



1.a) Physical design of IoT focuses on how IoT devices are built internally & how they communicate with each other.

- "Things" in IoT refers to an IoT device with a unique identity that has capability of sensing, monitoring & actuating. IoT devices can send & receive data directly or indirectly & also has ability to process it to information. This can be done locally, remotely, using a centralised server or a cloud based application platform. The communication is done over the internet.
- Link layer manages physical level of data communication in the network. Eg. copper wire, twisted pair cable, radio waves or coaxial cable etc. It protocol manages communication between devices & hosts to which devices are connected. Some well known protocols are 802.3, 802.11, 802.16, 2G/3G/4G, Network/Internet Layer, IPv4, IPv6.
- Transport layer manages end to end communication irrespective of underlying network. Transport layer defines communication to be connection oriented or connectionless. Added features such as error correction, segmentation, congestion control & flow control are also managed by transport layer. TCP & UDP are transport layer protocols.
- Application layer protocol manages how the lower layer protocols & application interface will be communicated - for sending & receiving of data packets. Applications usually use files as a transfer mechanism. Such files are encoded by application layer protocols &

Compressed by transport layer protocols. Some well known application layer protocols are HTTP, CoAP, WebSocket, MQTT, XMPP, DDS, AMQP.

2.a) REST is a resource based API because RESTful API is:

- Things vs Actions
- Nouns vs Verbs
- Identified by URIs
- Multiple URIs may refer to same resource as like CRUD operation on student resource using HTTP verbs.
- Separate from their representations - resource may represent as per as request content type either JSON or XML

Representation

- How resources get manipulated
- Part of resource state - transferred between client & server
- Typically JSON or XML

REST architectural constraints are:

Client Server : By separating user interface concerns from data storage concerns, we improve the probability of user interface across multiple platforms & improve scalability by simplifying server components.

Stateless : Each request from client to server must contain all info necessary to understand the request be it implicitly or explicitly labelled, as cacheable or non-cacheable and cannot take advantage of any stored context on the server. Session state is therefore kept entirely on the client.

Cachable : Cache constraints require that data within a response to a request be implicitly or explicitly labeled as cacheable or non-cacheable.



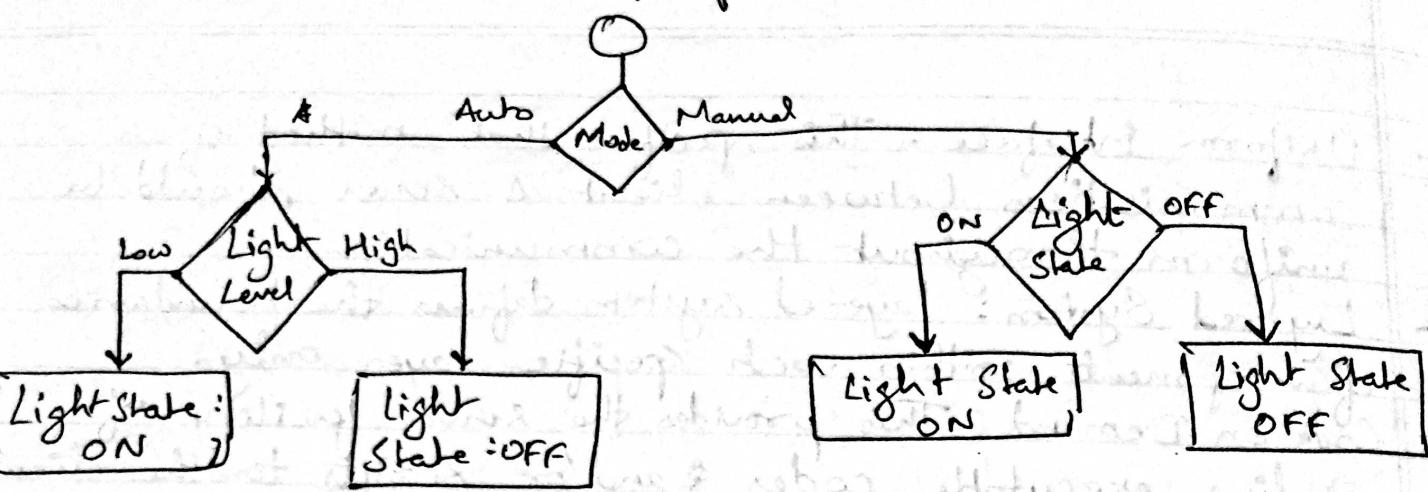
- Uniform interface : This specifies that method of communication between client & server should be uniform throughout the communication.
- Layered System : Layered system defines the boundaries of components within each specific layer only.
- Code on Demand : This provides the server facility of sending executable codes & and/or scripts to the clients. This constraint is optional.

