ACY 2020-21

Sri Shridevi Charitable Trust (R.)

SHRIDEVI INSTITUTE OF ENGINEERING & TECHNOLOGY

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TUMAKURU - 572106.

SHRIDEVI EDUCATION

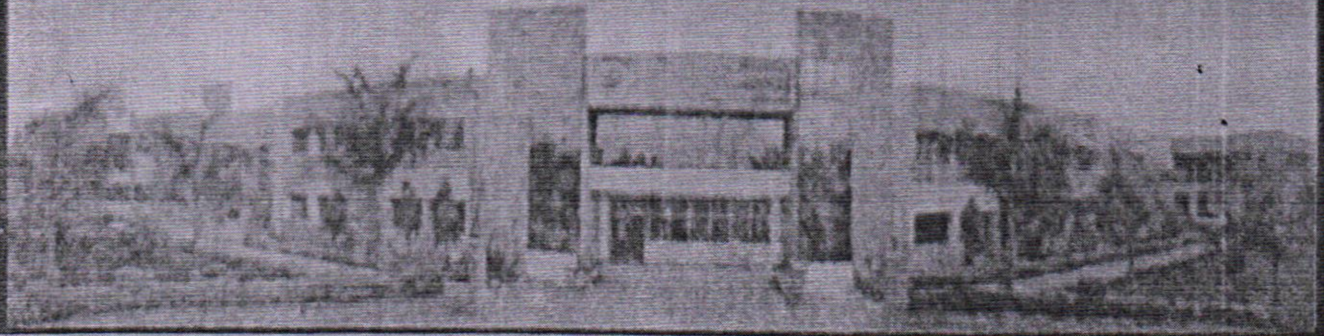
BLUE BOOK

USN : | 1 | S | V | 1 | 7 | C | S | 0 | 0 | 4 |

Name of Student : Aman Prasad Kalwar

Course : Internet of Things Technology Code : 17CS81

Semester : VIII Branch : Computer Science



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INTERNAL ASESSMENT MARKS

Date	Test No.	Max. Marks	Marks Obtained	Course Instructor Signature
24/5/21	01	30	29	(signature)
29/6/21	02	30	26	(signature)
19/7/21	03	30	30	(signature)
	Average	30	28	(signature)
	Assignment	10	10	(signature)
	Total	40	38	(signature)

CERTIFICATE

This is to certify that Kum/ Sri ...Aman Prasad Kalwar...

with USN ...1SV17CS004...has satisfactorily completed the course of tests in the subject of ...Internet of Things Technology... as prescribed by the Visvesvaraya Technological University for the ...IV/VIII...year / semester B.E. degree course in the year 2020 -2021

Signature of the Student Course Instructor Head of the Department

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TEST NO. 1

Q.No.	a	b	c	d	Total
Q1	7	7	6		20
Q2	7	7	6		20
Q3					
Q4					
Q5					
Q6					
Test -1 Marks					40

TEST NO. 2

Q.No.	a	b	c	d	Total
Q1					
Q2					
Q3					
Q4					
Q5					
Q6					
Test -2 Marks					

TEST NO. 3

30/30

Q.No.	a	b	c	d	Total
Q1					
Q2					
Q3					
Q4					
Q5					
Q6					
Test -3 Marks					

REMARKS

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Name: Aman Prasad Kalwar
Sub: IOT - IA-1
USN: 1SV17CS004

