

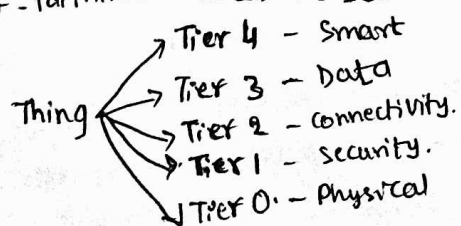
## Chapter-2

### Thing in context of IOT

- \* It is an entity (or) physical object that is a unique identifier, an embedded system, having the ability to transfer data over a network.
- \* Capability to sense the environment.
  - through the embedding of sensors.
- \* Ability to communicate.
  - with humans also, to solve bigger problem, dynamically together to do the work.
- \* Computation capabilities.
  - Capable of thinking & analysing, capability depends on characteristics of the computing hardware
- \* Control other things.
  - can remotely access other things to affect a change in its state.
  - can trigger certain functionality in a remote thing by commanding
- \* Accessibility.
  - Can have a unique address/code that can be used to identify it uniquely out.

### Needs of an IOT Thing

- \* Maslow's hierarchy of needs is a theory that describes the behavioural motivation of a human.
- \* Applied in Data science, Choosing a right data center, employee needs, market analysis, Retail, Technology integration.
- \* Basic needs  $\left\{ \begin{array}{l} \text{physiological - food, water, warmth, rest} \\ \text{safety - security, safety.} \end{array} \right.$
- \* psychological needs  $\left\{ \begin{array}{l} \text{Belongingness & love - intimate relationships & friends} \\ \text{Esteem needs - prestige & feeling of a accomplishment} \end{array} \right.$
- \* Self-fulfillment needs - Self actualization



#### ① Self existence

- physical needs. (Tier 0)

- \* having power to be "on" & having ability to sense the environment and a connection, that helps to transmit the values that are sensed
- \* need protection from external environment & various things need different kinds of physical enclosures.

- security needs. (Tier 1)

- \* Having a protective shield.

- \* Able to distinguish between a genuine user, asking for attributes and a rogue (hacker) trying to extract information.

- \* Protection in form of encryption, authentication & authorization

## ② self expression.

- After basic needs met, things looking for a way to connect with other things & feel the belongingness, the data that thing gathers should be usable & shareable.

- Connectivity needs (Tier 2).

- \* The ability of a thing to reach out & express about its form & function, that is, self-expression is fundamental to its existence.

- \* Unique identity makes it enable to communicate with each other.

- \* Transport & network protocols comes into play to fulfil the connectivity.

- Data needs (Tier 3).

- \* It determines what, where, how & quantity of data the 'thing' is going to acquire. Based on need of particular 'thing'.

- \* Kind of environment, locations, modalities of acquisitions & frequency of data collection are all programmed. Thing needs a way to pre-process & store the data, to make it available for higher-level processing.

## ③ self-actualization.

- \* It reflects ability of thing to reach its full potential, able to display intelligent & learned behaviour.

- Smart needs (Tier 4).

- \* Thing finally is able to realize itself & get the feeling of self-fulfilment, able to perform the functions it is made for.

- \* Have several attributes, such as predictivity, self-configuration & learned behaviour.

## Commonly Used Smart Things.

- \* Home - Many things can become smart such as power outlets, lighting & switches, door knobs, door bells, water taps, door locks.

- \* Kitchen - Bluetooth-enabled cutlery, connected refrigerator, remotely controllable crack-pot, cooker, etc --

- \* Office - badges for security, lighting, window shading, chairs, meeting, scheduling, etc

## How can Things Become Smart?

- \* Smartness to things should make them to do tasks which they are already performing in an easier way & adding new functionality that the thing is not originally intended to do.

with following technologies

### - Sensors & Actuators

- \* Sensors enable things to sense their surroundings & obtain certain information & used to perform task.

- \* Actuator is not only a sensor, but is also able to perform a certain action based on the change of a state of a certain parameter.

- \* Thing can command another thing to perform certain action, actuator comes into picture at this juncture.

- \* Actuator is able to move & control a mechanism.

### - Communication over network interfaces

- \* To interconnect with other things is a central part of IoT and requires communication protocols.

- \* HTTP, TCP & IP stack are being transformed to specifically IoT devices communication.

- \* Because the IoT devices are deployed in diverse ways, several communication protocols such as WiFi & low power technologies such as LPWAN & IEEE 802.15.4

### - Connecting to the Internet.

- \* Things usually connect to other things via local network in situation where only local communication is necessary.

- \* main feature of IoT is ability to remotely control things & transmit data measured by things over the Internet, connecting to IP network.

## Machine-to-Machine Technology

- \* resides in non-consumer world.

- \* mostly a business solution for automation & instrumentation, where machines of same type or function are usually connected either by wired & wireless.

- \* Helps in remote monitoring and management of equipment.

- \* Some examples where M2M technology is prevalent are, supply chain, traffic control systems, logistic services, telemedicine, etc.

## European Telecommunication Institute (ETSI) - M2M

- \* ETSI developed a set of M2M specifications based on Representational State Transfer (RESTful) architecture to the way heterogeneous devices can offer services & access to them seamlessly.



\* The components of this M2M system are.

### M2M device:

- \* consists of sensors and communication equipment that are at the lowest end of M2M system.
- \* connected to an operator's own network such as Zigbee, Bluetooth, Device Language Message Specification (DLMS), etc.
- \* Gateways play a major role in ensuring that data is further moved for processing, and responsible for the proper addressing & routing of the devices. & outside the scope of network operator.
- \* The devices connected to fixed network, form the end points of network & so managed by network operator.

### M2M Area Network Layer

- \* Connection b/w M2M device and gateways, possible via various area networks such as WBAN & WPAN using technologies such as IEEE 802.15.6 Zigbee / IEEE 802.15.4, Bluetooth, etc.

### M2M Gateways

- \* Gateways along with routers are equipment that ensure the connection of M2M devices to communicate with M2M applications, via communication network.
- \* If M2M devices are not connecting directly to the network, then gateway acts as an end point to operator's network.

### M2M communication network

- \* At first, relied on specialized communication networks.
- \* mainly the communications b/w the M2M gateways & M2M applications.
- \* Technologies such as GSM, WiMAX, WLAN, satellite, etc.

### M2M service layer

- \* One of the core M2M layers which provides M2M standardized device and data related functionalities such as data transport & device management.
- \* One M2M is a global initiative to standardize a common M2M service layer platform.

### M2M applications

- \* Top of the M2M system.
- \* A middleware layer sits between the communication layer & applications.
- \* Typical applications are -  
Health monitoring, Remote access & monitoring of equipment, smart grid applications, smart meters, Tracking & monitoring of assets, monitoring production chain in a manufacturing unit.