Unit-5:- Syllabus

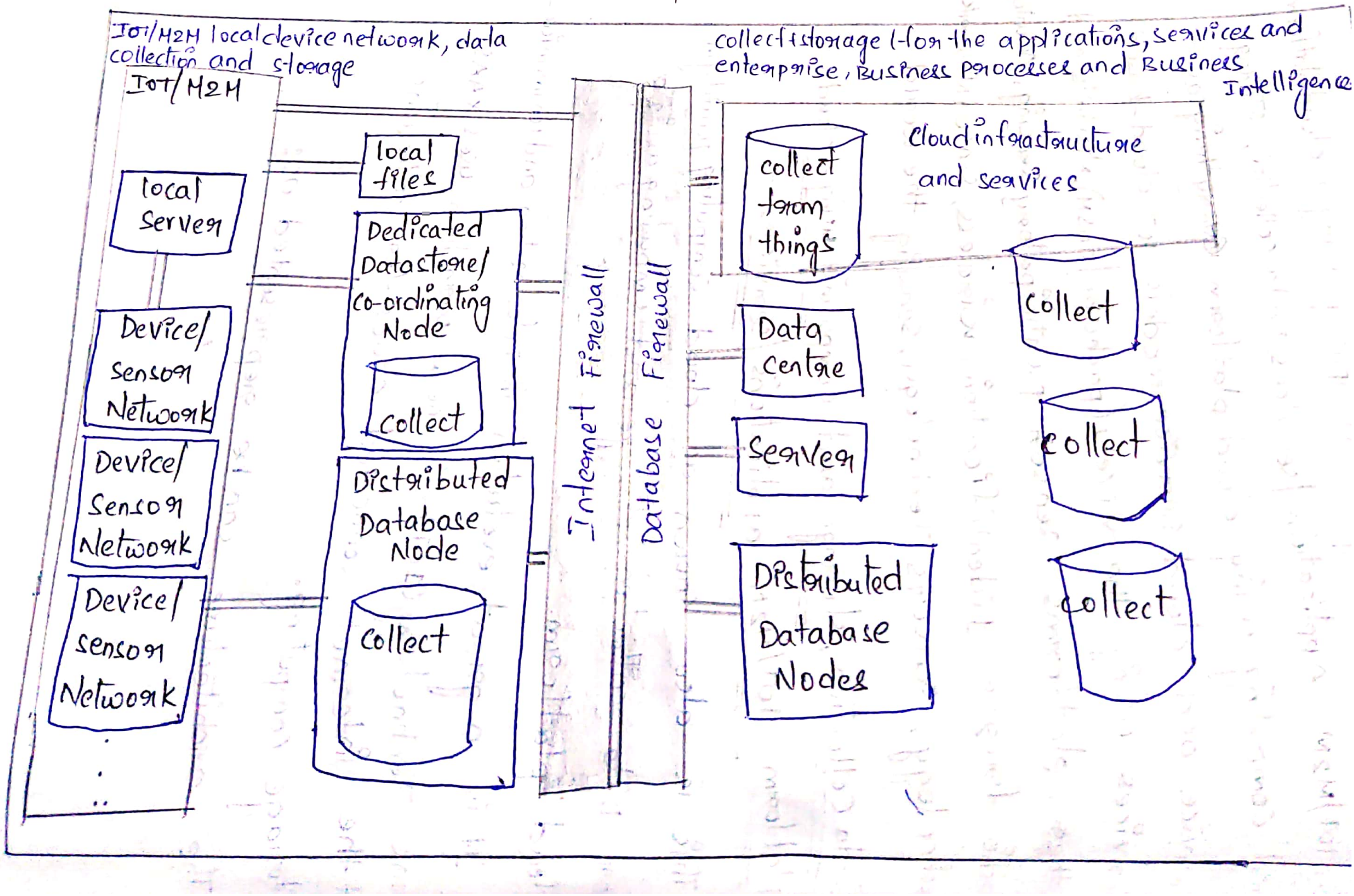
Data collection, storage and computing using a cloud platform for IOT/M2M Applications/services, Data collection, storage and computing using cloud platform Everything as a service and cloud service models, IOT cloud-based services using the xively (pachube/cosM), Nimbits and other platforms Sensor, participatory Sensing, Actuator, Radio frequency identification, Wireless, Sensor Network technology, Sensors Technology, Sensing the world.

1) Data Collection, storage and Computing using a cloud platform IOT/M2M applications/services:-

This is also known as cloud computing paradigm for Data collection, storage and computing using a cloud platform.

It is a great evolution in information and communications Technology (ICT). The new paradigm uses XAAS at the internet connected clouds for collections, storage, computing.

The architecture can be represented as:



It shows,

1) Devices or sensor networks data collection at the device web servers.

2) local files.

3) Dedicated data store at co-ordinating node.

4) local node in a distributed DBMS.

5) Internet-connected server.

6) Internet-connected data center.

7) Internet connected distributed DBMS nodes.

8) cloud infrastructure and services.

Some of the key terms in cloud computing are:-

Resource:-

A Resource refers to one that can be read, written and executed. A Resource is an atomic information which is useful during the computations.

System Resource:-

A system resource refers to an operating system such as memory network, servers and sw ~~opportunities~~ applications.

Edge Computing:-

It is a type of Computing that pushes the Computing of application data and services away from the centralized nodes to IOT data generating nodes.

4) Distributed Computing:-

It refers to computing and usage of resources which are distributed at multiple computing environments over the internet.

5) grid computing:-

It refers to the computing by using the pooled inter connected grid of computing resource and environments in the place of web services.

6) cloud Computing:-

A cloud computing refers to a collection services available over the internet that provides computational functionalities.

7) XAAS:- A software Architectural concept that enables the deployment & the development of application and offers services using web and SOA (service-oriented-Architecture).

Cloud Computing paradigm:-

A collection of services available over internet.
Delivers the computational ~~frequency~~ functionality.
Deploys infra structure of a cloud service providers.
Deploys computing infrastructure on a utility or grid Computing or web-services.

A computing environment that includes network, system, grid of computers or servers or data centers.

cloud platform Services:-

1) Infrastructure for large data storage of devices RFIDs, industrial plant machines, automobiles and device networks.
2) computing, capabilities, such as analytics, IDE
3) collaborative computing and
4) Data store sharing.

cloud platform usages:-

1) For connecting devices, connecting data, connecting API's.
2) connecting applications and services, connecting persons, connecting enterprises
3) connecting businesses and
4) Connecting XAAS.

Virtualisation :- It means user application (or) service access by using abstract data base interface (or) file system. A virtualization can be classified into 3 types:

1) Network function Virtualization :- It means a user application (or) a service access the resources appearing in one network.