ACY 2020-21

Date: / /
Page No. 1

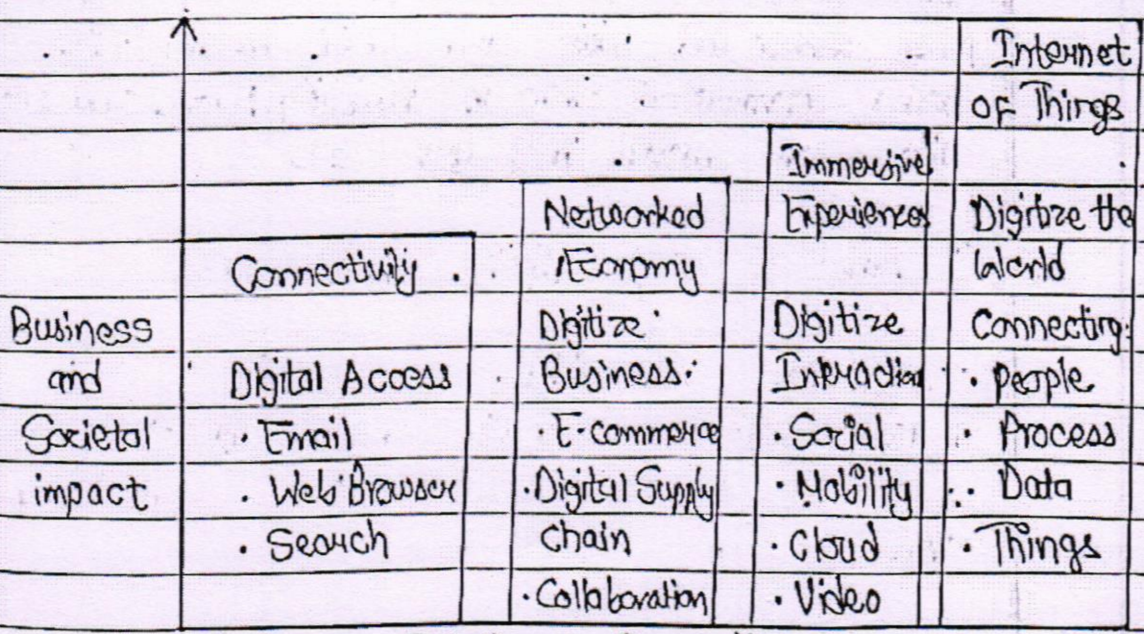
Q.no.1.a)

→ IOT is a technology in which devices will allow us to sense and control the physical world by making objects smarter and connecting them through an intelligent network.

When objects and machines are sensed and controlled remotely across a network, a tighter integration between the physical world and computers is enabled.

Genesis of IOT

The person credited with the creation of the term "Internet of Things" is Kevin Ashton. While working for Procter & Gamble in 1999, Kevin used this phrase to explain a new idea related to linking the company's supply chain to the Internet.



Intelligent Connections

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The evolution of the Internet can be categorized into four phases. Each of these phases had a profoun impact on our society and our lives. These four phases are further defined in below:

i) Connectivity (Digitize access)

This phase connected people to email, web services and search so that information is easily accessed.

ii) Networked Economy (Digitize Business)

This phase enabled e-commerce and supply chain enhancements along with the collaborative engagement to drive increased efficiency in business processes.

iii) Immersive Experiences (Digitize interactions)

This phase extended the Internet experience to encompass widespread video and social media while always being connected through mobility. More and More applications are moved into the cloud.

iv) Internet of Things (Digitize the world)

This phase is adding connectivity to objects and machines in the world around us to enable new services and experiences. It is connecting the unconnected.

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Q.no. 1.b)

→ One of the greatest challenges in designing an IoT architecture is dealing with the heterogeneity of devices, software, and access methods.

By developing a horizontal platform architecture, oneM2M is developing standards that allow interoperability at all levels of the IoT stack.

