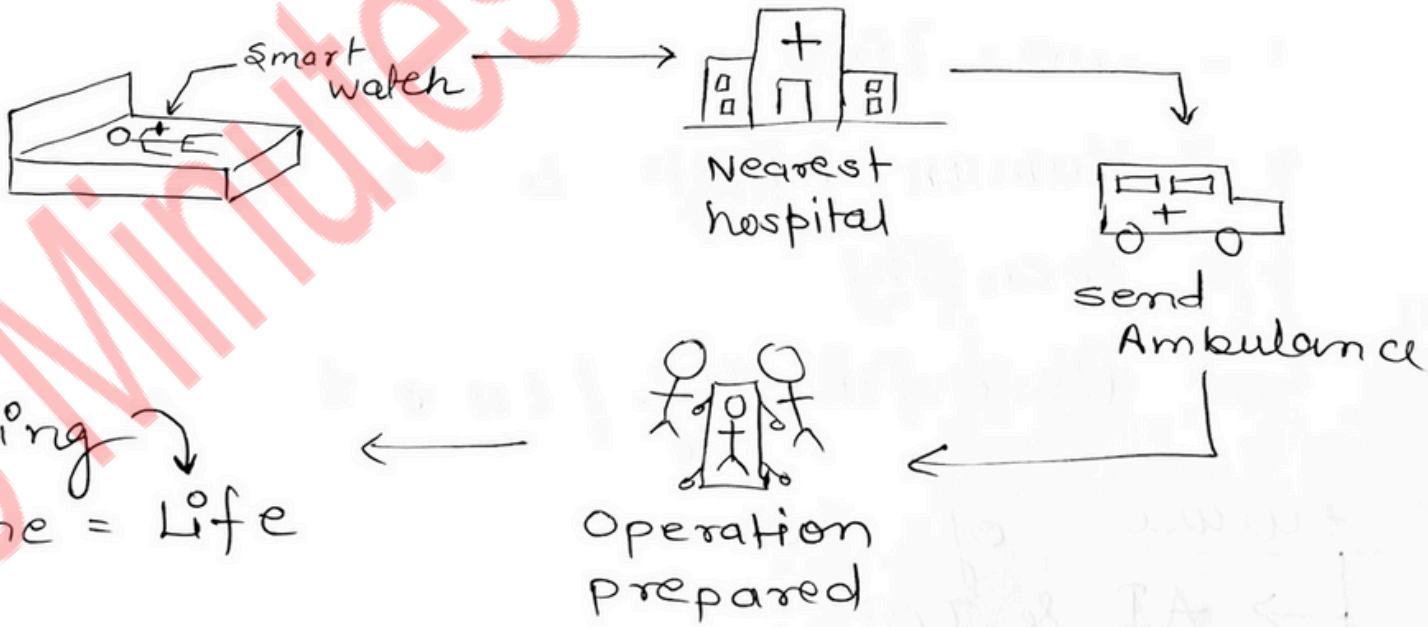
IOT

Internet Of Things



→ AC, oven, washing machine, speaker, TV..

Eg:

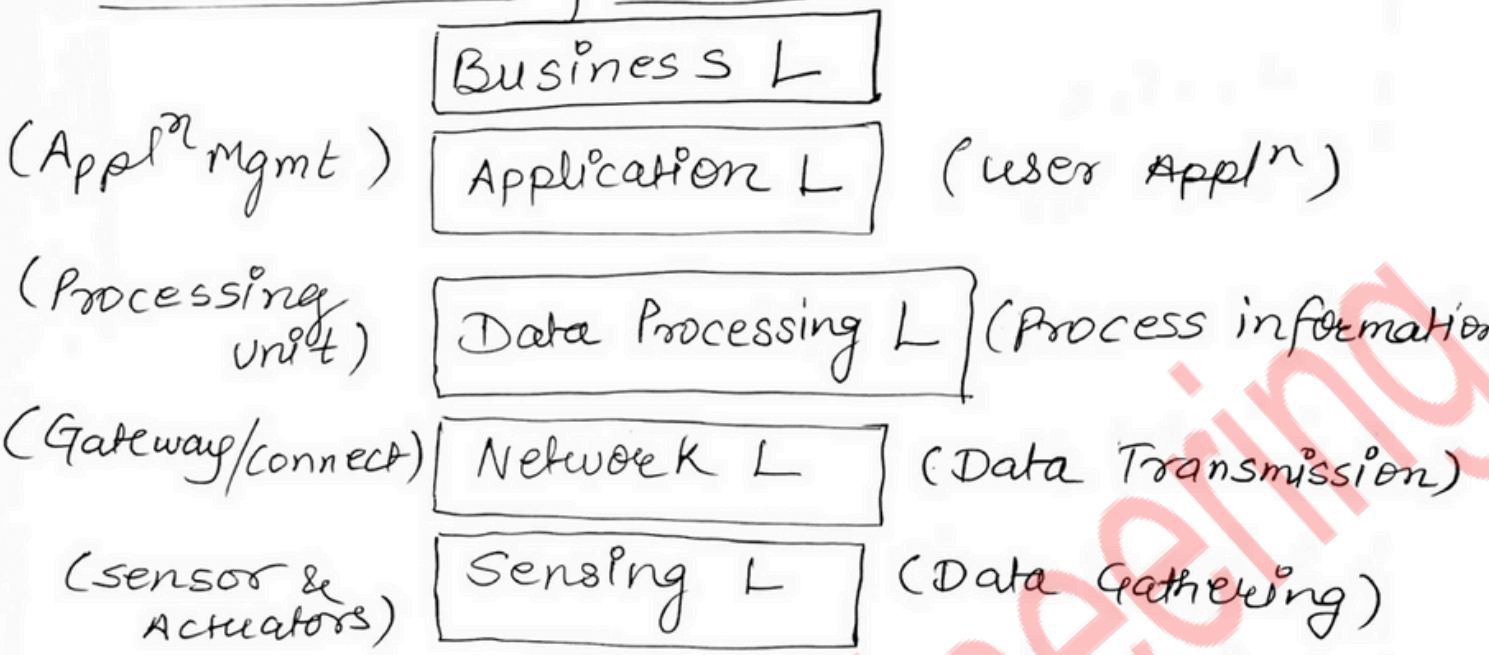


- Characteristics of IOT
  - Unique Identity
  - Dynamic Nature
  - Self Adapting
  - Self Configuring
  - Heterogenity
  - Integrated to Information Network.