2) Virtualization of servers:- In this, a user application not only access one server it can access multiple servers.

3) Virtualized desktop:- In this, the user application can change and deploy multiple desktops access by the users through their own computer platform.

Virtualization storage:- Means user application or service accesses physical storage using abstract database interface or file system or logical drive or disk drive, though in fact storage may be accessible using multiple interfaces or servers.

cloud computing features:-

1) Resource pooling
2) on Demand self service
3) Easy maintenance
4) Availability
5) security
6) Automatic system

cloud computing concerns:-

1) possible data loss
2) limitations of the services available.
3) Non delivery as per defined SLA specified Performance.

1.) Different APIs and protocols used at different clouds.

Cloud Deployment Models:-

Public cloud:-
This model can be used by educational institutions, industry and business enterprises. This can be accessed by all users.

Private cloud:-
This model can exclusively used by institutions and industries. It can be accessed only related employees with in the organization.

Community cloud:-
This model forms a community with a group of people and the people belongs to that community only access that data. The community provides security comes consideration.

Hybrid cloud:-
It specifies a set of 2/more different clouds with different data stores and application that combined blw 2 sets to develop a standard technology.

2) Cloud platform as Everything as a service and cloud service models:-

Cloud connects the devices, data, applications, services, persons and business. cloud services can be considered as distribution service - a

service for linking the resources and for provision of co-ordinating between the resources.

cloud computing can be considered by simple equation

cloud computing = saas + Iaas + paas + Daas

Saas:- It means software as a service. The s/w is made availble to an application or service on demand. It is a service model where the applications or services develop the host at the cloud and made availble, the host through the internet on demand by service.

Eg:- google docs, office 365, salesforce.com, extensible CRM.

paas:- It means platform a service. It is availble to a developer of an application on a demand. paas is a service model where the applications and services develop and executes using the platform.

Eg:- google app engine, MS-azure, Aws IoT, rively, Nimbits.

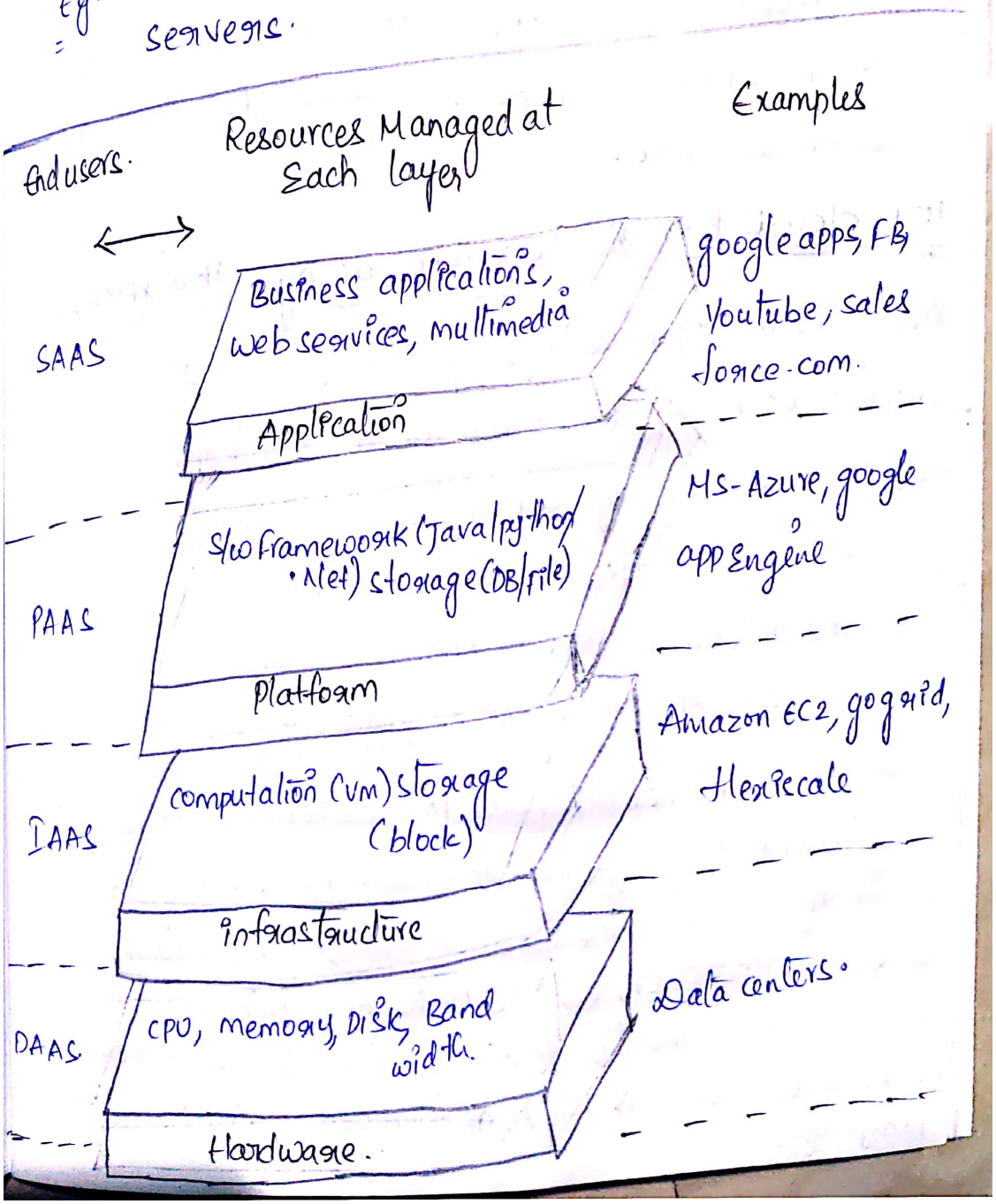
Iaas:- Infrastructure as a service. It is a service model where the applications use the

infrastructure which is availble through internet on demand.

Eg:- Amazon web services, virtual servers, EC2, cloud.com, cisco Iaas.

4) Daas:- Data as a service. It is a service model where the datastore or data warehouse is made availble through internet on demand.

Eg:- EC2, ~~Co~~ Tata communications, gogrid virtual servers.



3) IoT cloud-based services using the xively (pachube/cosm), Nimbits and other platforms Sensors:

*use of cloud IoT cloud based service:-

→ The service provides for the data collection, data points, messages and calculation objects.

→ The service also provisions for the generation and communication of triggers, alerts and feeds to the users.

→ A user is an application or service. The user obtain responses or feeds from the cloud service.