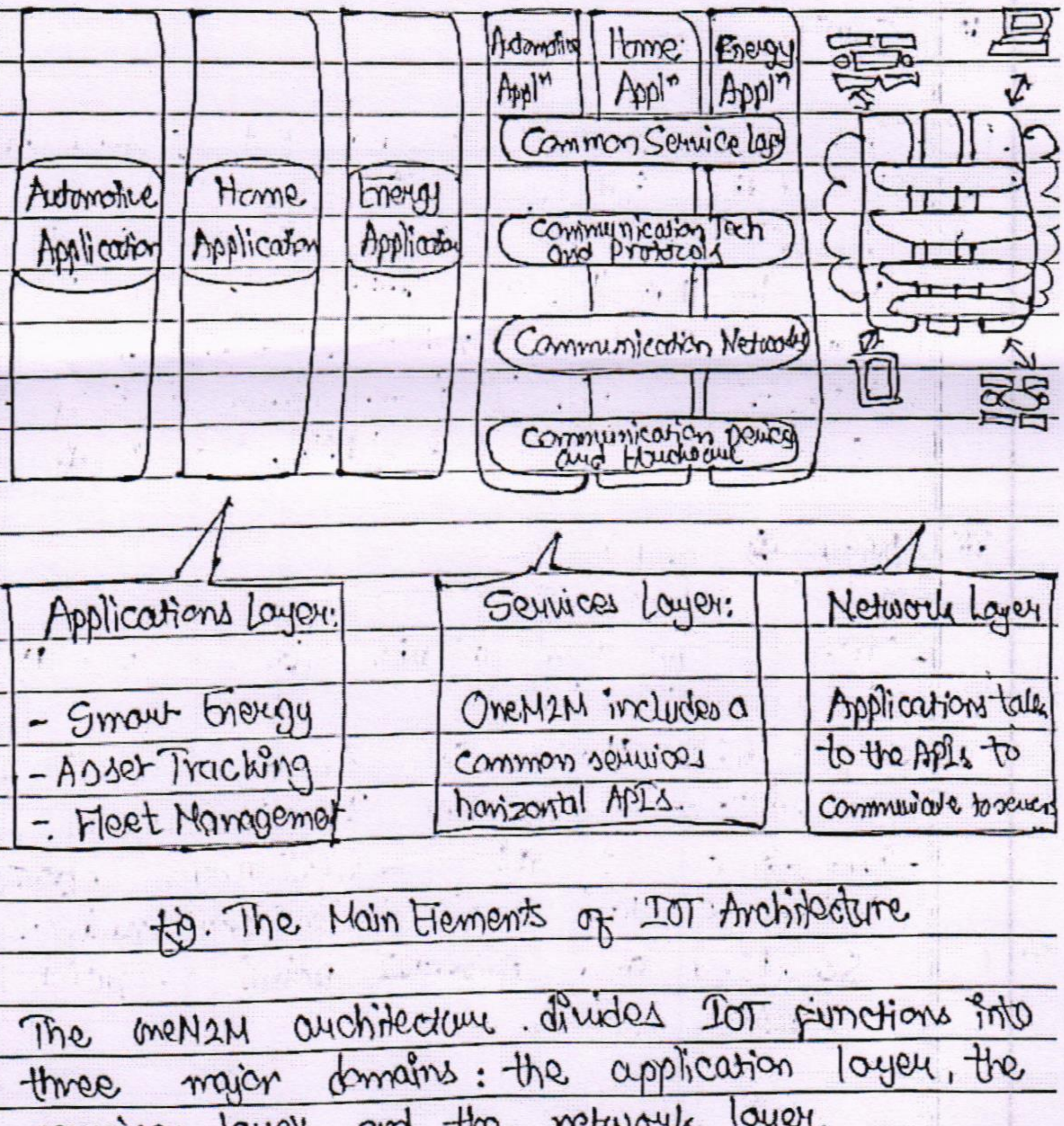

fig. The Main Elements of IoT Architecture

The oneM2M architecture divides IoT functions into three major domains: the application layer, the services layer, and the network layer.

i) Applications Layer

- The architecture gives major attention to connectivity between devices and their applications.
- The domain includes the application-layer protocols and attempts to standardize northbound API definition for interactions with BI systems.
- Applications tend to be industry specific and have their own sets of data models.

ii) Services Layer

- This layer is shown as horizontal framework across the vertical industry applications.
- At this layer, horizontal modules include the physical network that the IoT applications run on, the underlying management protocols, and the hardware.
- Examples include backhaul communications via cellular, MPLS networks, VPNs, and so on.

iii) Network Layer

- This is the communication domain for the IoT devices and endpoints.
- It includes the devices themselves and the communications network that links them.
- Embodiments of this communications infrastructure include wireless mesh technologies, such as IEEE 802.15.4, and wireless point to point and multipoint systems.

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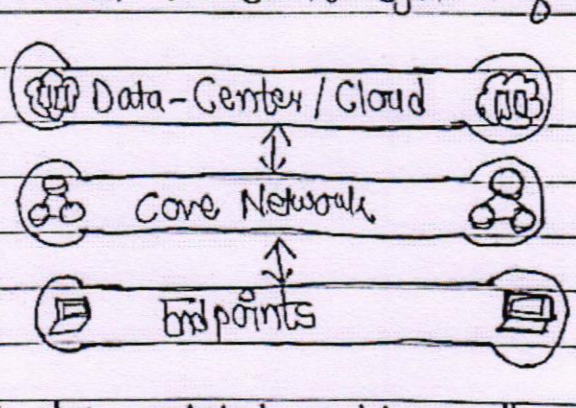
Q.no. 1 c>

→ The data management and compute stack model has some limitations. As the volume of data, the variety of objects connecting to the network, and the need for more efficiency increase, new representations appear. These are the following requirements:

(i) Minimizing latency: Since milliseconds matter for many types of industrial systems, and when we are trying to prevent manufacturing line shutdowns or restore electrical servic

ii) Conserving network Bandwidth: The offshore oil rigs generate 500 GB of data weekly and commercial jets generate more than 10TB of data every 30 minutes. So, it is not necessary to transfer all these data and many do not require cloud scale processing.

iii) Increasing local efficiency: It may not be useful for collecting and securing data across a wide geographic area. Analyzing both areas in the same system of cloud may not be necessary.



