



SNS COLLEGE OF ENGINEERING

An Autonomous Institution

Coimbatore-107



19IT503-INTERNET OF THINGS

UNIT-1 IoT INTRODUCTION AND APPLICATIONS

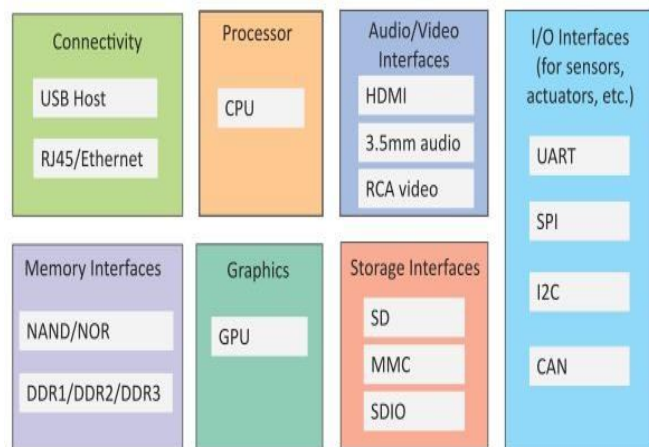
Topic:5– Physical Design of IOT-Logical Design of IOT

Physical Design of IoT

- The "Things" in IoT usually refers to IoT devices which have unique identities and can perform remote sensing, actuating and monitoring capabilities.
- IoT devices can:
 - Exchange data with other connected devices and applications (directly or indirectly), or
 - Collect data from other devices and process the data locally or
 - Send the data to centralized servers or cloud-based application back-ends for processing the data, or
 - Perform some tasks locally and other tasks within the IoT infrastructure, based on temporal and space constraints

Generic block diagram of an IoT Device

- An IoT device may consist of several interfaces for connections to other devices, both wired and wireless.
 - I/O interfaces for sensors
 - Interfaces for Internet connectivity
 - Memory and storage interfaces
 - Audio/video interfaces.



Generic block diagram of an IoT Device

Connectivity

- Devices like USB host and ETHERNET are used for connectivity between the devices and server.

Processor

- A processor like a CPU and other units are used to process the data. these data are further used to improve the decision quality of an IoT system.

Audio/Video Interfaces

- An interface like HDMI and RCA devices is used to record audio and videos in a system.

Input/Output interface

- To giving input and output signals to sensors, and actuators we use things like UART, SPI, CAN, etc.

Storage Interfaces

- Things like SD, MMC, SDIO are used to store the data generated from an IoT device.

Memory Interfaces

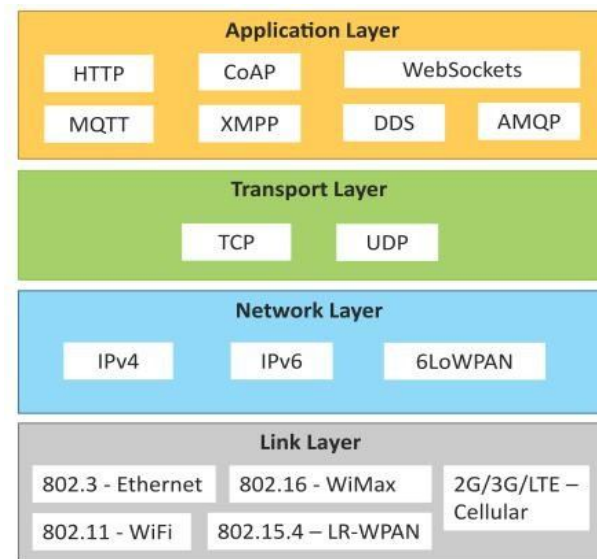
- Memory interface are usually chipsets, which makes computations / processing along with processor.

Graphics

- GPU is a processor that is specially-designed to handle intensive graphics rendering tasks.

- Link Layer
 - 802.3 – Ethernet
 - 802.11 – WiFi
 - 802.16 – WiMax
 - 802.15.4 – LR-WPAN
 - 2G/3G/4G
- Network/Internet Layer
 - IPv4
 - IPv6
 - 6LoWPAN
- Transport Layer
 - TCP
 - UDP
- Application Layer
 - HTTP
 - CoAP
 - WebSocket
 - MQTT
 - XMPP
 - DDS
 - AMQP

IOT Protocols



IOT Protocols

Application Layer protocol

- In this layer, protocols define how the data can be sent over the network with the lower layer protocols using the application interface. These protocols including HTTP, WebSocket, XMPP, MQTT, DDS, and AMQP protocols.