- Benefits of IOT
  - Efficient Resource Utilization
  - Saves Time
  - Human Efforts & Errors
  - security
  - User friendly / Easy to use

- future of IOT
  - AI & IOT
  - VUI
  - Miniaturization of Things
  - Power
  - Big data & IOT

Architecture of IoT



- Sensing :- (Analog, Digital, Scalar & vector)
  - output
  - Data type

- Actuation
  - → Hydraulic
  - → Pneumatic
  - → Electric
  - → Thermal / Magnetic
  - → Mechanical.

° fundamental Terms of IOT

- Device
- Resources
- Controller services
- Database
- Web services
- Analysis Component
- Application

° Physical Design:

↳ Graphical Representation of ↳ system's

- Internal Entity (within the system) (Transform data)
- &
- External Entity (outside the system. (Transform data)
- flow of data (IN & OUT)

① UI Design
- User Input
- Display Output

② Data Design
- Data Representation
- Data storage within System

③ Process Design
- flow
- movement
- validate
- Transform

} data.

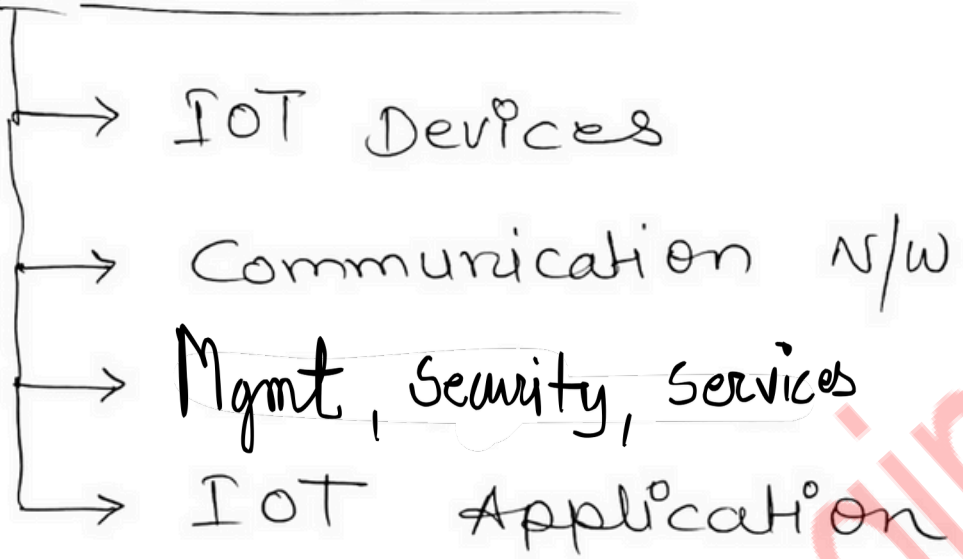
* Logical Design of IoT
- Graphical/T approach for a system showing its processes and the flow of data in & out of processes.
- ER Diagram