∴ IoT cloud based services using the xively:-

xively is an open source platform for Arduino which is open source prototyping platform that provides connectivity with web deploying internet. pachube is a platform for data capture in realtime over the internet. cosm is changed domain name, where using a concept of concole, one can monitor the feeds.

xively is a Commercial paas for the IoT/M2M. It is used as a data aggregator and data mining website often integrated into the web of things. The platform supports the REST, websockets and MQTT protocols and connects the devices to xively cloud services. There are native SDKs for Android, ARM mbed, Java, php, Ruby languages.

An account with xively need to be created by the user while deploying xively APIs for carrying out data collection and other functionalities. It is based on concept of users, feeds, data streams, triggers.

Features of Xively paas Services:—

1) It offers data collection in reallime across the internet.
2) It allows data visualization for the data of connected ~~devices~~ sensors fo IoT devices.
3) It provides graphical plots of the data collected
4) It provides access to old data.
5) It provides support for programming languages such as Java, python, ruby and for platform namely android.
6) It produces feeds representing real-world objects.
7) It can function on REST protocol.
8) It can operate on ARM mbed, Arduino and hardware platform based IoT devices.
9) It provides services, business services, platforms that allows internet connectivity to the products and operations.
10) It generates alerts.

push or pull methods:— It provides 2 modes for data capture, viz, a pull method (automatic feed type) where data is collected for http servers and push method (manual feed type) where data is written to xively using an http client.

Data formats and structures:— Multiple data formats and structures allow to carryout interaction, data collection and services with xively.

Private and public data access:- A free account supports up to 10 sensor feeds updated in near real time and data is stored for up to 3 months. The application can even use other user's data feeds as inputs.

Data streams, datapoints, triggers:- Data stream means continous sensed data flow over the internet, Data points means data values, triggers means action on a state change.

Visualizing Data:- It enables visualising data of feeds and data streams. Actively will allows the manual as well as automatic feeds.

** IOT Cloud based services using Nimbits:-

Nimbits enables IOT an open source distributed cloud. Nimbits cloud paas deploys an instance of Nimbits servers at the device nodes. Nimbits functions as an M2M system data store, data collector and logger with access to historical data. Nimbits architecture is a cloud based google App Engine. Nimbits server is a class hierarchy com.nimbits.server.system.ServerInfo of Java.lang.Object.

Features of Nimbits paas services:-

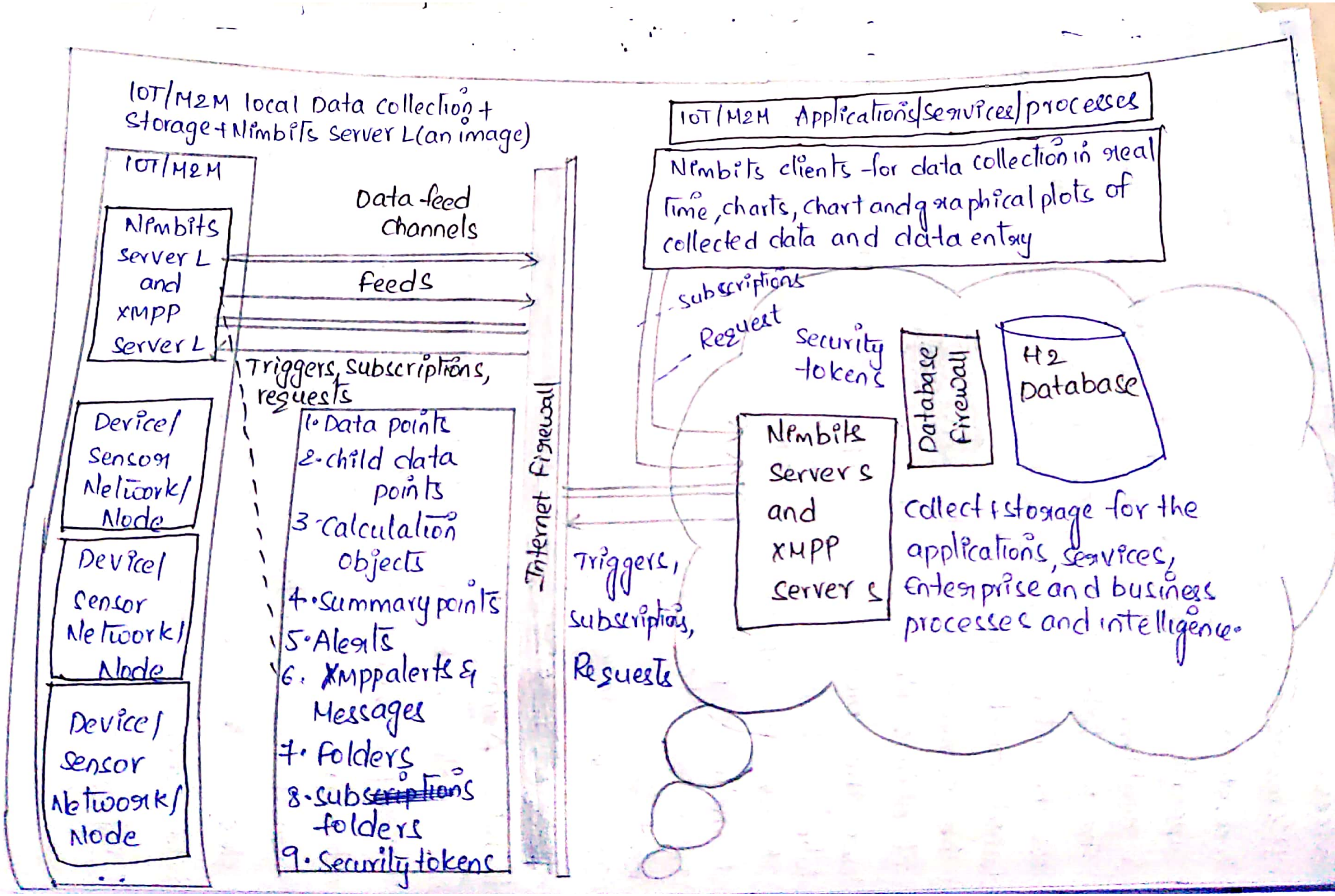
1) It provides a data logging service and access, and stores the historical data points and data objects.
2) storage in any format that can be serialised into a string, such as JSON or XML.
3) It filters the noise and important changes sent to another larger central instance.
4) It processes a specific type of data and can store it.
5) Time or geo-stamping of the data.

6) Data visualization for data of connected sensors to IOT devices.
7) It creates streams of data objects and stores them in a data point series.
8) supports the alerts subscription, generation and sending in real time over the internet.
9) The Nimbits clients offer data collection in real time across the internet charts and graphical charts for the data colleded and data entry.
10) The servers of Nimbits serves as a backend platform.
11) It offers Nimbits, is an open source Java library that allows the process of developing Java, web and andriod solutions in a simple manner.
12) It provides support for ARM mbed-based, Arduino based and hardware-platform based on IOT devices.
13) It allows to access and monitor the data from any location.
14) It allows to deploy slw on Google AppEngine and any servers of J2EE on Raspberry pi or on Amazon EC2.