HTTP

- Hypertext transfer protocol is a protocol that presents in an application layer for transmitting media documents.
- It is used to communicate between web browsers and servers.
- It makes a request to a server and then waits till it receives a response and in between the request server does not keep any data between two requests.

CoAP

- Constrained Application Protocol (CoAP) used for M2M applications, meant for constrained environments, networks and devices.
- It is used for web transfer protocol and uses request –response model
- It runs on UDP instead of TCP

XMPP

- Extensible Messaging and Presence Protocol(XMPP) is a protocol for real-time communication and streaming XML data between network entities. It provides messaging, gaming, presence, data syndication, multi-party chat, voice/video calls.

WebSocket

- This protocol enables two-way communication (Full duplex) between a client and server. It is based on TCP

MQTT

- Message Queue Telemetry Transport, is light weight messaging protocol based on publish-subscribe model. It is well suited for constrained environment with limited resources.

AMQP

- Advanced Message Queuing Protocol is a protocol for message-oriented middleware environments. It supports both point-to-point and published/subscriber model.

DDS

- Data Distribution Service (DDS) is a data-centric middleware standard for M2M communication. It uses publish-subscriber model. DDS provides QoS control and configurable reliability.

Transport Layer

- This layer is used to control the flow of data segments and handle the error control. also, these layer protocols provide end-to-end message transfer capability independent of the underlying network.

TCP

- The transmission control protocol is a protocol that defines how to establish and maintain a network that can exchange data in a proper manner using the internet protocol.

UDP

- a user datagram protocol is a part of internet protocol called the connectionless protocol. this protocol not required to establish the connection to transfer data.

Network Layer

- This layer is used to send datagrams/datastream from the source network to the destination network. we use IPv4 and IPv6 protocols as a host identification that transfers data in packets.

IPv4

- This is a protocol address that is a unique and numerical label assigned to each device connected with the network. an IP address performs two main functions host and location addressing. IPv4 is an IP address that is 32 bit long.

IPv6

- It is a successor of IPv4 that uses 128 bits for an IP address. It is developed by the IETF task force to deal with the long-anticipated problems.

6LoWPAN

- **IPv6 over Low power Wireless Personal Area Network**, It brings IP protocol to the low power devices with limited processing capability. It operates in 2.4 GHz at 250 Kb/s transfer rate.

Link Layer

- Link-layer protocols are used to send data over the network's physical layer. It also determines how the packets are coded and signaled by the devices.

Ethernet

- IEEE 802.3 is a collection of wired ethernet standards for the link layer. It is a set of technologies and protocols that are used primarily in LANs. it defines the physical layer and the medium access control for wired ethernet networks.

WiFi

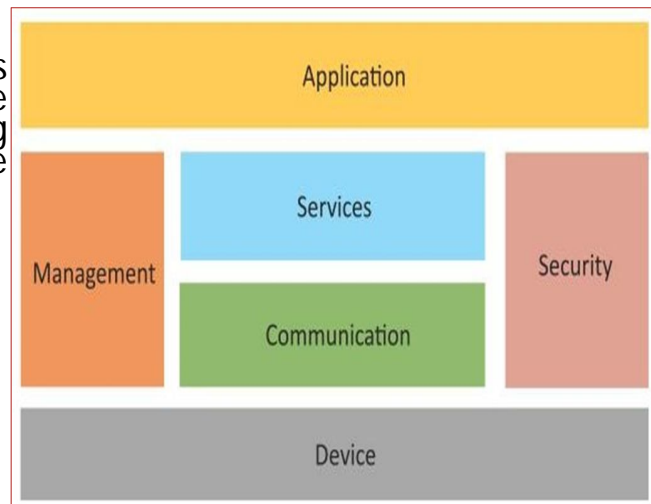
- IEEE 802.11 is a collection of WLAN communication standards, including extensive description of link layer. It operates mostly in 2.4 Ghz/5 Ghz. Some Others operates at 60Ghz.

- **WiMax:** IEEE 802.16 (**worldwide interoperability for microwave access**) is a collection of wireless broadband standards, including extensive description for link layer. It provides data rates from 1.5 Mb/s to 1 Gb/s. The recent update 802.16m provides data rates of 100 Mbits/s for mobile stations and 1 Gbits/s for fixed stations.
- **LR-WPAN:** IEEE 802.15.4 is a collection of standards for **low rate WPANs (LR-WPANs)**. These standards form the basis of specifications for higher level communication protocols such as ZigBee. These standard provides data rates from 40Kb/s 250 Kb/s.

