

21/02/2022

Internet of Things (IoT)

Block diagram of computer:-

Input, CPU, control unit, Memory unit, ALU, O/P.

Memory unit:- Primary memory & Secondary memory
→ RAM & ROM → ~~ROM~~ Harddisk.

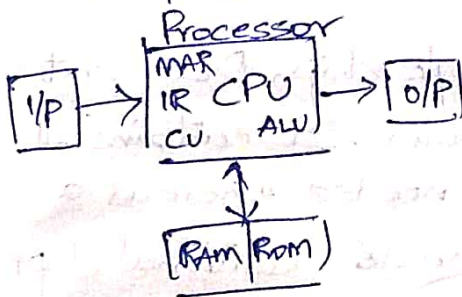
Types of software:- Application sw, System sw, Embedded sw.
(3) in RAM in ROM

POST program from Secondary memory to ROM (loaded)
Next Bootstrap program.

Read op. → Mem. to Processor

Write op. → Pro. to Mem.

Microprocessor



Same as processor, but on small operations.

Ascii → 8 bits

4 bits → for sending one char.

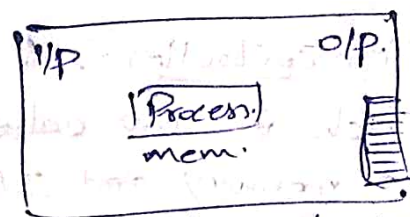
8 bits → one time send | two time send

16 → at a time 2 chars

32 → '4'

64 → '8'

Microcontroller



all components integrated in a small chip. (single)

① Size - small.

② art of embedded systems.

③ Occupies less space

④ Cost is ↓ing.

⑤ Power Consumption - less as all component inbuilt.

⑥ Have power saving mode

① size → large

② art of computer

③ occupies more space.

④ Cost ↑ing.

⑤ Power consumption more as all devices connected externally

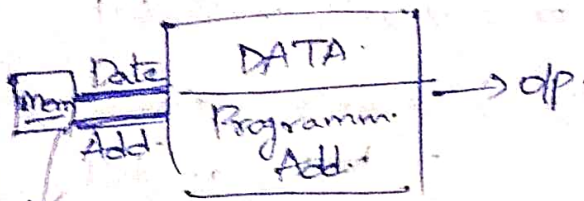
⑥ Most of them do not have power saving mode.

(7) less registers

(7) more no. of registers

(8) Von Neumann architecture

(8) Hardware architecture



Two separate buses for data & address.
(Speed - more)

WRAN
WWAN
WMAN

Internet

WLAN → Wifi, Wi-max (one to many)

WPAN → Bluetooth, Zigbee (802.15.4)

(one to one) Single device controls multiple devices.

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Micro controller:- It is a single chip, DLSI unit which is also called microcomputer. It contains all the memory and I/O interfaces needed whereas a general purpose microprocessor needs additional chips to offer by necessary functions.

Micro controllers are widely used in embedded systems for real-time operators.

Microprocessor:- A microprocessor is a single chip, semi-conductor device. ~~It contains~~ ^{This} CPU contains a program counter, ALU, stack pointer, memory address register, instruction register and timings circuit.

Examples of microprocessor based systems

- Gall bladders
- Game machines
- Traffic lights
- Complex industrial controllers
- Military applications
- Computation systems

Examples of microcontroller based systems

- Mobile phones
- CD/DVD players
- automobiles
- washing machine
- microwave oven
- cameras