Nimbits Architecture:—

Nimbits & server L and XMPP server L are deployed at every device node are instances of Nimbits Server S and xmpp server S respectively. Here, the former one is responsible for producing calculation objects for device nodes while the latter one is responsible for producing data feed channels for alerts and messages of xmpp.

Diagram:—


IOT/M2M local Data collection + Storage + Nimbits server L (an image)
IOT/M2M
Nimbits server L and XMPP server L
Data feed channels
Feeds
Triggers, subscriptions, requests
Device/ Sensor Network/ Node
Device/ Sensor Network/ Node
Device/ Sensor Network/ Node
1. Data points
2. child data points
3. Calculation objects
4. Summary points
5. Alerts
6. XMPP alerts & Messages
7. Folders
8. Subscriptions folders
9. Security tokens
Internet Firewall
Triggers, subscriptions, Requests
IOT/M2M Applications/services/processes
Nimbits clients - for data collection in real time, charts, chart and graphical plots of collected data and data entry
Subscriptions Request
Security tokens
Database Firewall
H2 Database
Nimbits Servers and XMPP Servers
Collect + storage for the applications, services, enterprise and business processes and intelligence.

Data points:-

A data point means collected value of sensors in a group of sensors. Data points organize the data in one of ways. points can be in folders. Any type of document can upload and organise them with the points.

Data channels:-

A user can create a data feed channel which shows the system events and messages that also shows data alerts which are subscribed to show up in the feed. The user data feed is just another Nimbits data point.

Advanced features:-

Very fast, open source, JDBC, API.
Embedded and server modes, in memory databases
Encrypted database
ODBC drivers
Full-text search
Multi version concurrency
Browser based console application.

Security tokens:-

Nimbits 3.9.6 provides security tokens in a new way

Breakthrough performance and ~~security~~ Data integrity:-

Nimbits server 3.9.10 provides breakthrough performance and data integrity.

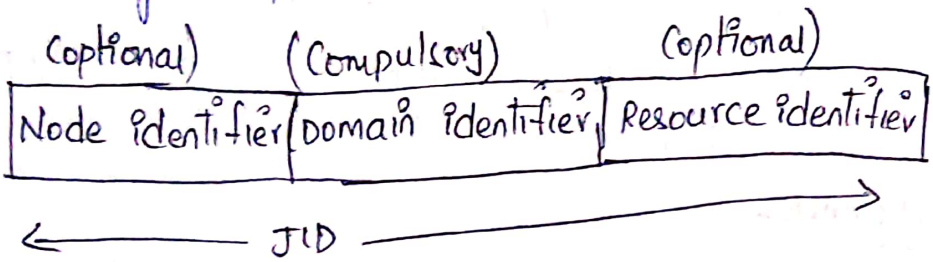
Filters:-

A filter refers to applications of rule to obtain latest or new data for the data point. The custom IDs of data points can be used for sending alerts and messages across XMP.

Jabbing:-

Jabbing is defined as the process of publishing the message s or alerts frequently and quickly. every message

alert is associated with a Jabber ID(JID), which involves 3 parts namely node, domain and resource identifier.



Summary point:- It can be created by user to calculate minimum, average, maximum, standard deviation, variance and sums of other point on the basis of particular time interval.

calculation:-

Calculation objects for a single point can be created by ~~viewer~~ user. Multiple formulas for a point can be applied by a user and the objects can be organised in a tree.

Subscriptions:- Several subscriptions for a point can be created by user. It might subscribe to another user's point or public point of another unknown user.

4) participatory Sensing:-

According to Debroah Estrin, participatory sensing is defined as a process that allows individuals and communities to adopt well sophisticated mobile phones and cloud services in order to perform systematic data collection and analytics so that it can be used in knowledge discovery.

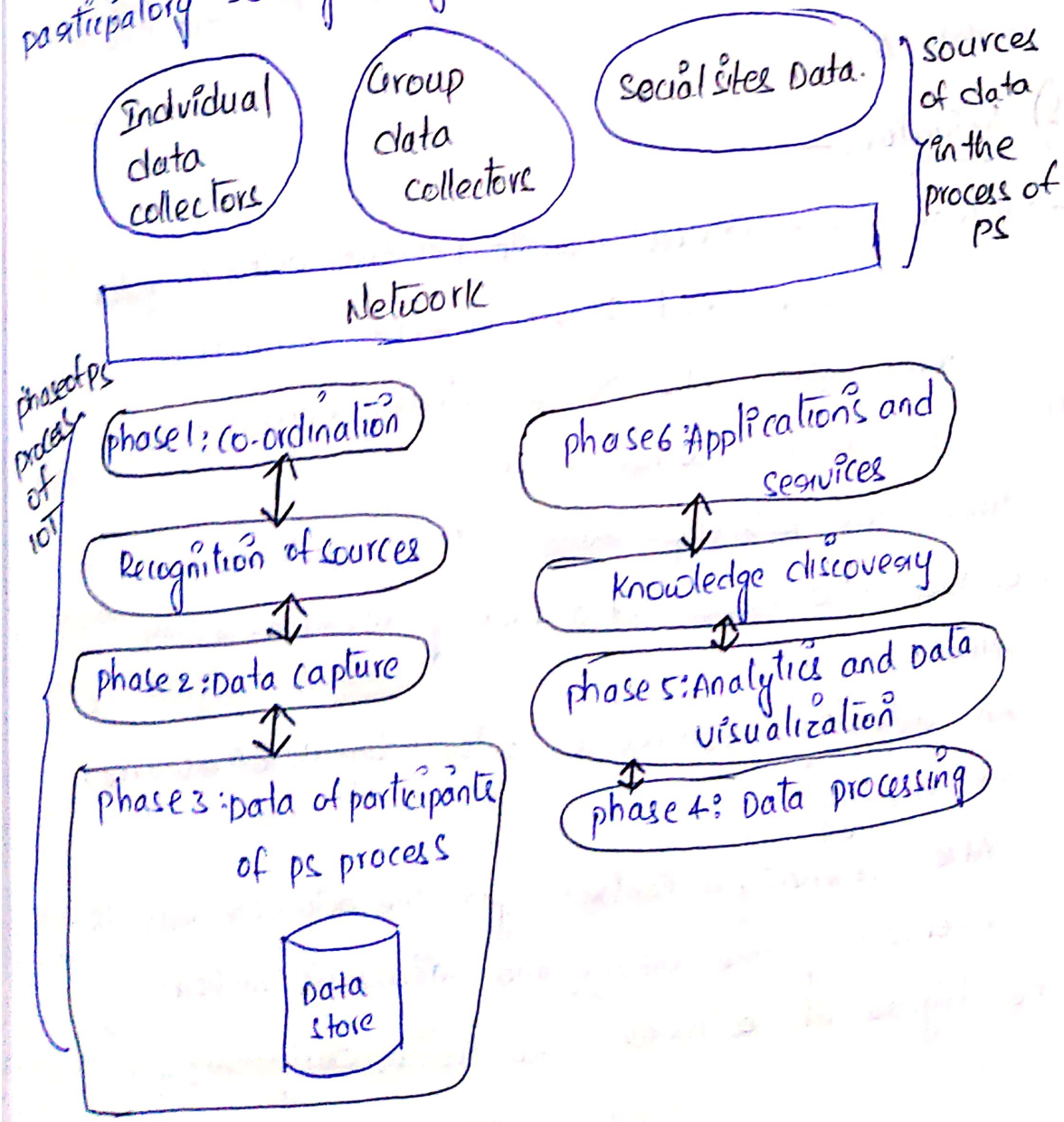
In this process, a participant could be sensors employed in mobile phones. These mobile phones include various sensors such as camera, temperature and humidity sensors, compass, infrared sensors, NFC sensors,