- **2G/3G/4G-Mobile communication:** This includes
 - 2G GSM and CDMA
 - 3G UMTS and CDMA2000
 - 4G including LTE

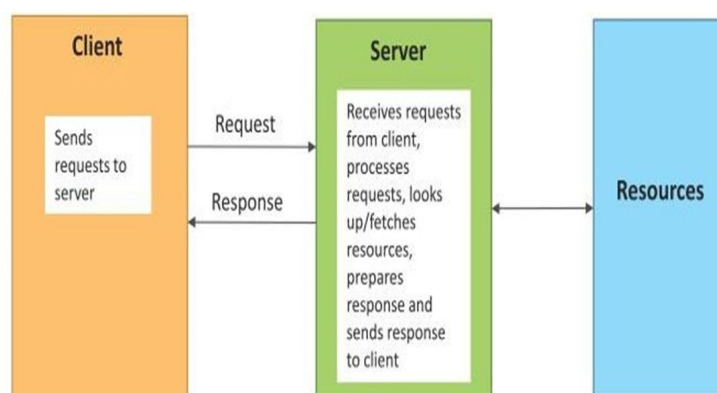
Logical Design of IoT

- Logical design of an IoT system refers to an abstract representation of the entities and processes without going into the low-level specifics of the implementation.
- An IoT system comprises of a number of functional blocks that provide the system the capabilities for identification, sensing, actuation, communication, and management.



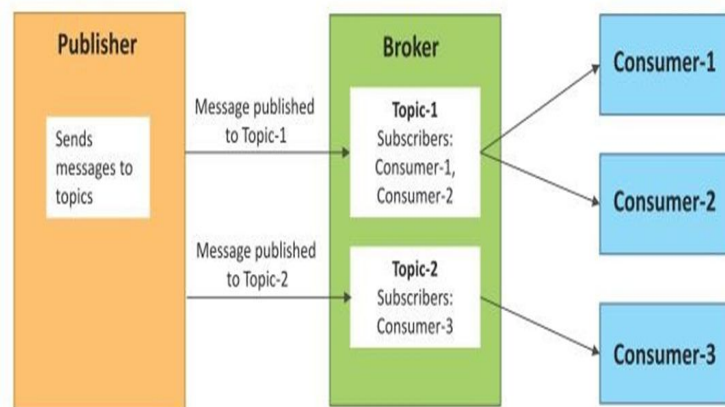
Request-Response communication model

- Request-Response is a communication model in which the client sends requests to the server and the server responds to the requests.
- When the server receives a request, it decides how to respond, fetches the data, retrieves resource representations, prepares the response, and then sends the response to the client.



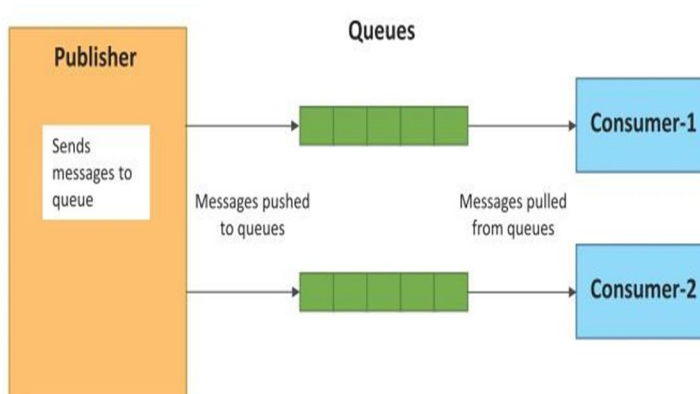
Publish-Subscribe communication model

- Publish-Subscribe is a communication model that involves publishers, brokers and consumers.
- Publishers are the source of data. Publishers send the data to the topics which are managed by the broker. Publishers are not aware of the consumers.
- Consumers subscribe to the topics which are managed by the broker.
- When the broker receives data for a topic from the publisher, it sends the data to all the subscribed consumers.