2.b) Feature	LoRA	NB-IoT	CAT LTE M1	SIGFOX
i) Modulation	SS Chip	OFDMA	OFDMA	UNB/GFSK/GPSK
ii) Rx Bandwidth	500-125 kHz	200 kHz	20-1.4 MHz	100 Hz
iii) Data Rate	290 bps-50 kbps	Avg. 20 kbps	200 kbps - 1 Mbps	100 bit/sec 12/8 bytes max
iv) Max output power	20 dBm	20 dBm	23/30 dBm	20 dBm
v) Link budget	154 dB	150 dB	146 dB	151 dB
vi) Power Efficiency	Very High	Medium High	Medium	Very High
vii) Interference immunity	Very High	Low	Medium	Low
viii) Coexistence	Yes	No	Yes	No
ix) Security	Yes	Yes	Yes	No
x) Mobility/localization	Yes	Limited mobility	Mobility	Limited Mobility No localization

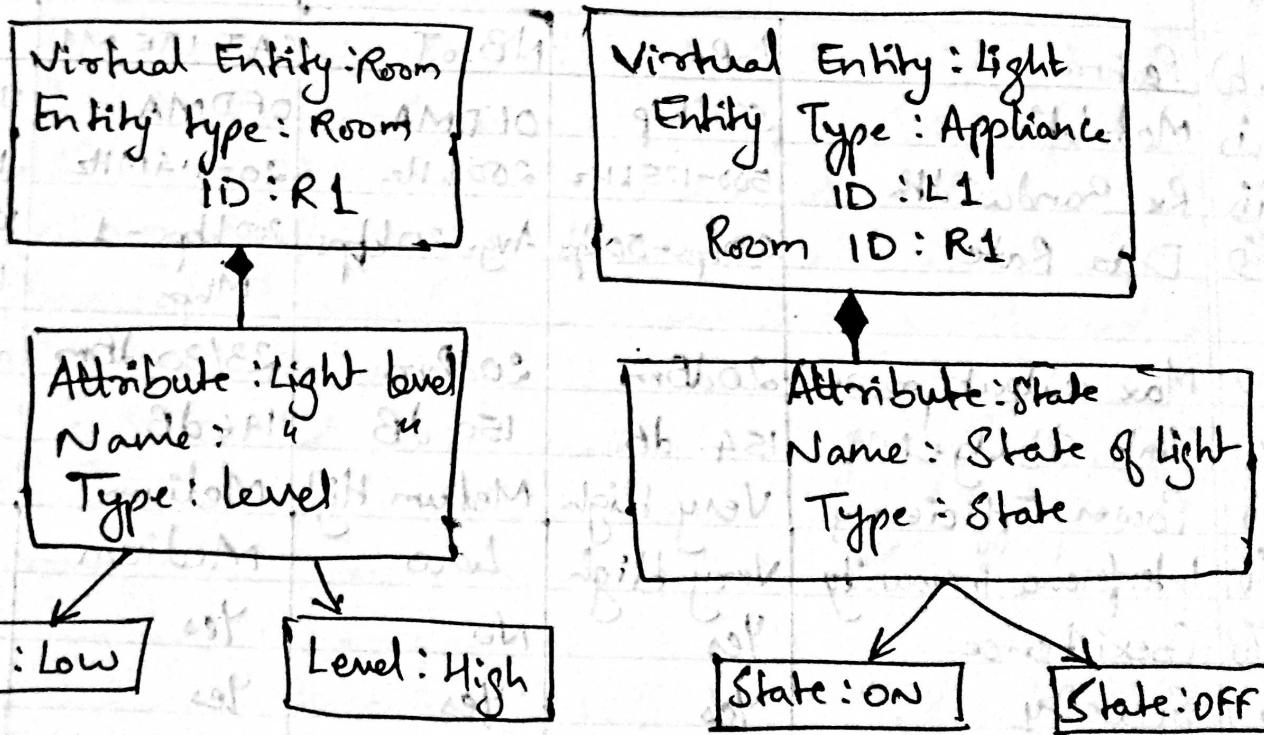
- 3.a) This is the fifth step in design methodology where we define a service specification that is describing various services in IoT system. It includes defining various services in the system, their service types, service

Inputs & outputs, service endpoints, service schedules, service preconditions, & service effects.