microphone, bar or QR codete readers and Gps. Mobile interact over the internet using sensed information associated with time, date and location stamps.

The several challenges involved in participatory

Sensing are:

1) security
2) privacy
3) Reputation
4) poor incentives to participants, The following figure illustrates various sources of data involved in the process of participatory sensing along with various phases involved in it.



phase 1:-

This phase involves co-ordination where in participants organize soon after locating the data sources.

phase 2 & phase 3:-

In these phase, data capture, communication as well as storage on servers or cloud takes place.

phase 4, phase 5:-

In these phases, data processing and analytics, visualisation and knowledge discovery takes place

phase 6:-

This phase involves intiation of respective actions.//

5) Actuator:-

→ Actuators are devices used to produce action or motion.

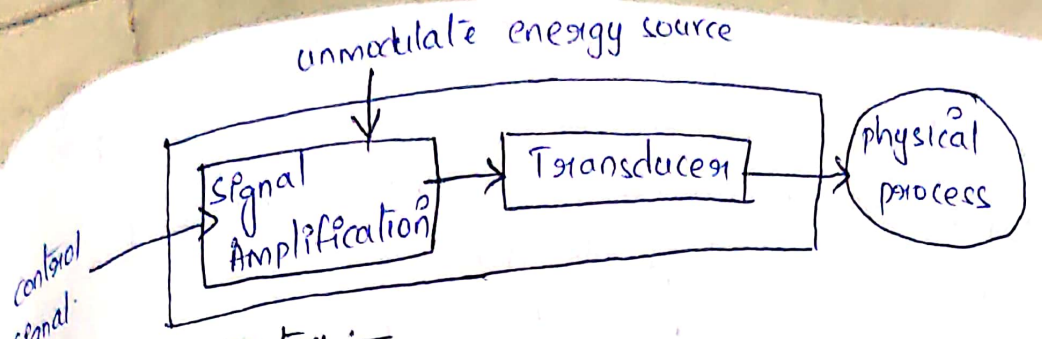
→ It is a device that starts or stops mechanical equipment with the help of electric current, air, hydraulic fluid or other source.

→ These are ~~actually~~ usually used in automation to control the motion of a moving members in any machine.

→ An actuator requires a control signal of a source of energy

→ After receiving a control signal, the actuator responds by converting the energy into mechanics motion.

The figure of actuator functional diagram:-



Types of Actuators :-

① Hydraulic Actuators :-

It uses hydraulic power to perform a mechanical operation. The mechanical motion is converted to rotary, linear, oscillary motion, acc to the need of IoT device.

Eg:- construction equipment uses hydraulic actuators because hydraulic actuators can generate a large amount of force.

② pneumatic Actuators :-

A pneumatic actuator uses energy formed by a vaccum or compressed air at high pressure to convert into either linear or rotary motion.

Eg:- used in robotics, use sensors that work like human fingers by using compressed air.

③ electrical Actuators :-

It uses electrical energy, is usually actuated by a motor that converts electrical energy into mechanical torque.

Eg:- A solenoid based electrical bell.

6) Radio Frequency Identification Technology (RFID):-

RFID is a form of wireless communication that uses radio waves to identify & track objects.

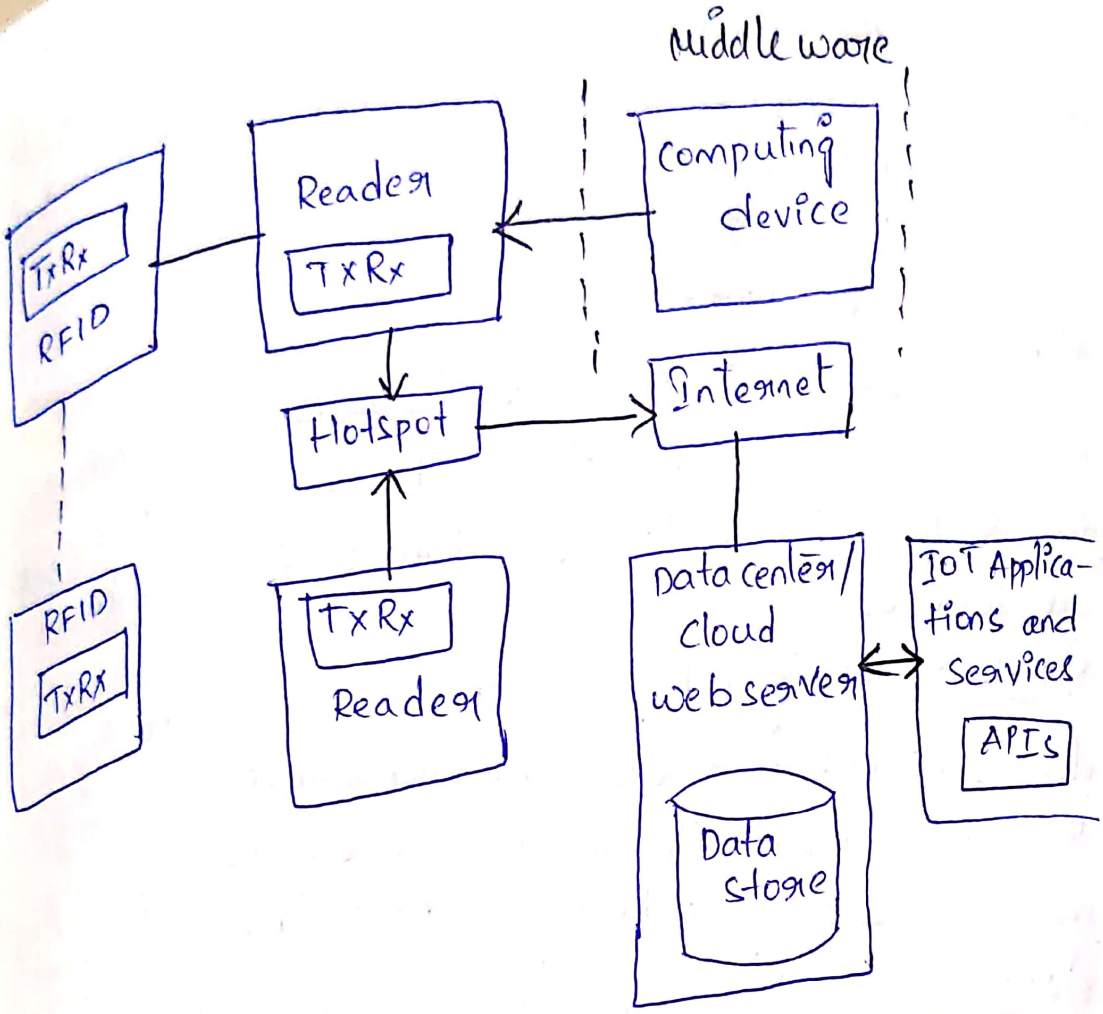
→ It used electromagnetic fields to automatically identify and track tags attached to objects.
→ It can also be used to track animals & birds by implementing RFID tags into them.
→ These tags contain electronically stored information.
→ RFID's altogether represents IOT network which is connected to an IOT server of ~~network~~ internet. usually, IOT server contains RFID identity manager, device manager, analyse, storage as well as database server and services.