There are several data related problems that needs to be addressed. Bandwidth, Latency, The volume of data and Big Data which is getting bigger should be solved.

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Q.no. 2. a)

→ Sensors are designed to sense and measure practically any measurable variable in the physical world. They convert their measurements into electric signals or digital representations. On the other hand, actuators receive some type of control signal that triggers a physical effect.

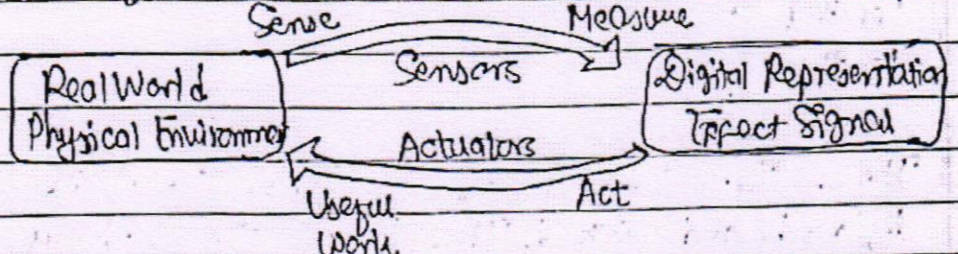

Fig. How Sensors and Actuators interact with the environment

Much like sensors, actuators also vary greatly in function, size, design, and so on. Some common ways of classification:

- Type of motion: Actuators can be classified based on the type of motion they produce.
- Power: Based on their power output (for example high power, low power, micro power)
- Binary or continuous: Actuators can be classified based on the number of stable state outputs
- Type of Energy: Based on the type of energy.

Actuators classification based on Energy Type

Type	Examples
Mechanical actuators	Lever, screw jack, hand crank
Electrical actuators	Thyristor, bipolar transistor, diode
Electromechanical actuators	AC motor, DC motor, step motor
Electromagnetic	Electromagnet, linear solenoid
Micro & nano actuators	Electrostatic motor, microvalve

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Q.no. 2.b>

→ Smart objects are the building blocks of IoT. They are what transform everyday objects into a network of Intelligent objects. These intelligent objects are able to learn from and interact with their environment.

The characteristics of smart objects are as follows:

(i) Processing unit: Smart objects contain processing unit for acquiring data, processing and analysing sensing information received by the sensors, coordinating control signals to any actuators, and controlling a variety of functions on the smart object, like communication.

(ii) Communication Device: The communication unit is responsible for connecting a smart object with other smart objects and the outside would (via the network). Communication devices for smart objects can be either wired or wireless.

(iii) Sensors and actuators: Smart objects are capable of interacting with the physical world through sensors and actuators. A smart object doesn't need to contain both sensors and actuators. Smart objects can contain multiple sensors and actuators.

(iv) Power source: The components of smart objects require power. The communication unit of a smart object uses the high volume of power. So, there is need of a power source since the objects component consume power.

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Q.no. 2.c)

→ Wireless Sensors Networks are made up of smart objects, motes.
→ The following are the limitations of the smart objects in WSNs:

- Limited processing power
- Limited memory
- Lossy communication
- Limited transmission speeds
- Limited power

These limitations greatly influence how WSNs are designed deployed, and utilized. The below figure shows an example of data aggregation function in a WSN where temperature readings from a logical grouping of temperature sensors are aggregated as an average temperature reading.