⟹ functional Block

⟹ communication Model

⟹ communication API

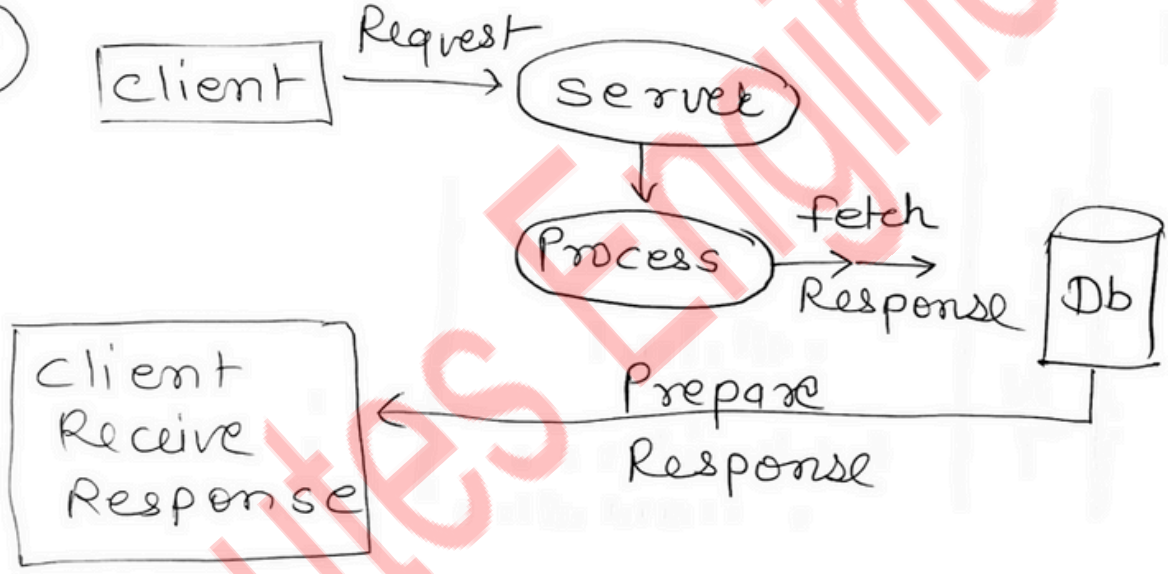
1] functional Block



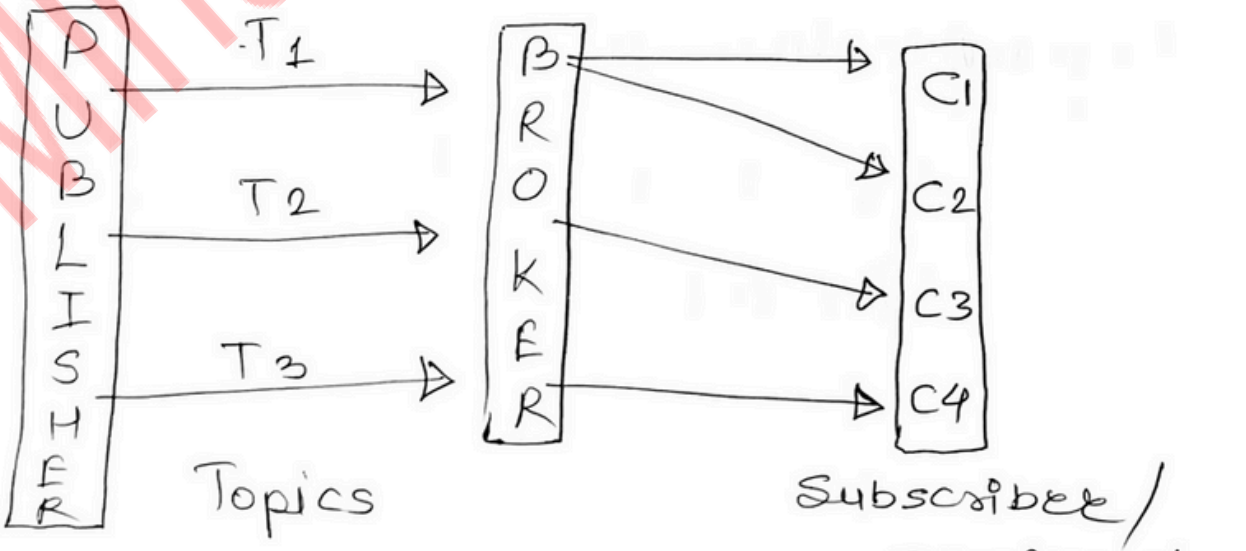
2] Communication Models

- Request - Response Model.
- Publisher - Subscriber Model
- Push - Pull Model
- Exclusive Pair.

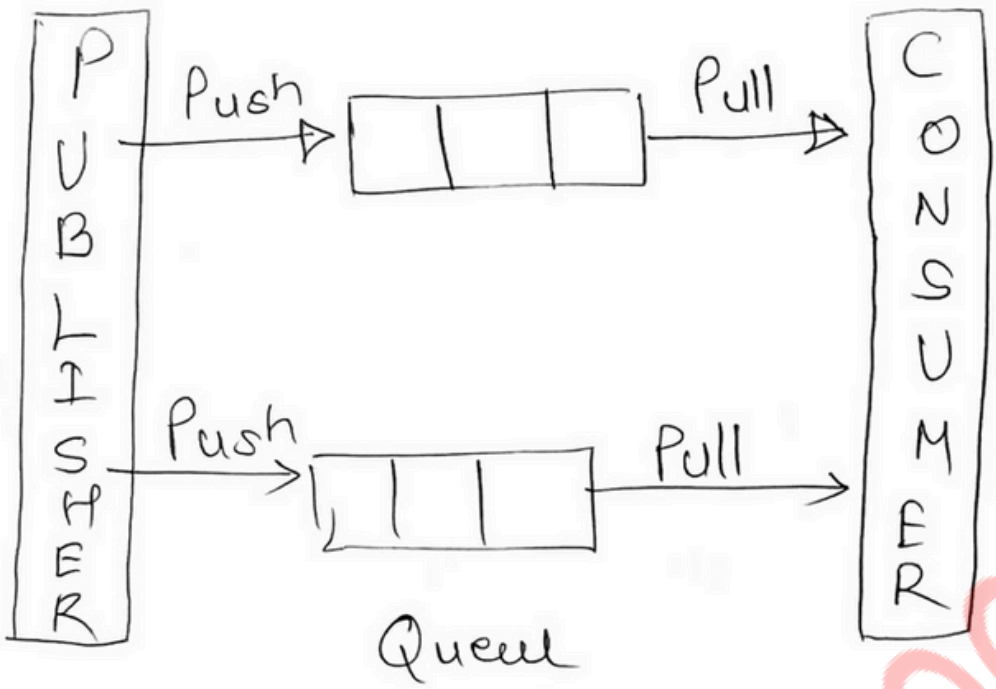
(I)



(II)



III



IV

3] Communication APIs

- → REST-based
- → WebSocket-based.

REST Vs websocket

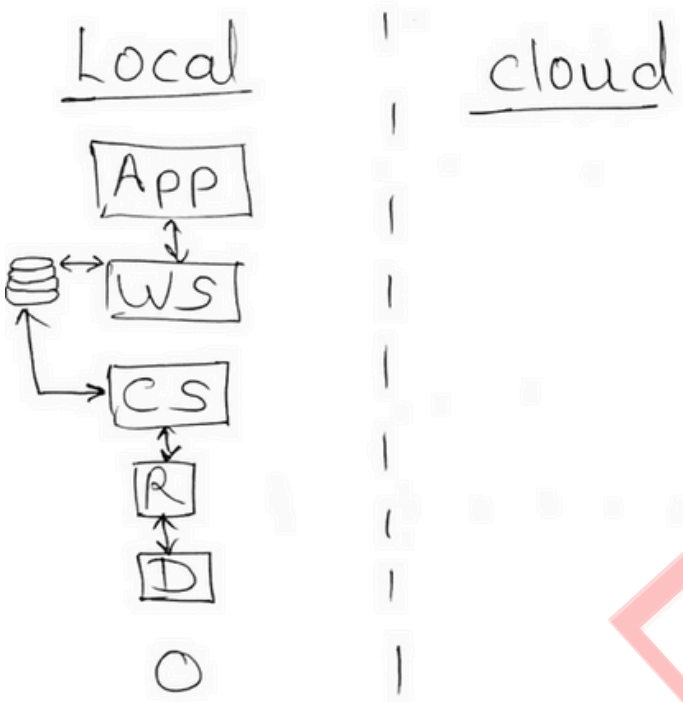
REST	websocket
① stateless	① stateful
② Request - Response	② full duplex
③ Each Request involves setting up a new TCP connection.	③ single TCP connection.
④ Header overhead	④ No Header overhead
⑤ Not suitable for RTA	⑤ Suitable of RTA

* IOT Enabling Technologies

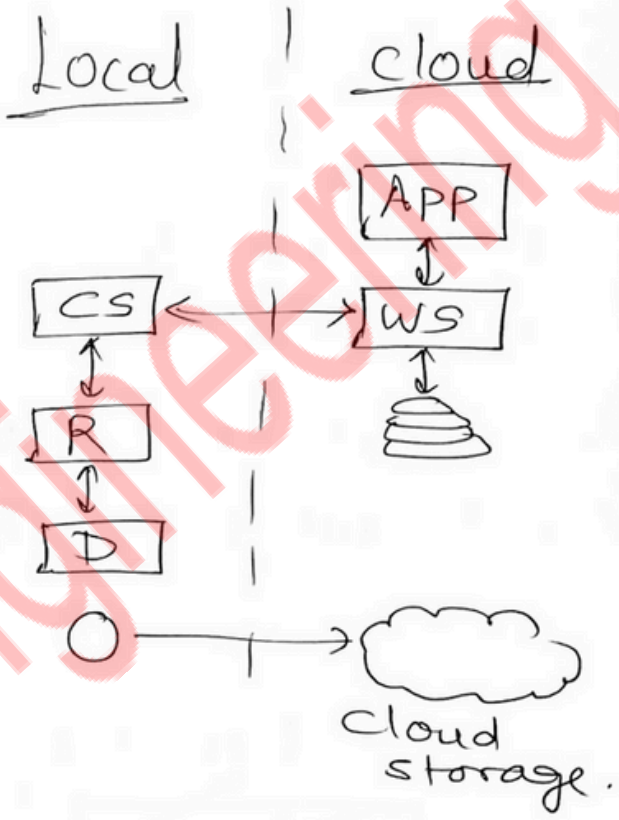
- → Wireless sensor N/w. (WSN)
- → Cloud computing
- → Big Data Analytics
- → Embedded Systems