Principle of RFID:-

A tag is an electronic circuit which transmits its ID using RF signals. The ID transmits to a reader, then that transmits along with the additional information to a remote server or cloud connected through the Internet. The additional information is as per the application.

The processing of RFID data is simple and therefore the concept of RFID tag is more advantageous compared to bar code ~~light~~ (or) QR code. A short string of data is transmitted back to RFID reader by the tag. In addition, the tag can be made invisible to a person by using short range RF transceivers rather than laser (or) light in QR code. later, the reader receives the RF signals and interacts with remote server on the internet.

Components of RFID system:-



1) RFID Tags:-

→ It contains a microchip that is ~~eat~~ encoded with information about the object being tagged.

→ RFID tag is a transreceiver which receives a radio signal & in response to it sends out a radio signal.

→ The chip is one of 3 types - passive, active and battery powered passive.

2) Transreceiver:-

→ It is built in one chip and interacts with a reader at a distance ranging from 10cm to 200m based on the type of chip. It uses standard frequency ranging between 120kHz to 150kHz, 13.56MHz, 433MHz and higher frequencies in case of UHF and microwave frequencies.

3) RFID Reader:-

It uses the transreceiver built in for receiving the ID. The header field received using UART protocol consists of 3 fields: 1) start byte
2) 10 byte ID
3) 1 end byte.

4) Middle ware:- It refers to s/w units that are adopted at not only readers but also read managers and data store for the transaction data store and API's of IoT applications and services.

5) Data processing subsystem:- It contains computing devices as well as middle-ware and enables connectivity to large networks like internet either directly or by means of gateway containing data adaptation sublayers.

6) Applications and services:- These make use of data store residing at web servers or cloud servers.

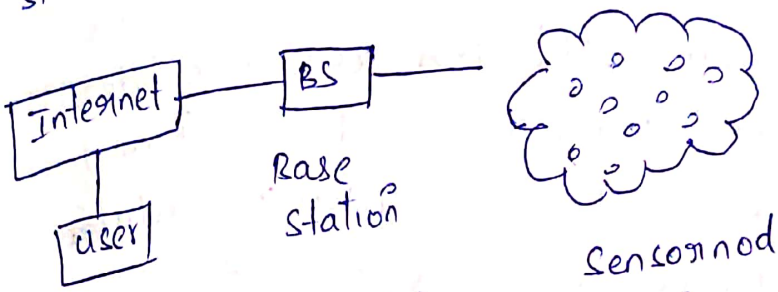
7) Wireless Sensor Networks Technology (WSN):-

WSN are spatially distributed autonomous sensors to monitor physical or environmental conditions such as temperature, sound, pressure etc.... and to cooperatively pass their data through the network to a main location.

→ WSN is built of "nodes" from a few to several where each node is connected to one sensors.

[o sensor network Node]

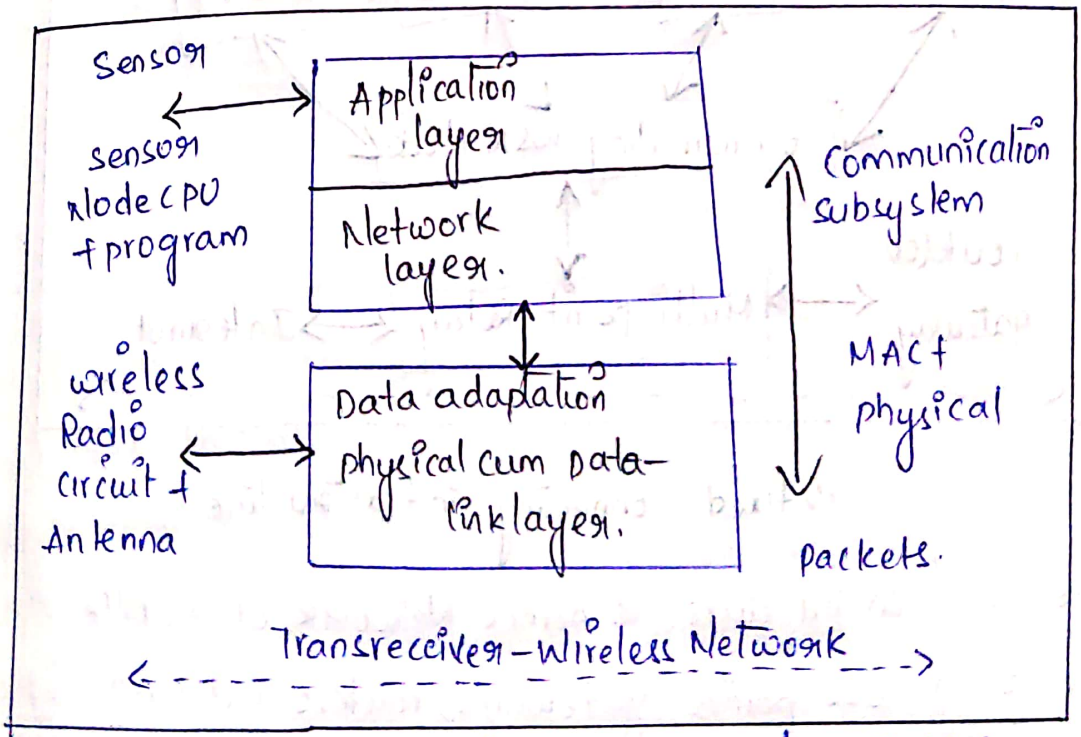
→ The topology of the WSNs can vary from a simple star network to an advanced multi-hop WSN.