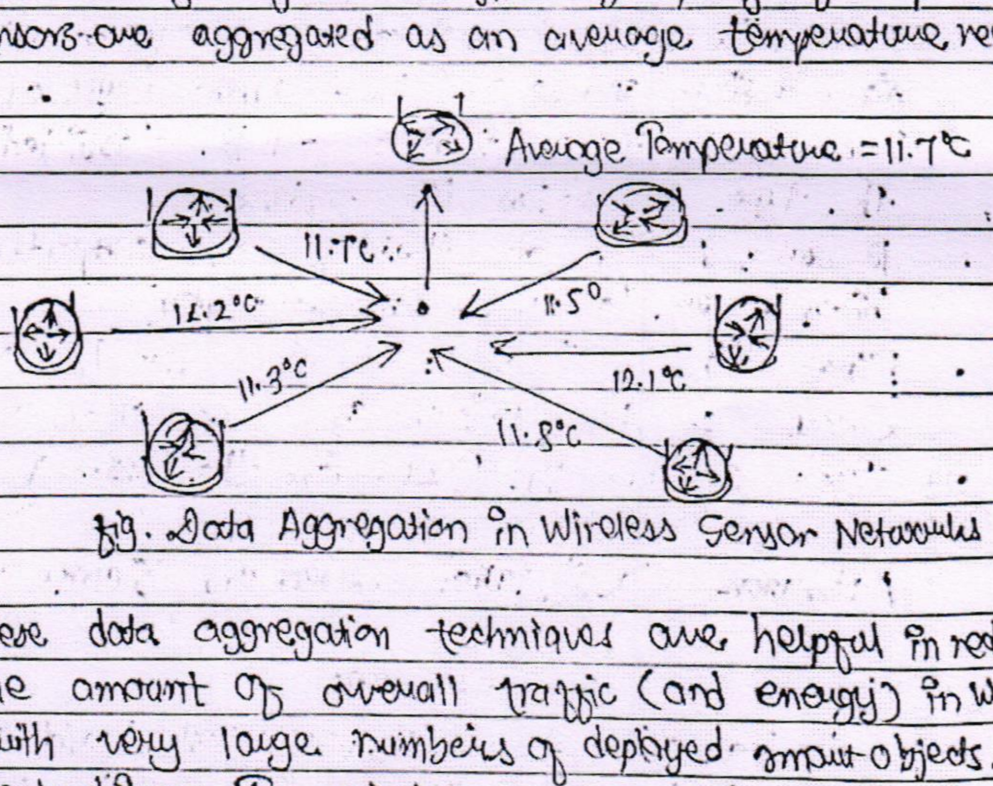

fig. Data Aggregation in Wireless Sensor Networks

These data aggregation techniques are helpful in reducing the amount of overall traffic (and energy) in WSNs with very large numbers of deployed smart objects.
Event driven: Transmission of sensory information is triggered only when a smart object detects a threshold.
Periodic: Transmission of sensory information occurs only at periodic intervals.

[signature]
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IOT - IA-2

Name : Aman Prasad Kalwar
USN : 1SV17CS004

Date : / /
Page No. 1

Q.no 1. a)

→ The working of IP as the IOT Network Layer is given below:

(i) The Business Case for IP: This section discusses the advantages of IP from an IOT perspective and introduces the concepts of adoption and adaptation.

(ii) The Need for Optimization: There are several challenges of constrained nodes and devices when deploying IP. This section looks at the need of migration from IPv4 to IPv6 and how it affects IOT networks.

(iii) Optimizing IP for IOT: There are some common protocols and technologies in IOT networks utilizing IP, including 6LOWPAN, 6TiSCH, and RPL.

(iv) Profiles and Compliances: It provides a summary of some of the most significant organizations and standards bodies involved with IP connectivity and IOT

The key advantages of Internet Protocol

- One of the main differences between traditional information technology (IT) and operational technology (OT) is the lifetime of the underlying technologies and products.

- IP is able to maintain its operations for large numbers of devices and users.

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In order to send data packet, IPV6 over 6LOWPAN, it is necessary to have a method of converting, the packet data into a format that can be handled by the IEEE 802.15.4 lower layer system.

To overcome the address resolution issue, IPV6 nodes are given 128 bit addresses in a hierarchical manner.

The IEEE 802.15.4 devices may use either of IEEE 64 bit extended addresses or 16-bit addresses that are unique within a PAN after devices have associated.

Q.no. 1c)

→ Deployments of legacy industrial protocols such as DNP3 and other SCADA protocols, in modern IP networks call for flexibility when integrating several generations of devices and operations that are tied to various releases and versions of application servers.

Transports of the original serial protocol over IP can be achieved by either tunneling using raw sockets over TCP or UDP by installing an intermediate device that performs protocol translation between the serial protocol version and its implementation.

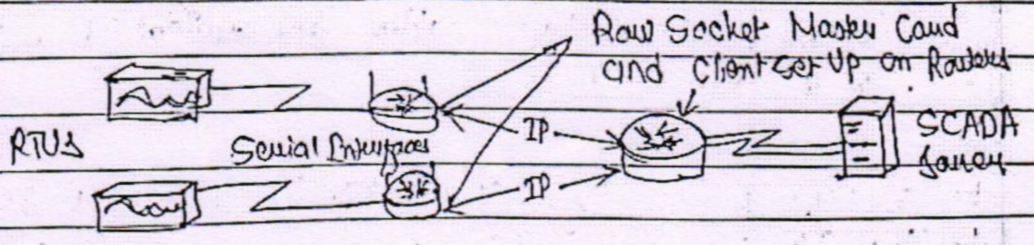

fig. Scenario of Raw Socket between no change on SCADA server

Q.no. 2.a)

→ The core functions of edge analytics are as follows.