→ Security alarms → Keyboard controllers

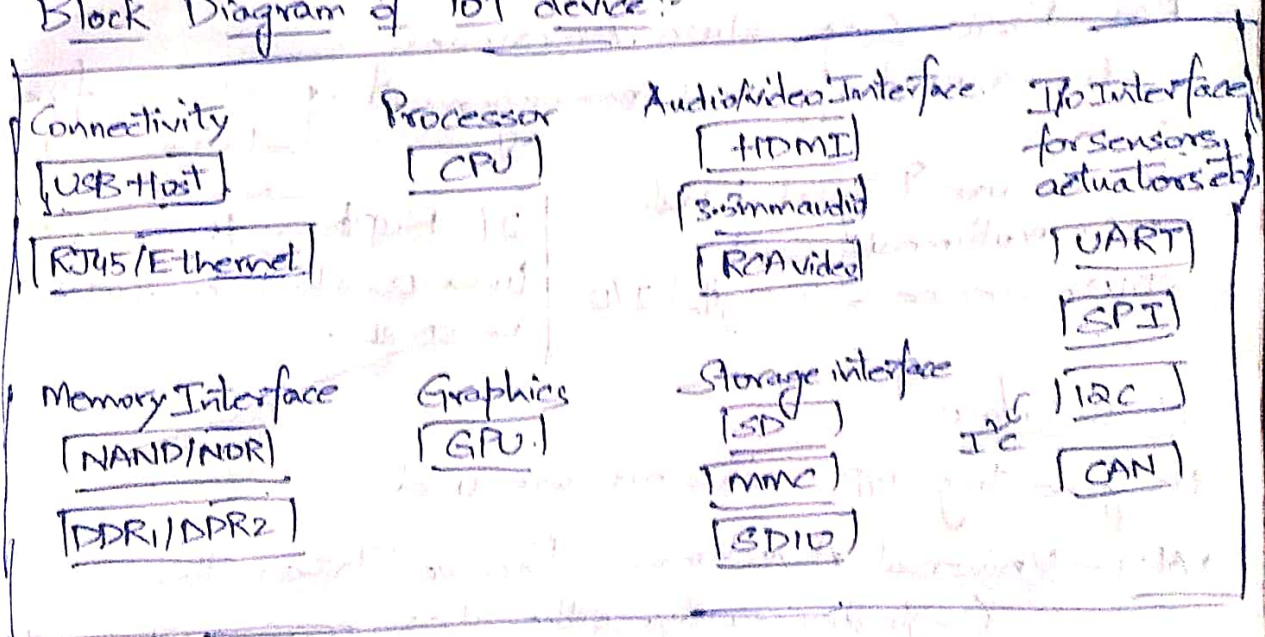
Embedded system:- An embedded system is microcontroller based system. It is the combination of software and hardware which is designed for particular task. It is an independent system, it is the part of large system.

Characteristics of IOT:-

- (1) Dynamic & Self adapting
- (2) Self-configuring
- (3) Interoperable communication protocol
- (4) Unique Identity
- (5) Integrated into information n/w.

IOT:- It is the collection of independent system communicating through internet.

Block Diagram of IOT device:-



UART - Universal Asynchronous receive Transmit

SPI - Serial peripheral interface

I²C - inter-integrated circuit

CAN - Control Area Network

For IPv4 \rightarrow ~~28~~ ³² devices can be connected.

IPv6 \rightarrow 2^{128} .

No. of devices \nearrow CPU not sufficient, GPU also used.
To use cloud data, we use GPU.

CAN - Control Area Network Bus.

RJ45 / Ethernet - cable either to connect with LAN
(802.3) through (or) wired LAN (Ethernet).

If RaspberryPi board - we use SD card.

Flipflops that store only 1 bit are made of NAND/NOR gates only.

Register - group of flipflops.

Each NAND/NOR gate is made up of transistors, diodes, capacitors, resistors.

\rightarrow RAMs mostly of DDR - Dynamic Data Rate.

RCA - Radio Corporation Americans.

(For color brightness management, pixels modifications, ...)

Storage

SD - Secure Digital Flash.

MMC - Multimedia Card.

SDIO - Secure ~~IO~~ Digital I/O.

If Raspberry Pi used with Linux OS should be installed on SD at.

I/O Interface

For generating o/p - actuators are used.