IOT Levels

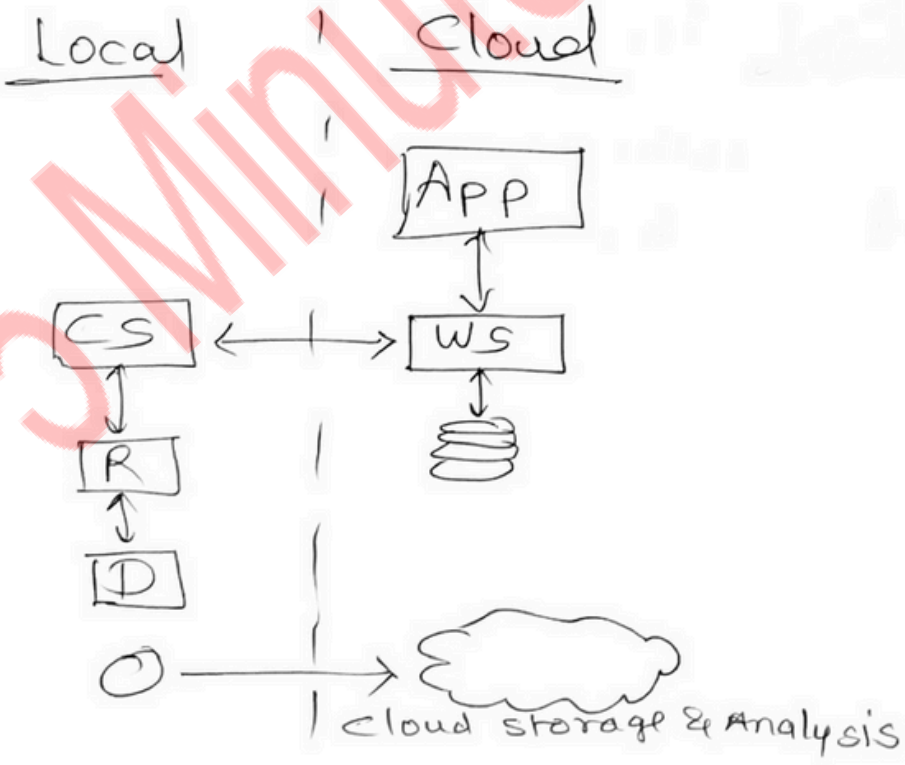
Level - 1



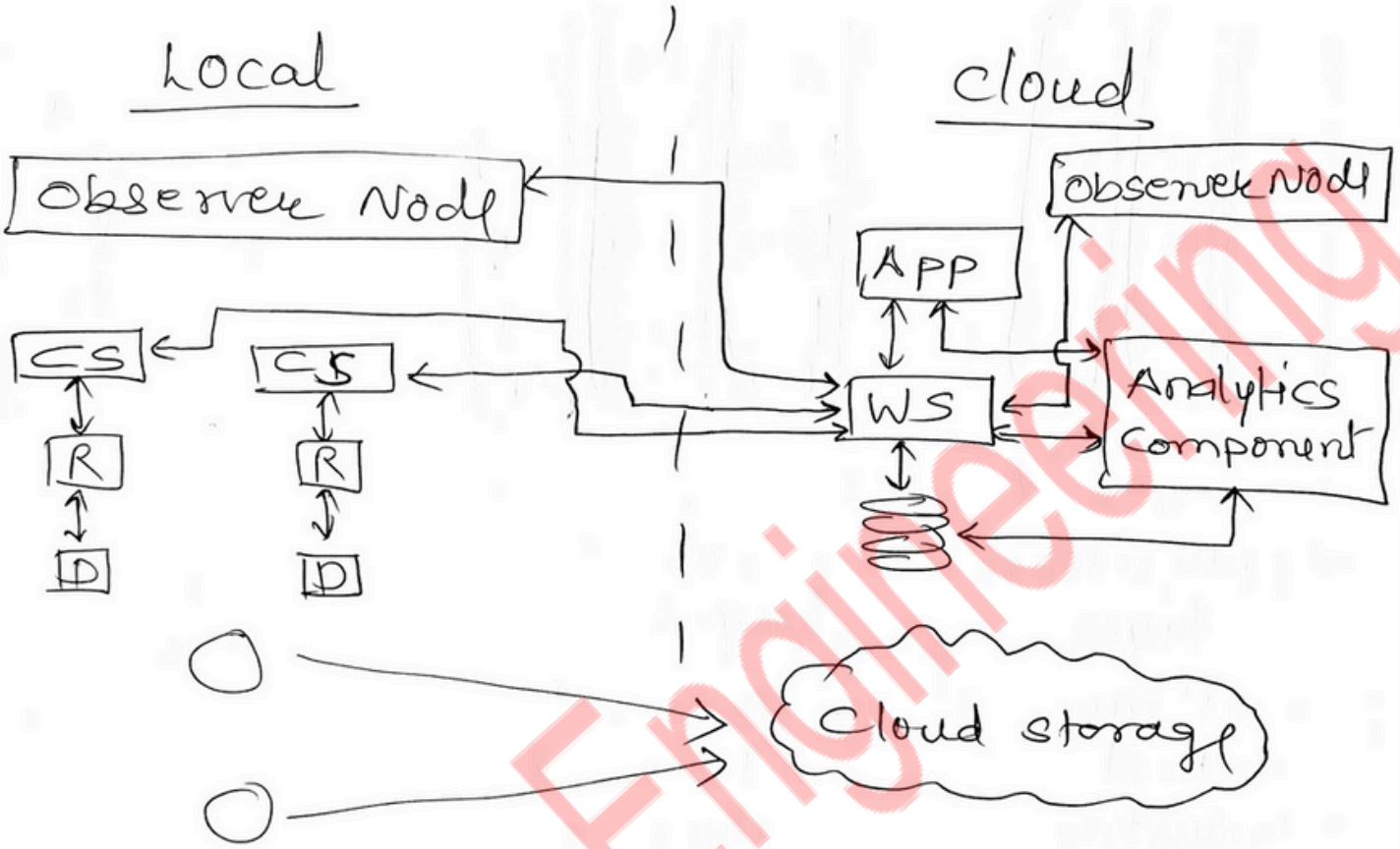
Level - 2



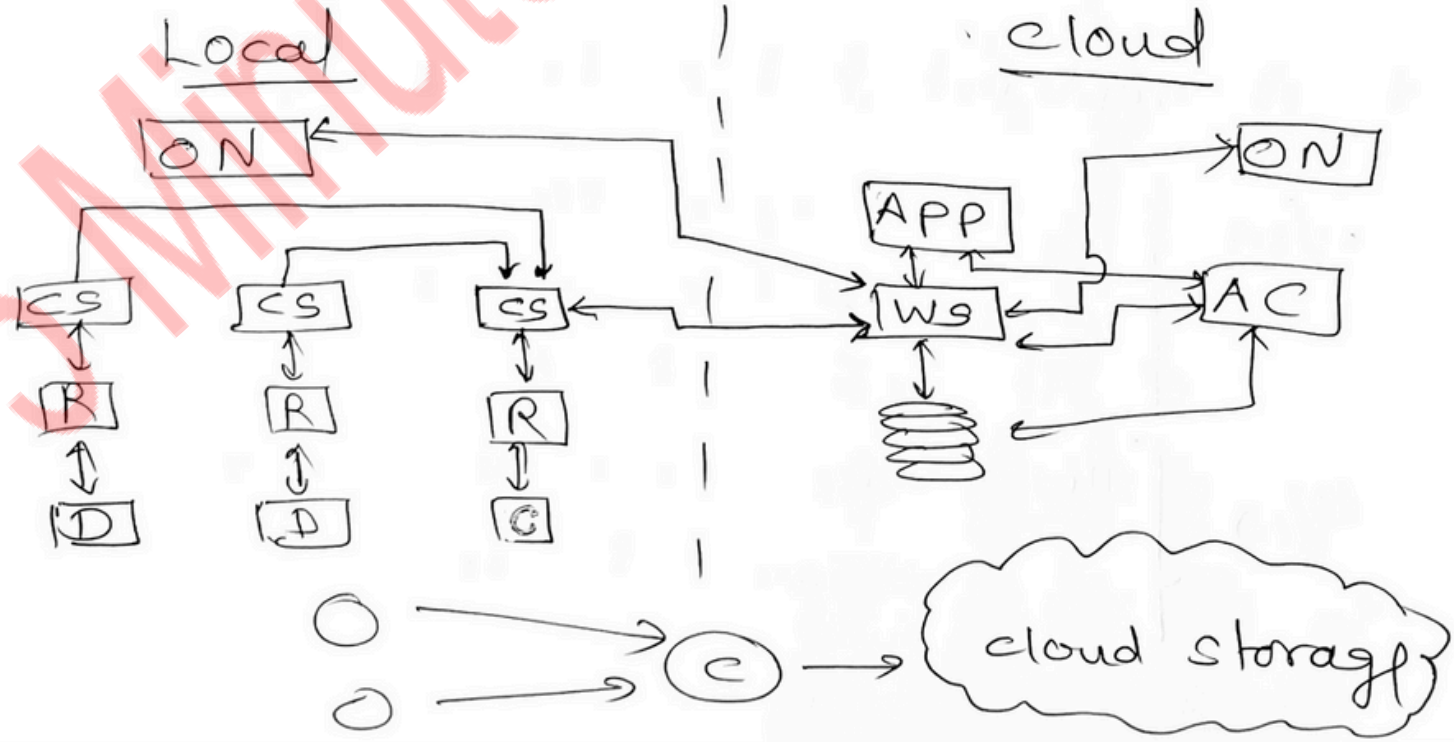
Level - 3



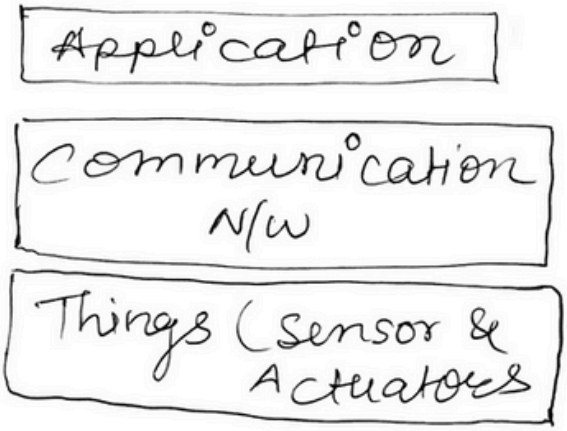
Level - 4



Level - 5



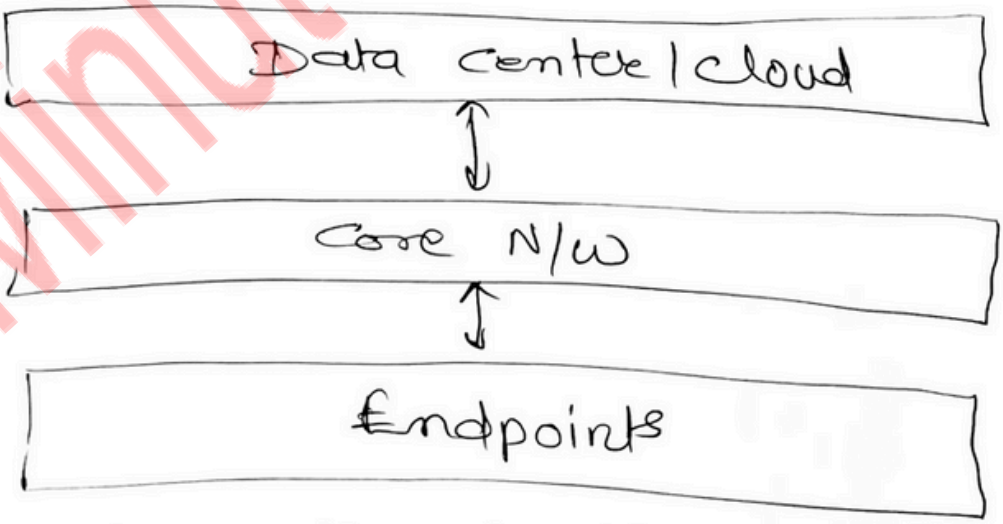
* Core IoT functional Stack



* IoT Data Mgmt & Compute Stack

⇒ IoT Data Mgmt & Compute stack

- → Minimizing Latency
- → Conserving N/w Bandwidth
- → Increasing Local Efficiency



(Traditional IT Computing Model)

- **Data-Related problems**
  - → B/w limited
  - → Latency can be high
  - → Volume of data transmitted can be high

To address these problems, we need to distribute data mgmt throughout IoT system.