→ WSN can be used for processing, analysis, storage, and mining of the data.

Architecture of WSN:-

There are 3-layer architecture of a node. The three layers are application, network layer, physical cum data ~~adaptation~~ link layer.

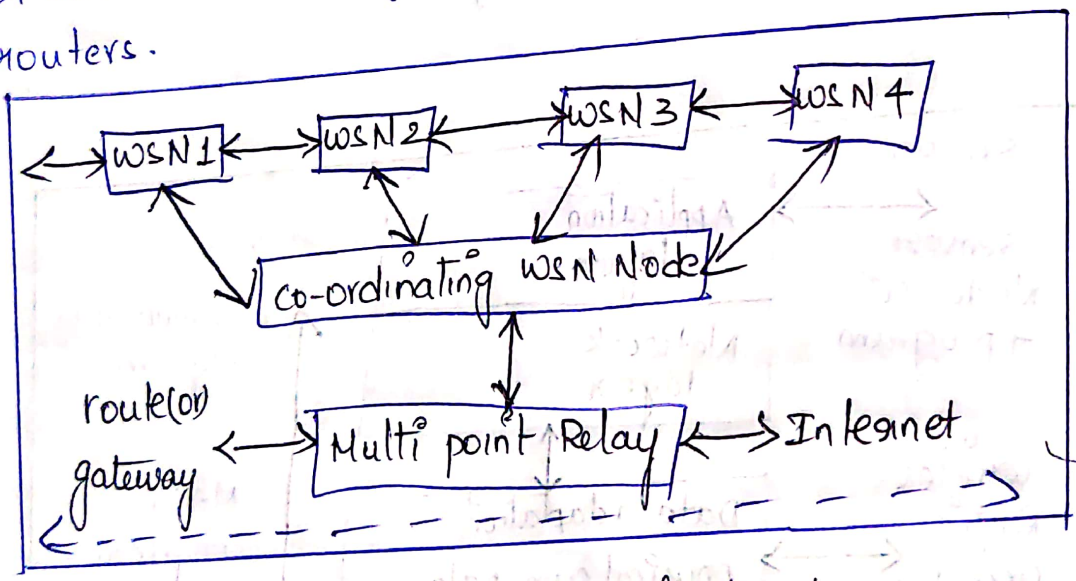


The application layer software components are sensor management, sensor query and data dissemination, task assignment, data advertisement and application's-specific protocols.

sensor, cpu and program sensor node constitute the application and network layers. Network layers links serially to the data-link layer, and may include the co-ordination or routing software. A serial link interconnects the layers to a wireless radio circuit and antenna. The radio circuit is at physical cum data link layer. Communication subsystem uses MAC and physical protocols.

Architecture for connecting Nodes:-

There are 2 architectures for connecting WSN Nodes. The first architecture is fixed connecting infrastructure of WSN Nodes, relays, co-ordinators, gateways and routers.



i) fixed - connecting infrastructure

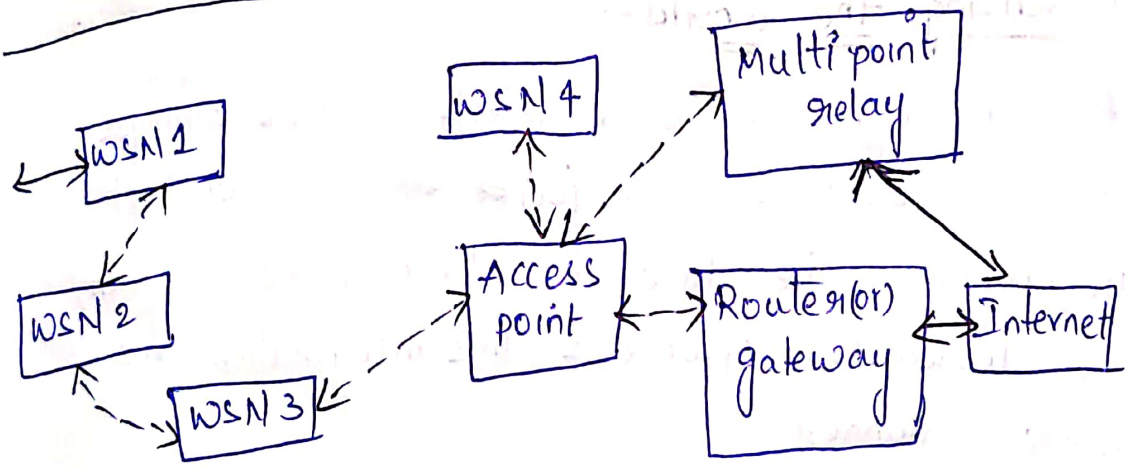
The 2nd architecture is Adhoc Network of mobile WSNs, access points, gateways, routers and multipoint layers.

i) Access point:- A fixed point transreceiver, which is responsible for providing access to nodes located within the range.

2) Multipoint-relay:- It is responsible for connecting to large networks like internet or mobile service provider network.

3) Routers:- It is responsible for transmitting the packets along with the path selected from several paths existing the network.

4) co-ordinators:- It is responsible for providing a connection or link between the nodes.



8) Sensors technology:-

Sensor technology is a technology used for designing sensors and associated electronic readers, circuits, and devices. A sensor can sense a change in physical parameters such as temperature, pressure, light, metal, smoke. Sensors can also sense acceleration, orientation, location, vibration or smell, organic vapours or gases. A microphone senses the voice and changes in the sound and used to record voice/music.

A sensor converts physical energy ~~to~~ like heat, sound, strain, pressure and motion into electrical energy. A electronic circuit connects to the input to a sensor. The circuit receives the o/p of the sensor. the o/p is according to the variation in physical condition. A smart sensor includes the electronic circuit within itself and includes computing and communication capabilities.

Examples:-

Humidity sensors, light, Acceleration, LIDARs.

9) Sensing the world:-

A sensor is a device which detects or senses changes in the ambient conditions (or) ~~use~~ & it detect the changes in the state of another device or system, and forwards or processes this information in a certain manner.