UART - Universal Asynchronous Receive Transmitter.

(single device only - either it can receive (or) transmit).

SPI - Serial Peripheral Interface.

IC - Inter Integrated Circuit.



Ex - One is serial transmitter and the other is parallel, each bit is transferred at once.

UART \rightarrow supports START, and STOP bits.

Asynchronous - stop and start bits are considered but not in synchronous.

Any data cannot be sent directly - sent in the form of signals either digital or analog.

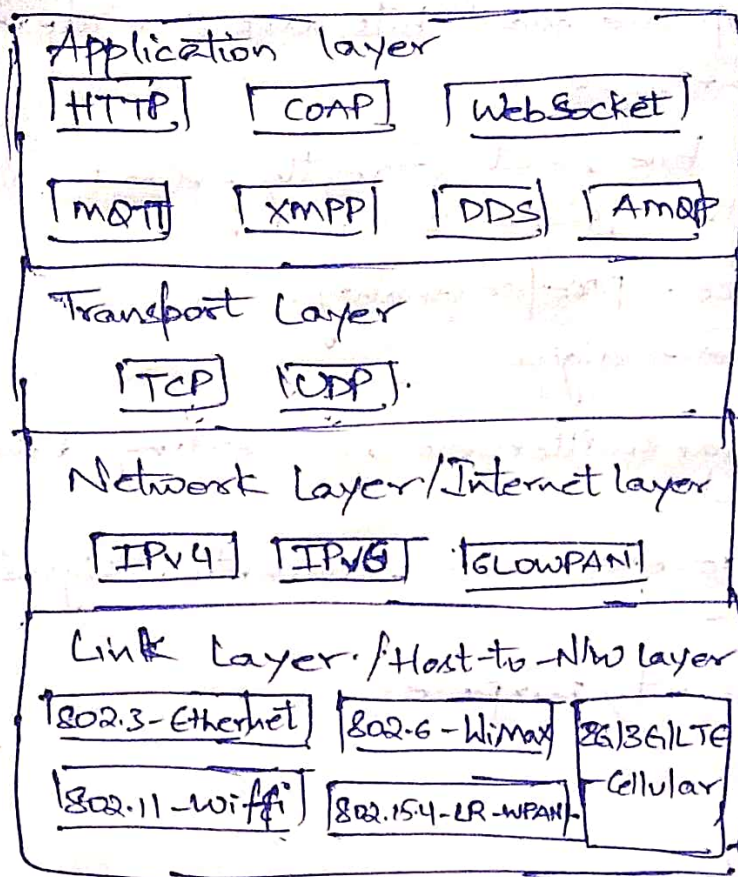
If large distance - prefer analog.
Small distance - digital.

Encoding :- At the transmitter side, converting data into signals.

Decoding - At the receiver side, converting signals into data.

Encryption - for security purpose.

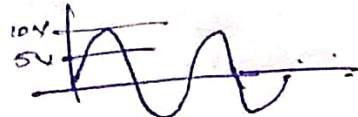
IoT Protocols:-



Digital:-



Analog:-



Data-link

LLC

(logical link) control

→ provides link from N/w layer & physical layer
→ Error Control.

MAC

→ flow control
→ Access control

Ethernet - wired - short distance

Wifi - Wireless - long.

WiMax - broadband - high data rate.

LR-WPAN - sensors data collection.

2G/3G/LTE - Cellular → Long Term Evolution Cellular Network
Mobile Communications.

Audio/Text data
Multimedia data.

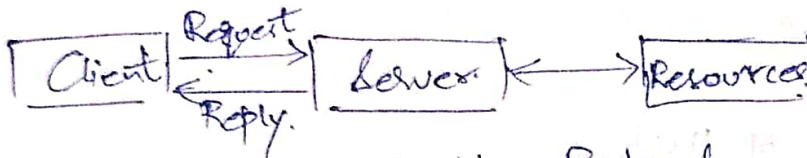
6LoWPAN - low range Wireless PAN.
or low power

Transport layer HTTP - 80 26 \Rightarrow 0 - 65,535.
Port address SSH - 22
FTP - 23

TCP - connection oriented
UDP - connectionless

Application layer

HTTP - for web pages - HyperText Transfer Protocol.