- M2M (Machine to Machine)
  - Remote Monitoring
  - Control
  - Transfer
  - Protocols
    - Zigbee
    - Bluetooth
    - Modbus
    - 6LowPAN

M2M nodes EM

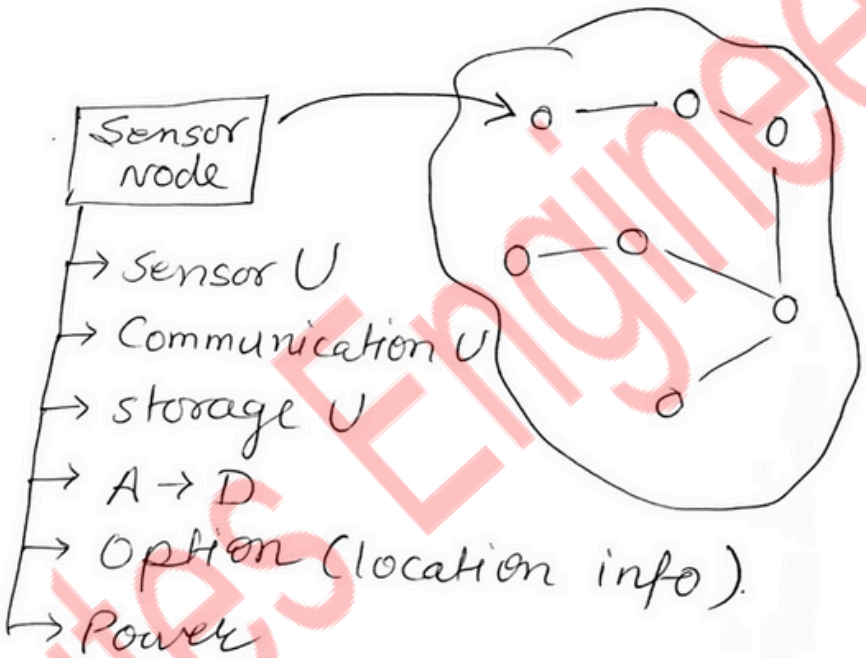
Communication n/w (wired/wireless)

→ Human Involvement (↓)

→ Efficiency & optimization (↑)

IOT	M2M
① Internet of things	① Machine to Machine
② Internet required	② Not dependent on Internet.
③ Cloud communication	③ Point-to-point communication
④ Both H/W & S/W	④ Mostly H/W.
⑤ B2B & B2C	⑤ B2B
⑥ Components: Sensor, connectivity, UI & data processing	⑥ Components: Device, Area n/w, gateway & Appln server.

* Wireless Sensor Networks : (WSN)



- Types of SNodes.
  - → Stationary
  - → Mobile
    - → Underwater
    - → ~~Aerial~~ Aerial
    - → Terrestrial

IoT protocols

N/W Protocols

- Wifi
- Bluetooth
- ZigBee
- 6LoWPAN
- LoRaWAN
- Cellular.

Data Protocols

- AMQP
- MQTT
- HTTP
- CoAP
- DDS
- XMPP

IoT N/W Types

Cellular N/W

- 3G
- 4G
- 5G

LAN/PAN

- Bluetooth
- wifi

LPWANs

- LoRaWAN

Mesh Protocol

- zigbee

① IEEE 802.15.4

- wireless
- low power consumption.
- low data rate.
- PANs
- Cost effectiveness.
- Security: AES.

② 6LoWPAN

- IPv6
- Low Power
- Wireless PANs

- 200 m (max)
- 200kbps
- 100 max nodes.

③ ZigBee : (WSN, Mesh topology) (Mostly)

- AL
- PL
- SL
- TL
- NL

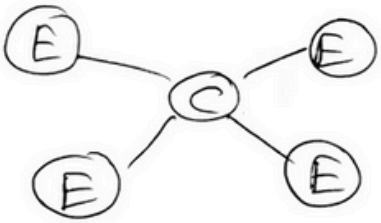
} ZigBee

Additional Communication Enhancement } Security, Authentication, Encryption, Routing.