~~Types~~ category of sensors in form of clauses:-

① Analog:- These types of sensor produces a continous o/p signal which is normally proportional to the Quantity which is being measured. generally, physical Quantities are temperature, pressure, speed, orientation, displacement are type of analog Quantity

② Digital:- These type of sensors give the o/p in discrete form which is in the form of voltage, these sensor produces the o/p in T/F or ON/OFF or 0/1 depends on application. The advantage is, we can store the o/p.

* Serial port interface :- The main advantage of this interface with ADC is that the ADC 8(or)10(or)12 bit of o/p will be sent as an input to the interface and the interface provides the input to serial port at micro controller.

* Analog to Digital Converter :- It is an analog sensor circuit that is connected to a signal conditioner amplifier and then to an Analog to Digital converter (ADC).

* Sampling ADC :- It is a process that an ADC is used to accept the i/p signals in particular ~~provide~~ periodic intervals and converting them into digits. Here, the interval will provided a/c to the signal frequency and other requirements.

* Signal Conditioning Amplifier :- It is used to amplify a signal at i/p and also to add or ~~something~~ subtract the offset voltage in such a way that the minimum $V_{in}(min)$ should be 0 V and the maximum $V_{in}(max)$ should be V_{ref} at the o/p of sc.

* Sensing of an On-off state :- The digital o/p of an on-off state detection requires a no. of conditions. It requires a circuit/ ~~help in sensing~~ micro controller to read the o/p.

Eg:- 1) sensing of petrol filling in the vehicle tank.
2) sensing of the traffic in a specific street.

* Sensing a set of on-off states:-

A no. of conditions together need detection in many applications. A circuit generates digital o/p for a set of on-off states.

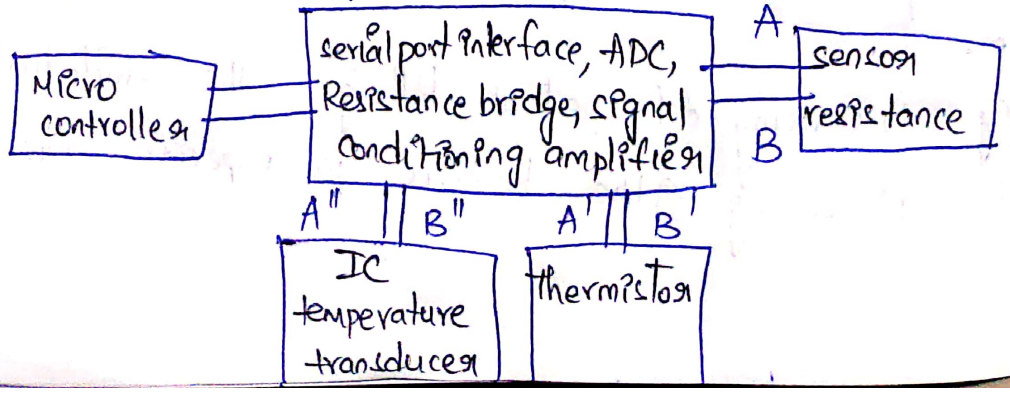
* Examples of Resistive, capacitive, Diode and Transistor-based Sensors:-

A micro controller is an associate computing device which consists of a sensor circuit that computes the touched position and links it to a user command when a resistive-based touch screen is used. Then, the mobile will respond as per the command.

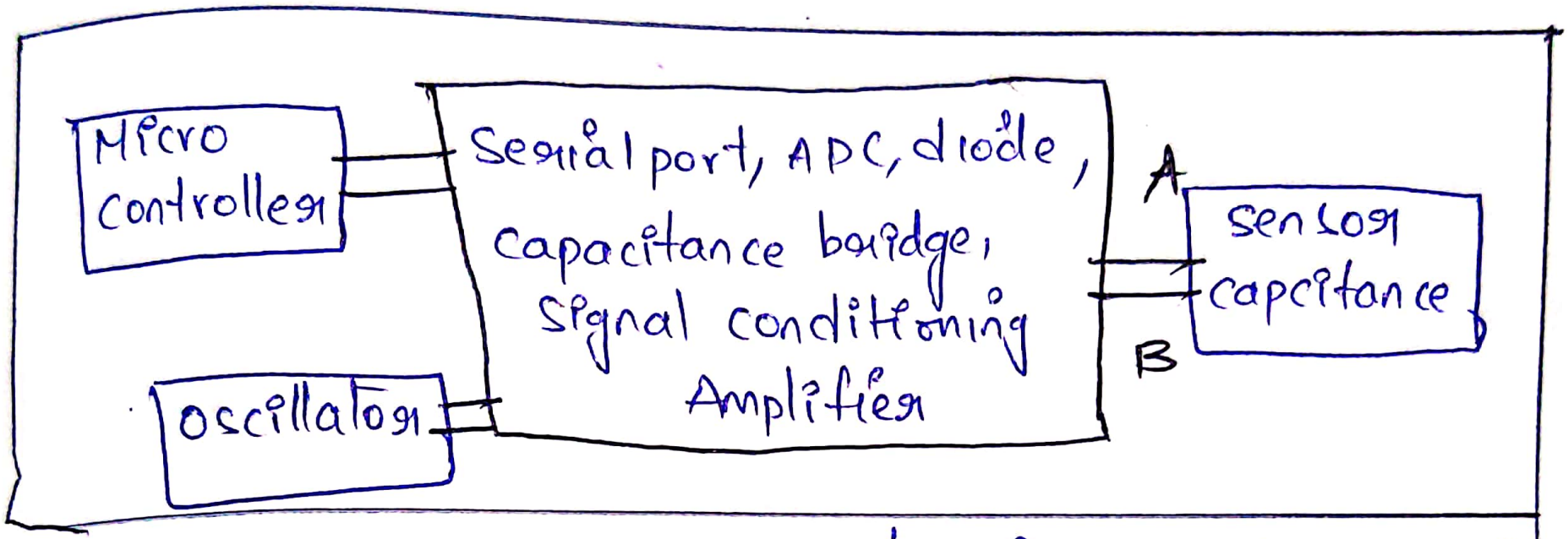
The characteristic parameter like resistance, capacitor of an electronic circuit changes as per the physical state/condition.

* Reading Temperature from Resistance Sensors:-

An electronic circuit consists of a resistor in the form of a wire or component. A/c to ohm's law, the resistance remains unchanged until the physical is changed. The resistor will run as a sensor when its values are changed measurably within the needed temperature range for sensing.



Reading ~~temperature~~ from capacitive sensor:—



The capacitance bridge consists of a sensing capacitor and 3 fixed capacitors.."

— X —