COAP - Constraint Application Protocol.

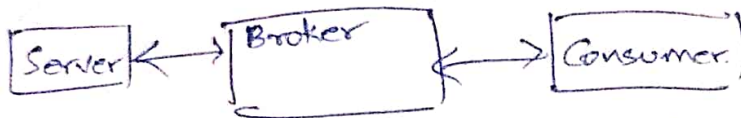
used for machine to machine communication.
(it is specially for IoT)

WebSocket - works as full-duplex mode.
in real time applications - video conferences.

MQTT - Message Queue Telemetry Transport

light weight messaging protocol.

based on public subscriber mode. Ex: YouTube



Server & Consumer not aware of each other.

Broker - acts as intermediate b/w them.

also called Statefull. (maintaining entire information)

XMPP - Extensible Messaging Presence Protocol.

- for real time communications

- client to server (or) server to server.

DDS - Data distribution Service.

- Data centric middleware for device to device (or)
machine to machine communication.

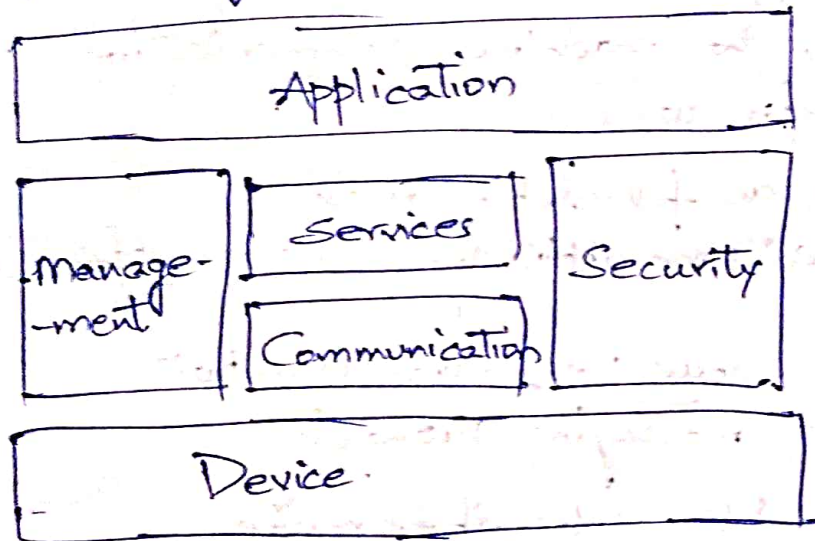
- also use Public Subscriber mode.

middleware :- ^{Go} Hotspot - acting as intermediate

AMQP :- Advanced Message Queue Protocol.

- Support point-to-point communication & public subscriber protocols.
- AMQP broker receive messages from publishers and route them over connection to the consumers.

