# IOT

[CIA-I - UPTO IOT sys mgmt]

Date:
10 x 2
3 x 10

PART-B

1. Layers
2. Protocols in layers
3. Levels of IOT
4. APIs Models
5. Domains & application

IOT - Internet of Things

## IOT Protocols :

### Link Layer

Standards for Data Link Layer

802.15.1 - Bluetooth

5GHz
60GHz
— ISM (Industry Scientific Medicine)

2G / 3G / 4G / 5G Mobile comm

Data link layer is responsible for

- converting IP addr to MAC addr
- Making connections (mapping)

802.11 - WIFI 802.15.4 WPLAN

802.3 - Ethernet

- 2G - GSM (Global system for Mobile)
- 3G - Universal Mobile Telecomm systems (UMTS)
- 4G - Long Term Evaluation (LTE)

2Ch 4Ch

Data rate: 9.6 kbit/s to 100 Mbit/s

10Ch - 10Mbit/s

## Network Layer:

- Responsible for getting data from upper layer
- Data in Transport layer is segments
- IPv4 or IPv6
- Segments from Transport layer converted to Packets in network layer
- In Data link layer the data is as frames

6LoWPAN - IPv6 over Low Power Wireless Personal Area networks

## Transport Layer:

- end-to-end msg transfer capability independent of underlying network

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- set up connections using handshakes (in TCP) without handshake/acknowledgements (in UDP) User Datagram Protocol
- Provides functions - segmentation, Error control, Flow control, congestion control

## Application Layer:

- application dependent
- Port numbers are used for application addressing
  - Port 80 for HTTP
  - Port 22 for SSH
- Enable Process-to-process connection using ports

HTTP - Hypertext Transfer Protocol

CoAP - Constrained Application Protocol

Websocket, XMPP (Extensible Messaging & Presence)

DDS (Data Distribution Service)

Explain Briefly all the IOT Protocols

Ans: 4 layers (Appli, Transport, Network, Link)

Draw the Diagram & explain

## IOT communication Models : (3)

- Request - Response
  client sends request to server & server responds to client request
- Publish - Subscribe
- Push - Pull

## IOT communication APIs : (2)

API - Application Program Interface

I. REST - Representational state Transfer based communication APIs
II. Websocket based APIs

Client-server Stateless

17.1.24.

## Logical design of IOT :

### IOT Functional blocks :

- Application
- Management
- Services
- Communications
- Security
- Device


Sensing - sensing the physical phenomena

Date:

### IOT communication models :

i) Request - Response : client-server, stateless
ii) Publish - subscribe : Publishers, brokers & consumers
source of data
iii) Push - Pull : push data to queues
queue → intermediate b/w producers & consumers
iv) Exclusive Pair : Stateful

### IOT comm APIs : (4)

(What are the two types of comm APIs ?)

I) REST architectural constraints :

1. client-server :- separation of concerns
2. Stateless :-
3. cache-able :-
4. Layered system : constraints behaviour of components
Scalability = hardswapping (adding some more components while the system is running)
5. Uniform Interface
6. Code on Demand

RESTful web service

- URI - Uniform Resource Identifier
- JSON - Javascript on - most popular media type for this service

|| WebSocket Based communication APIs :

> Bidirectional - full-duplex
> Exclusive pair comm model
> Don't req a new connection
> suitable for IOT applications
  • low latency & high throughput requirements

IOT Enabling Technologies. :

i) Wireless sensor networks (WSN) : coordinators
> source of i/p > end device > routers - Intermediate nodes
eg: Indoor air quality monitoring sys

ii) cloud computing
> storing info > computing, networking
Different forms => Infrastructure as a service
=> S/w as a service => Platform as a service

iii) Big Data Analytics
> Data cleansing, merging, processing
eg: sensor data from weather monitoring system,
> Data generated for location & tracking of vehicles


Charac of Big data
• volume • velocity • variety. Data ! ! !

iv) Communication Protocols
v) Embedded systems (ES)
eg: Digital watches, cameras, POS terminals, vending machine, washing machienes

IOT Levels & Deployment Templates :

> IoT system : comprises of
i) Device ii) Resource iii) controller service iv) DB
v) Web service vi) Analysis component
vii) Application

IOT System Level - 1
> Single node / device
> low-cost, complexity solns : not big Data
eg: Home Automation
> Controller service
> Application

Level 1 - Diag in PPT (All devices in local)

IOT System Level - 2 :
> Single node > Data stored in cloud
> Application : cloud based
> suitable for solns : big data
> eg: Smart irrigation
> cloud - based web service
> cloud - based application

Level 2 - Diag (uses both Local & cloud)

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> eg: Smart irrigation
> cloud-based web service
> cloud-based application

Level 2 - Diag
(uses both Local & cloud)

IOT system level-3 :

> single node > Data : Stored & analyzed in cloud
> Application cloud based > Soln : big data
eg : Facility package handling
> Bigger Alerts
> Benefits of using WebSocket

Drag for level 3

IOT system level-4 :

eg : Noise Monitoring
> Multiple nodes > Data : stored in cloud
> Appln : cloud-based
> Local & cloud-based observer nodes
> Observer nodes (coordinator)
> Soln : multiple nodes, big data
> level-3 vs level 4 - multiple nodes & observer in Lvl 4

Drag

IOT system level-5

> Multiple end nodes & 1 coordinator node
> Data stored & analyzed in cloud
eg : Forest Fire detection

Drag

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IOT system level-6

eg : weather monitoring

Drag

> Multiple nodes > centralised controller

Domain specific IoT : Diag

- cities
- Energy
- Logistics
- Industry
- Home Automation
- Environment
- Retail
- Agriculture
- Health & Lifestyle

} IOT Application

Components of a Microprocessor/Microcontroller :

Microcontroller : It is a microcomputer used for control purposes

Sensors : transducer that converts a physical stimulus from one form into a more useful form to measure the stimulus

5 & basic categories

1. Analog
2. Discrete — Binary / Digital

Types of sensors :

- Light
- Temperature
- Pressure / Force / weight sensor

RFID : (Radio Frequency ID)

RFID Applications : Tracking inventory control / Identification in supply chain systems

Passive RFID - no power source

Active RFID - have power source

PART - A 2m eg: what is use of IR sensor ?
Or for this application which sensor is used ?

IoT and M2M — Diff b/w IoT & M2M 5m

↓ with/without human intervention

↓ No human intervention

Virtualisation - resources are used in an efficient way among users.

cloud - where the resources are stored

Gateway - translation of protocols depending on objects

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Protocols in each layer IoT / M2M / IoT

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Software defined Networking (SDN):

Application layer
control layer → control plain
Infrastructure layer → Data plain

What is the interface b/w control & Infra layer & appli layer & control layer ?

↓

Southbound & Northbound Open API (open flow)

SDN → All the configurations are programmable

Infrastructure layer : data plane
Control layer : control plane
Application layer : User can interact

Key Elements of SDN :

- Centralized network controller
- Programmable Open APIs (One of prgming lang used is YANG)
- standard communication Interface (Open Flow)

(24) 5m, 7m or 10ms

# [SDN - Architecture, Layers, key elements]

## Network Functions Virtualization (NFV)

NFV Architecture

key elements of NFV:

- Virtualization layer
- NFV Infra (NFVI)
- Network Virtualization Functions
- Mgmt & orchestration (MANO)