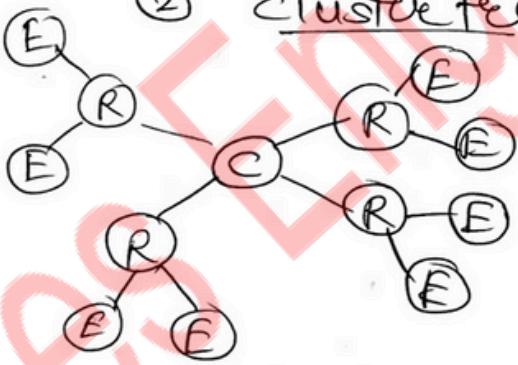
DLL, PL } IEEE 802.15.4

- Topology

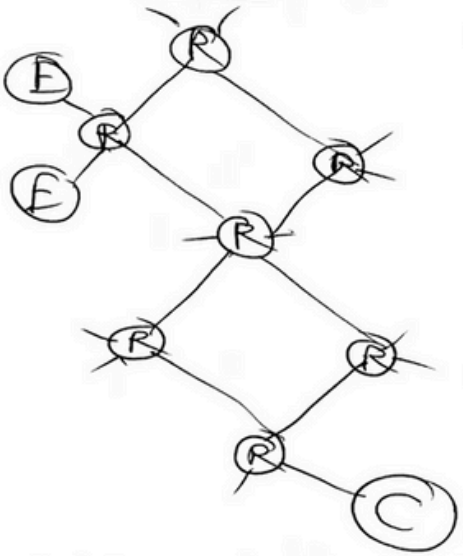
① star



② cluster tree



③ Mesh



C : ZigBee Coordinator

R : ZigBee Router

E : ZigBee End Devices

④ RFID

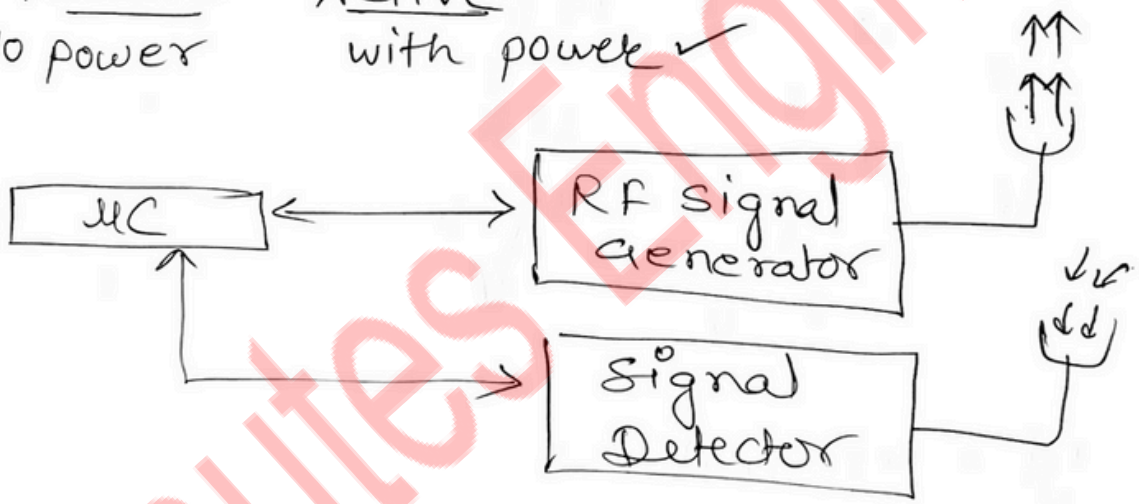
- RFID Tag
- RFID Reader
- AIDC (Automatic Identification & Data collection) (wired)

Data → |||||||| → Reader → Get data

Tag
- IC (R, W, RW..)
- Antenna
- Protective cover

Passive — No power

Active — with power



⑤ NFC [Near field communication]

- Active
- Passive
- 4cm ya kam (Short Range)
- NFC Tags & Business cards
- Transactions / Payments
- Security (↑)
- Electromagnetic Radio field
- Power (↓)

⑤ MQTT: [Message Queue Telemetry Transport]

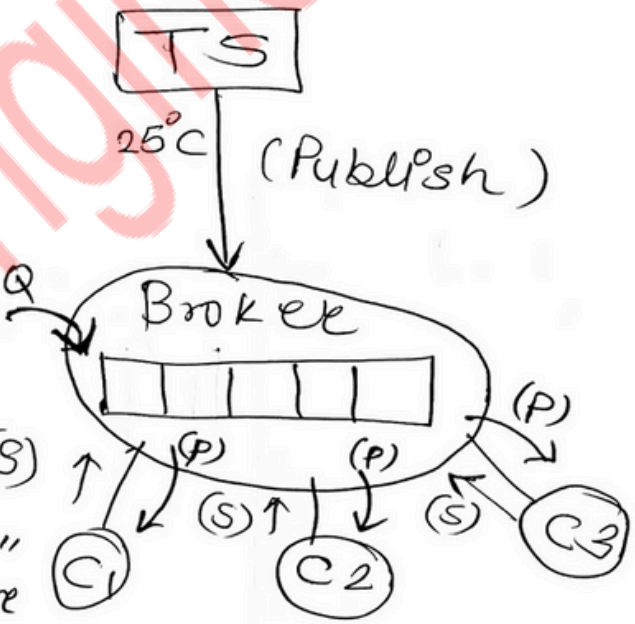
- Publish - Subscribe
- Introduced by IBM in 1999

* Components

- Publisher (sensors)
- Subscriber (client)
- Broker (Middleman)

* Methods

- connect
- Disconnect
- Publish
- subscribe



Topic:

" home / hall / temperature "

⇓

\+ ← wildcard (single level.)

(kitchen)

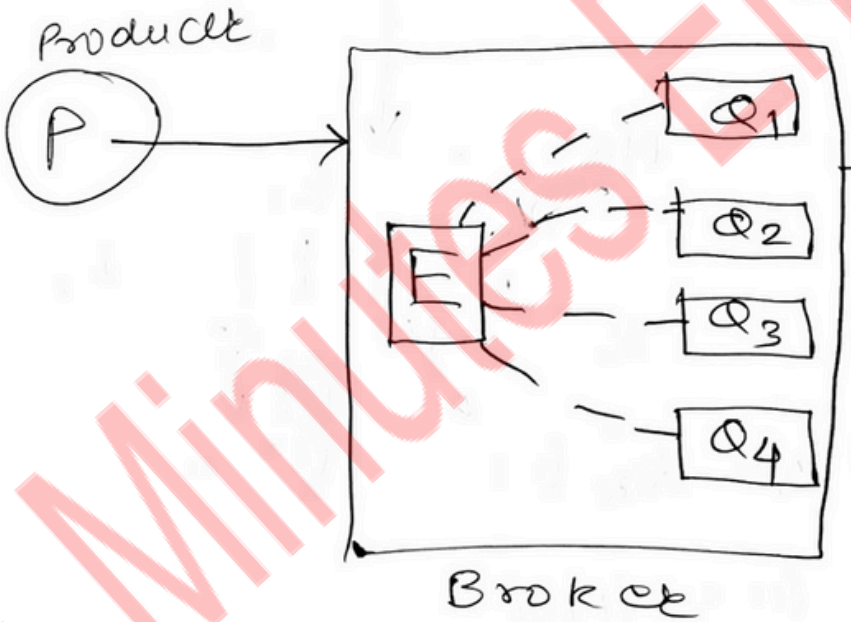
(Bedroom)

" home / # ← Multi level wildcard.