(i) To perform analytics at the edge, data needs to be viewed as real-time flows.

(ii) Filter : The streaming data generated by IoT endpoints is likely to very large, and most of the time it is irrelevant. For example, a sensor may simply poll on a regular basis to confirm that it is still reachable.

The filtering function identifies the information that is considered important.

(iii) Transform : In data warehousing world, Extract, Transform and Load (ETL) operations are used to manipulate the data structure into a form that can be used for other purposes.

(iv) Time : As the real-time streaming data flows, a timing content needs to be established. This could be correlated average temperature readings from sensors and on a minute by minute basis.

(v) Correlate : Streaming data analytics becomes most useful when multiple data streams are combined with different types of sensors.

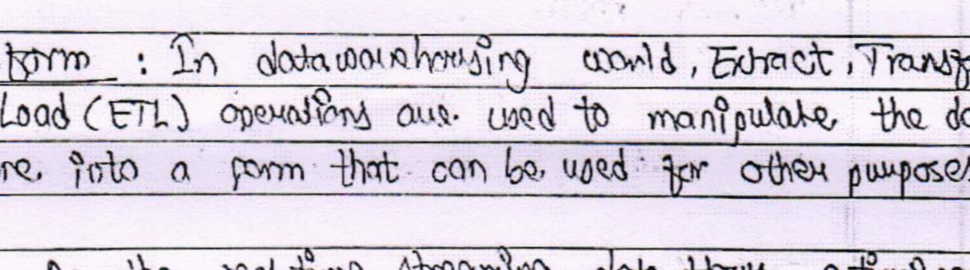

fig. Correlating Data Streams with Historical Data

Also, part of Flow Monitor is the Flow Exporter, which contains information about the export of NetFlow information

(ii) FNF Flow record:

A flow record is a very set of key and non-key NetFlow field values and to characterize flows in the NetFlow cache

Flow records may be predefined for ease of use or customized and user defined.

A typical predefined record aggregating flow data and allows users to target common applications for NetFlow.

(iii) FNF Exporter:

The NetFlow data is accessed either by using the show commands at the command-line interface (CLI), and using and application reporting tool.

NetFlow Export, unlike SNMP polling, pushes information periodically to the NetFlow reporting collector.

Multiple exporters can be configured per Flow Monitor.

(iv) Flow export timers:

Timers indicate how often flows should be exported to the collection and reporting server. The NetFlow export format simply indicates the type of flow reporting format.

9. Power LED Indicator: This LED lights up anytime the board is plugged into a power source.

10. Voltage Regulator: This controls the amount of voltage going into the Arduino board.

11. DC Power Barrel Jack: This is used for powering and Arduino with a power supply.

12. 3.3V Pin: This pin supplies 3.3 volts to power to your projects.

13. 5V Pin: This pin supplies 5 volts of power to your project

14. Ground Pins: There are a few ground pins on the Arduino and they all work the same.

15. Analog Pins: These pins can read the signal from an analog sensor and convert it to digital.

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IA – III

Q.no. 1. a)

→ Risk analysis is one of the important aspect in case IoT implementation in any cities or places. It is one of the serious concern to be taken care of during the utilization of internet of things. There are particularly two types of formal risk analysis structures:

(i) OCTAVE
(ii) FAIR

(i) OCTAVE (Operationally Critical Threat, Asset and Vulnerability Environment)

- OCTAVE is a risk analysis parameter by Software Engineering Institute which comprises of some steps to assess the risk.
- The first step is establishing the risk measurement criterion.
- Second step is developing asset profile infrastructure.
- Similarly, the third involves the identification of Asset Infrastructure containers.
- The fourth step in OCTAVE involves identification of security concern.

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- The next step in OCTAVE is identifying threats.
- The fifth step involves identification of risk.
- The next step requires analyzing the risk factors.
- The last step in OCTAVE involves the mitigation measures for risk mitigation.