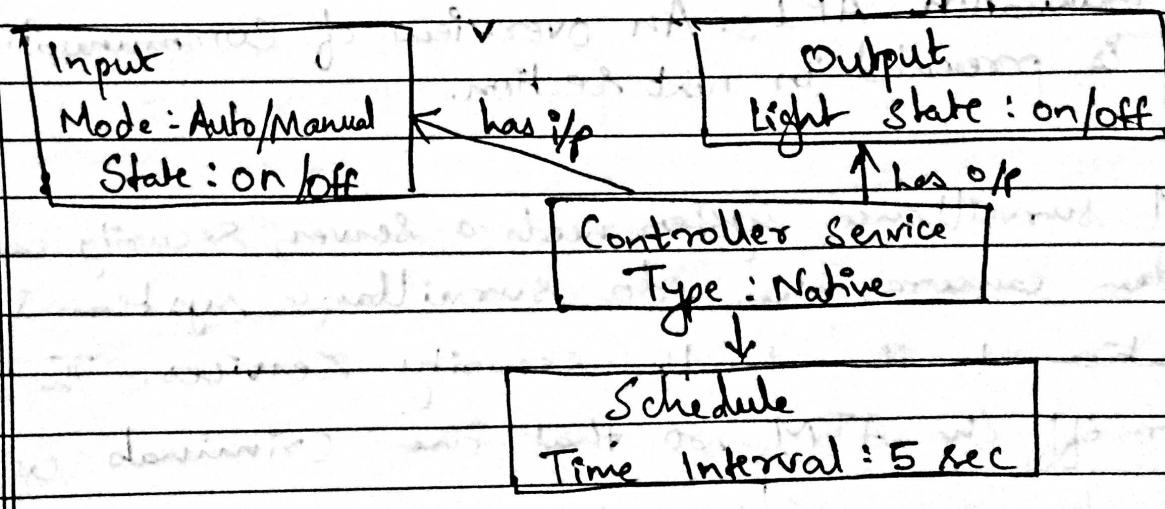
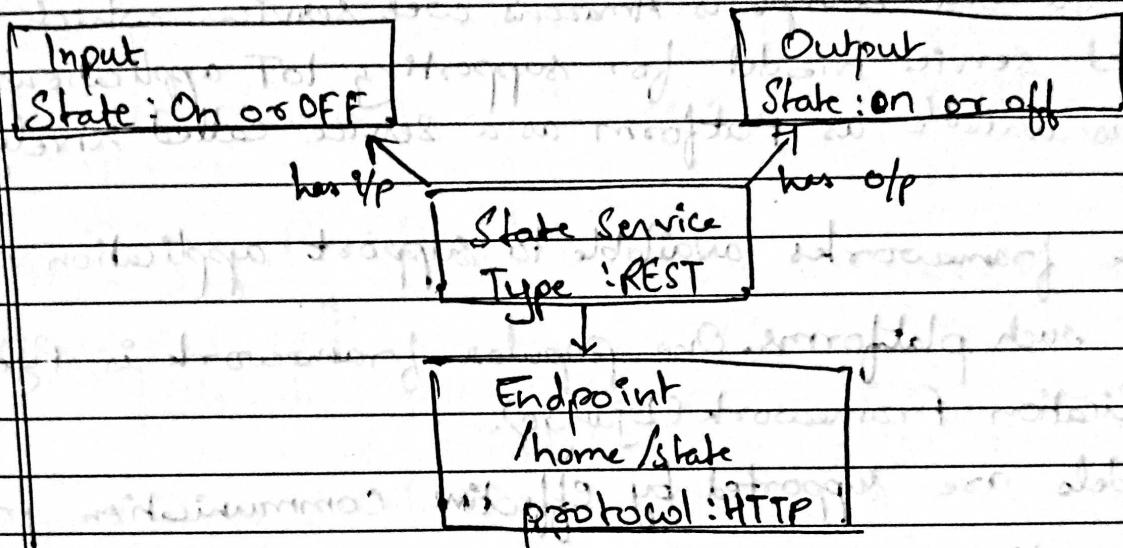
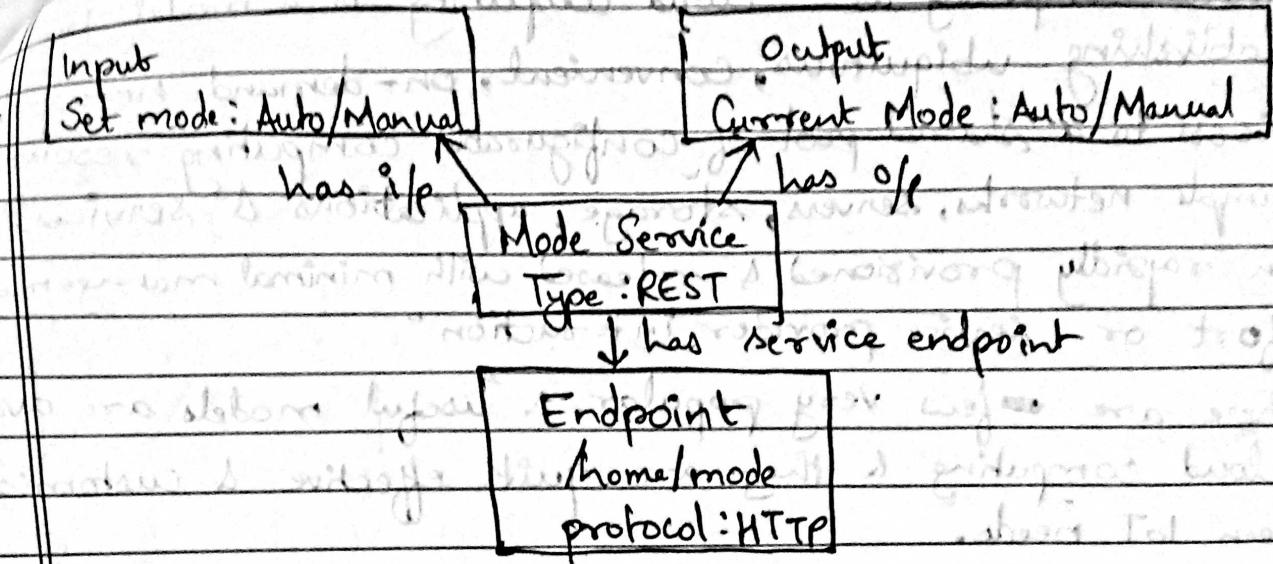
### Process Specification