⑥ AMQP : [Advanced Message Queuing Protocol]

↳ Basic unit : Frame

- Open
- close
- Begin
- End
- Attach
- Detach
- Transfer
- flow
- Disposition



Exchange Types

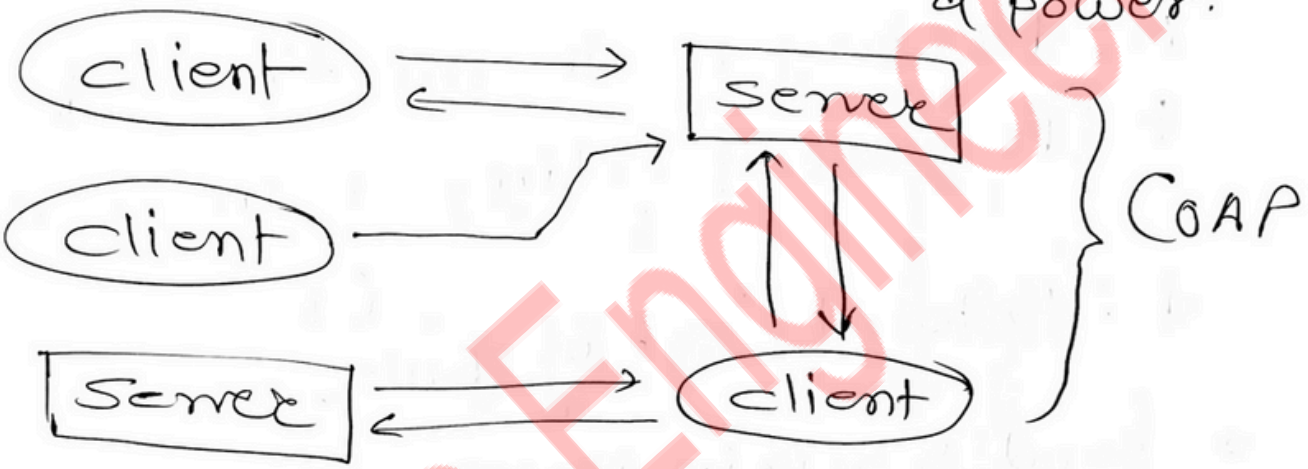
- Direct
- fanout
- Topic
- Header

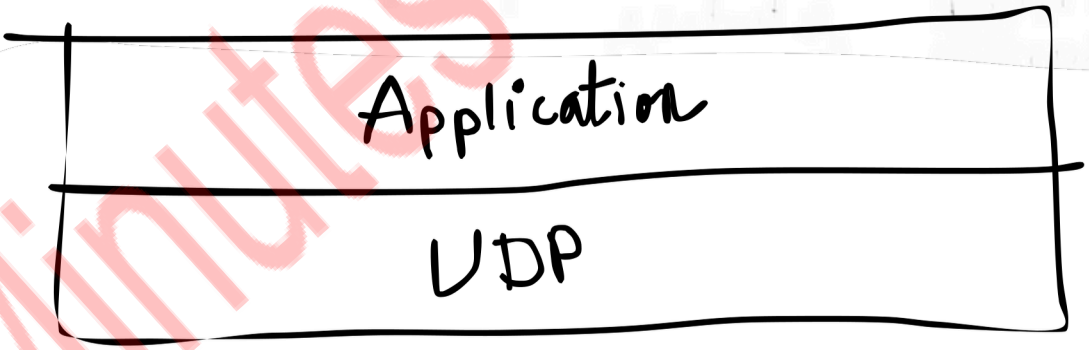
⑦ CoAP : [Constrained Application Protocol]

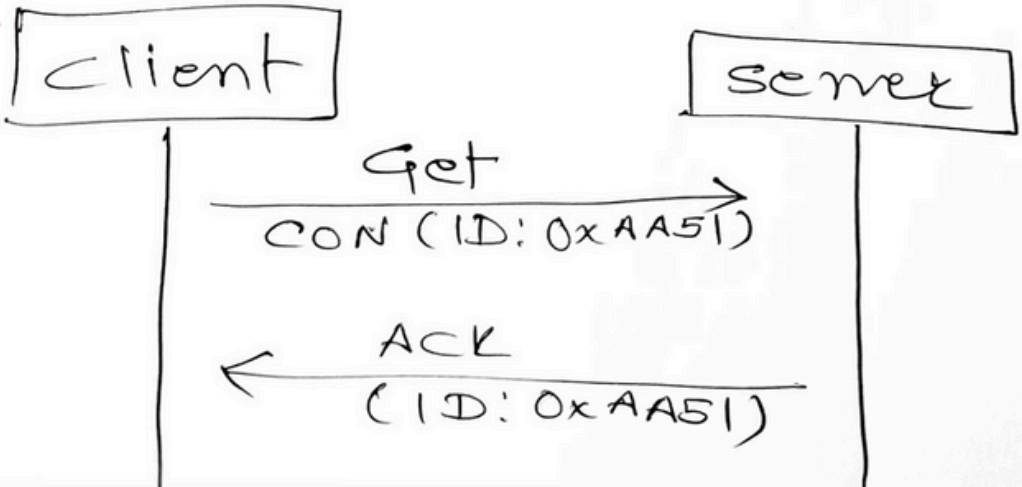
- Constrained → nodes & n/w
- Application → AL Protocol
- → web transfer protocol.
- → M2M communication.

"Constrained"

→ limited processor, memory & power.







⑧ XMPP : [Extensible Messaging & Presence Protocol]

- Based on XML
- chat protocol for transmission of XML fragments. betn n/ws.

~~X: exe~~

X: extensible [changed / extended]

M: Messaging in real time [Whatsapp]

P: Presence. [online / offline / busy] state

P: Protocol [set of Rules].

- send & receive messages.
- check status
- Manage contact
- Block user communication.

- DDS : Data Distribution Service
  - ↳ P S Protocol
  - ↳ Broker less/free
  - ↳ Distributed nature
  - ↳ single point failure
  - ↳ OMG
  - ↳ M2M communication
  - ↳ Layers
    - ↳ DCPS
    - ↳ DLRL

Arduino :

- Open source H/w & S/w platform
- free to study, update & distribute.
- Consists of a circuit board
  +
  Ready made S/w [Arduino IDE]
  (To write & upload code to board)
- Use of simplified version of C++.
- NO extra H/w required to load code onto board, just use USB cable.

- Raspberry Pi
  - Single Board Computer [SBC]
  - Consist of processor, memory, I/O interface on single circuit Board.
  - Uses of Raspberry Pi
    - Games
    - Editing
    - Browsing
    - Mgmt of Accounts
  - Developed by Raspberry Pi foundation
  - Small size & affordable.
  - features
    - CPU
    - HDMI Port
    - GPU
    - RAM
    - Ethernet Port
    - SD Card slot

Arduino

- Based on MC
- Simple H/w & S/w
- 8 bit CPU
- 2kB RAM
- Cheaper
- 200mW power
- LL = 5V
- Bf (↑↑)

RaspberryPi

- Based on Mp
- Complex
- 64 bit CPU
- 1GB RAM
- expensive
- 700mW power
- LL = 3V
- Bf (↑)