(ii) FAIR (Factor Analysis of Information Risk)

- FAIR is another risk analysis structure which was given by the Open Group.
- This structure follows almost the same methods like OCTAVE but the security threats are fairly assessed and then proper mitigation is taken.
- In case of FAIR, the risk is analysed at every step of the structure one by one so that the severity of the risk can be found out.

Q.no. 1 b>

→ The IT and OT security practices vary in various ways as both have different methods of risk analysis and mitigation measures.

- The IT security practices are applied to the technology industry in case of software systems while implementing various sensors and software

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devices across the fields.

- The Industrial OT security practices are applied and implemented in the manufacturing and product based service providers during the production, transportation and delivery services.

- In case of IT security practices various formal risk assessment infrastructures structures are implemented which at every step. Since there is transfer of data at various steps in binary form, it is necessary to take care of the attacks that can damage the system or bring serious security threats like private data being leaked and other critical information access to hackers.

- The two risk analysis structures in IT security practice and systems OCTAVE by the Software Engineering Institute and FAIR by the Open Group.

- There are steps to analyze the risks and then apply certain risk mitigation measures.

- The first step in IT systems for avoiding security threats is establishing risk measurement criteria and then developing asset infrastructure profiles and identifying asset infrastructure profile containers.

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- At the last stage, the mitigating measures are taken to avoid the threats.

- In case of OT security practices, the measures are taken on the basis of the requirements according to industrial standards.

Thus, the IT and OT security practices and systems vary a lot as they have different types of risks and threats to take care of and the methods of risk analysis are also different.

Q.no. 1.c)

→ The Secured Network Infrastructure utilizes OCTAVE Allegro methodology to assess the risks and different processes.

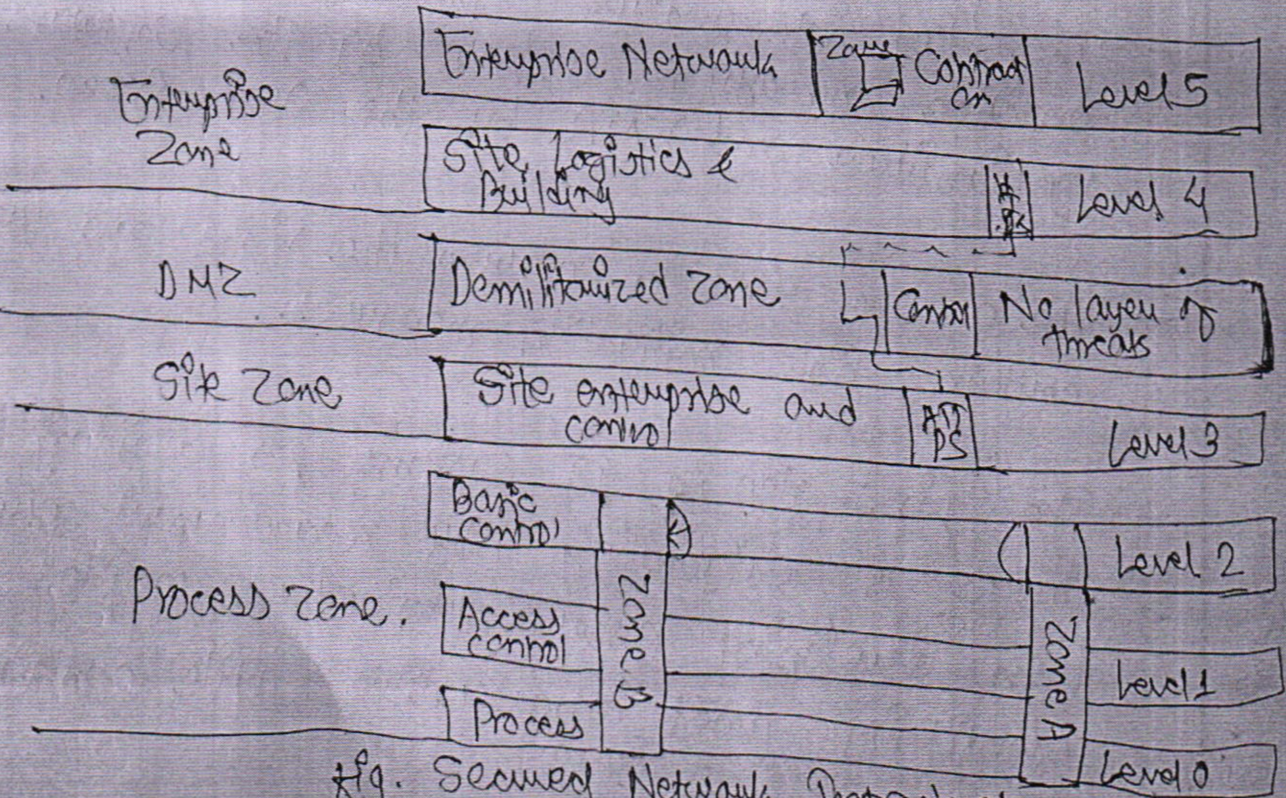

fig. Secured Network Infrastructure

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- The process control hierarchy model is based on OCTAVE Allegro secured Network infrastructure process.