### Information Model



From this process & information model specifications deriving service specifications:



4.a) Cloud computing has revolutionised the way services are exchanged over the Internet. Applications, data & services are delivered over the network using paradigm called cloud computing. NIST has specified the definition of cloud computing as "cloud computing is a model for establishing ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (for example networks, servers, storage, applications & services) that can rapidly provisioned & released with minimal management effort or service provider interaction"

There are few very popular & useful models are available for cloud computing & they are quite effective & customised for modern IoT needs.

One of the best examples is Amazon's web services which has dedicated service model for supporting IoT applications. Another model is available as platform as a service called Xively cloud for IoT.

There are frameworks available to support application development for such platforms. One popular framework is Python Web Application Framework (Django).

These models are supported by effective communication protocols & communication APIs. An overview of communication APIs is presented in next section.

5.a) ATM surveillance system needs a server, security camera or hidden camera, the video surveillance system sends a notification to the bank's security services. The officer can turn off the ATM so that the criminals will not be able to copy information or install any malware

on the ATM computer.

The function & features of ATM surveillance system are

Transfer of funds between linked bank accounts

Change your pin, receive account balance

An automated teller machine (ATM) is an electronic telecommunications device that enables customers of financial institutions to perform financial transactions such as cash withdrawals, deposits, fund transfer, account information inquiries, at any time & without the need for direct interaction with bank staff.

The purpose of a network video server is to translate the analog signal from CCTV cameras into a digital & IP based video stream capable of being broadcast over an IP network

Types of surveillance

Sentinel surveillance

Accelerated disease control - National Active

National Passive

The four type of components in surveillance system

Collection

Analysis

Response

Dissemination

Surveillance is the monitoring of behaviour, activities or information for the purpose of influencing or managing info for the purpose of directing.