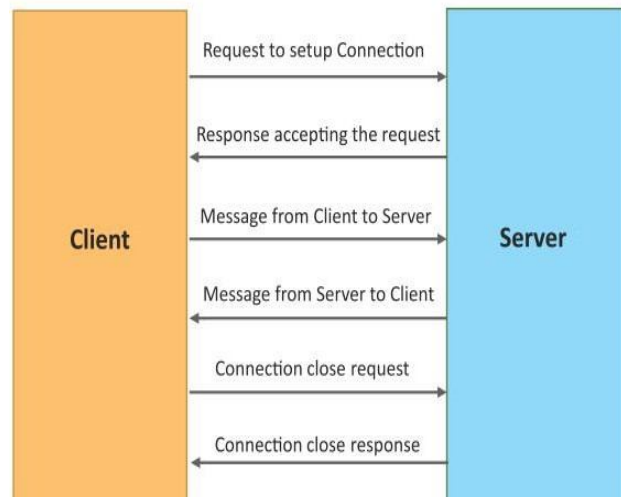
Push-Pull communication model

- Push-Pull is a communication model in which the data producers push the data to queues and the consumers pull the data from the queues. Producers do not need to be aware of the consumers.
- Queues help in decoupling the messaging between the producers and consumers.
- Queues also act as a buffer which helps in situations when there is a mismatch between the rate at which the producers push data and the rate rate at which the consumers pull data.



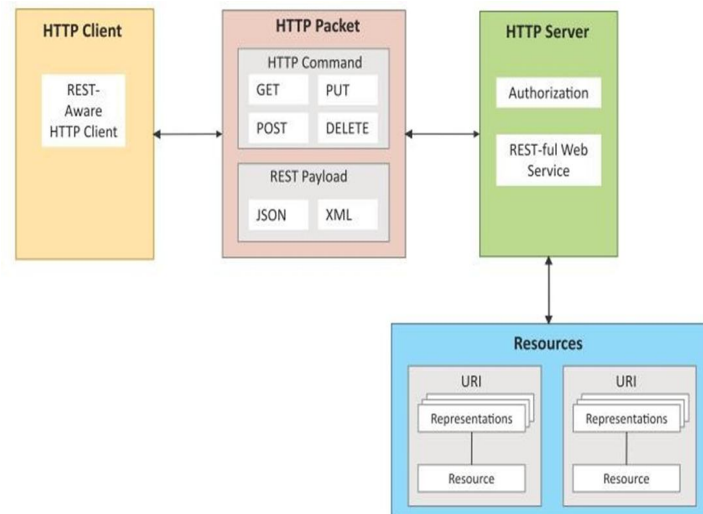
Exclusive Pair communication model

- Exclusive Pair is a bidirectional, fully duplex communication model that uses a persistent connection between the client and server.
- Once the connection is setup it remains open until the client sends a request to close the connection.
- Client and server can send messages to each other after connection setup.



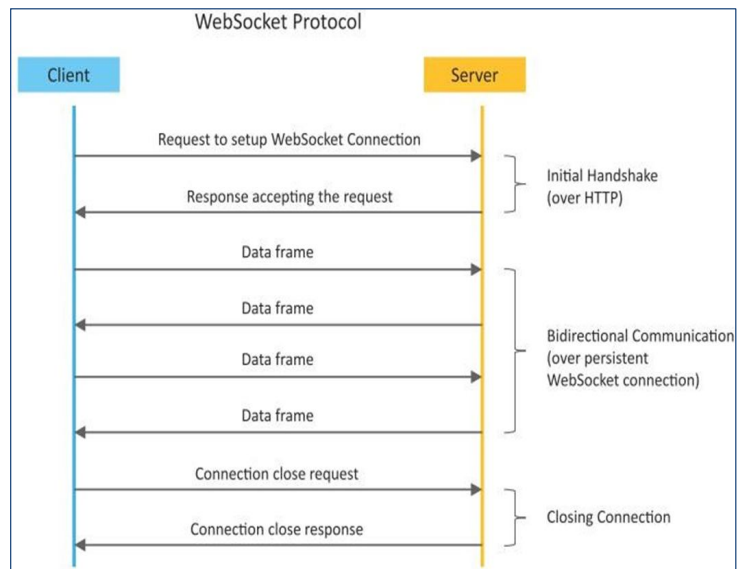
REST-based Communication APIs

- Representational State Transfer (REST) is a set of architectural principles by which you can design web services and web APIs that focus on a system's resources and how resource states are addressed and transferred.
- REST APIs follow the request-response communication model.
- The REST architectural constraints apply to the components, connectors, and data elements, within a distributed hypermedia system.



WebSocket-based Communication APIs

- WebSocket APIs allow bi-directional, full duplex communication between clients and servers.
- WebSocket APIs follow the exclusive pair communication model





Thank you