- The process control zone controls the basic process of collecting and authorizing data coming directly from the sensors.

- The access control zone is responsible for providing access only to the authorized persons.

- The Site operations zone performs various operations between the city layer and street layer. It acts as the transportation layer or network layer.

- The Demilitarized Zone is a bridge between two layers that helps in connection by utilizing the https between the Site logistics zone and the enterprise zone.

- The Enterprise Network consists of various security at enterprise level.

Q. no. 2. b)

→ Smart City layered architecture consists of four layer that helps in the transportation of collected data and finally providing services to the people.

The architecture of smart city is designed in such a way such that each layer has its own pivotal role to play.

(i) Street Layer

- The street layer is responsible for collection and gathering of data from various IoT devices and sensors. This layer accumulates all the data and then passes to the city layer.

- Sensors are devices that collect data from physical world. These devices are implemented in various IoT devices that collect data at the street layer.

(ii) City Layer

- The city layer of smart city architecture lies between the street layer and the data-centre layer.
- It is responsible for transporting the data which is collected in street layer to the data center layer.
- The city layer lies above data-centre layer so that the data collected can be sent to the data centre layer.

(iii) Data-Link Layer

- The data link layer is responsible for accessing the data and performing various operations to the data.
- The link layer performs central processing functions

on the data.

(iv) Service Layer

- This layer provides all the IOT smart city services to the city.
- There is less traffic and water is distributed properly in the city.
- Similarly, other services are also provided to the city people to help them live a comfortable life.

Q.no. 2.a)

```
→ import os
import glob
import time
os.system('modeprobe.w1-gpio')
os.system('nodeProbe.w1-glob')
base_dir sys/bin/w1/device/
device_folder = glob.glob(ban_dir + 128*) [0]
device_file = device - folder +/wo, slan
def read temp = rare()'
f = open( device file 'r')
Lines = f.read lines();
f close ()
return Lines
def read temp()
```


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```
Lines = read.scomp.rame()
write-line [0] ter read-temp
 temp. sleep(2)
Line = read-tmp-rawe()
 if Equal pus! == -1;
 temp-string = Lines [1]
 temp-s = temp (temp. String) / 000.0
 temp-if = temp - (*9.0/5.0+32.0
 return temp('f temp')
 write true:
      print (read-temp())
      temp.sleep().
```

Q.no. 2. c)

① Structure

```
void setup()
 {
 }
void Loop()
 {
 }
```

- The structure of arduino programming consists of two functions setup() and loop().
- The setup() function restarts when the arduino restarts from sketches.
- The loop() function consecutively loops through the program.

(ii) Functions

There are two functions in Arduino programming. One is setup() function and another is Loop() function.

a) Setup() : This functions initializes and starts when the Arduino is restarted.

b) Loop() : This function is used to consequtively perform various functions.

(iii) Variables

These are place holders that hold data. The variables that are declared under some functions are called local variables while those variable declared outside the function are called global variables.

```
x = 12;
void sum()
{
   int a = 2;
}
```

(int – datatype; a = – initialization; 2 – value)

(iv) Flow Control Statements

These statements in programming are used in loopofunc

a) if statement

```
if (condition)
{
  perform some action
}
```

b) ~~el~~ if-else statement

```
if (condition)
{
  perform some action
}
else
{
  perform some other action
}
```

c) if-elseif-else statement

```
if (condition)
{
  perform some action
}
else if (condition)
{
  perform another action
}
else{ perform some other action
}
```

d) Switch statement

It is used when there are certain cases to avoid for loop.

(v) • Data type

There are various data types in Arduino programming. int, float, double, unsigned int, long, etc. are the data types that are used.

(vi) Constants

These are variables which are 'read-only'. This means that their values cannot be changed.

For example:

```
flot const pi = 3.14;
    int a = 2;
    result = pi*a;
```

O/p = 7