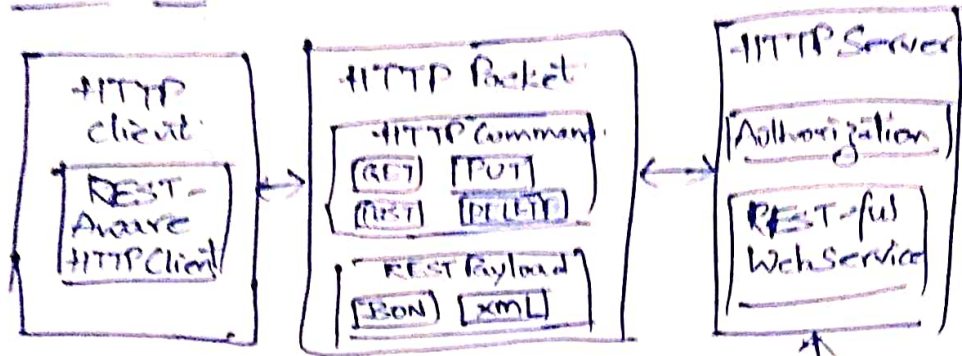
Logical Design of IOT



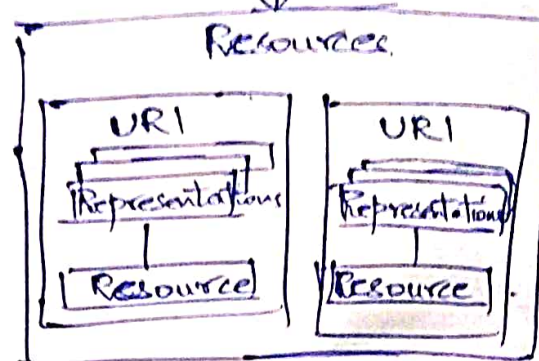
Communication API's

- (1) REST → Representational State Transfer API.
- (2) Websocket API.

REST API

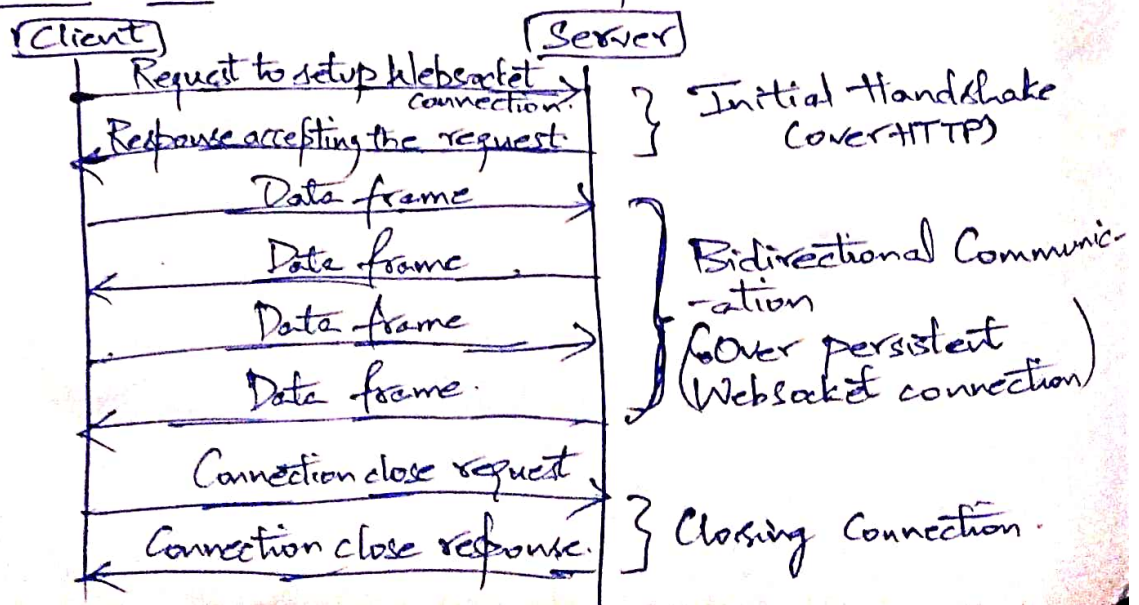


→ URI → Uniform Resource Identifier



- Client-server.
- stateless.
- Cache-able.
- Layered system.
- Uniform Resources.
- Code on demand.

Websocket API:- uses exclusive pair.



⇒ 3-way handshake process

→ TCP-oriented.

Technologies :-

(1) Wireless sensor networks

(sensor, sensor node, sensor networks)

(2) Cloud Computing

(3) Big Data Analytics.