



**IT - ITeS SSC
NASSCOM**

Participant Handbook



**Foundation Skills in
Internet of Things (IoT)**



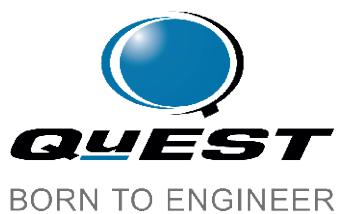
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Foreword

We are living in times of accelerating change in almost every area, be it political, financial, economic, climatic or technological. The field of Information Technology is witnessing the greatest rate of change. In fact, the advancement of technology and particularly information technology has today brought us to the edge of a revolution that will completely change the way we live and work - the **Internet of Things (IoT)** revolution. IoT, which is enabling increased connectivity of everyone, everything, everywhere and every time, is causing a fundamental shift in how we do things.

Globally, the installed base of IoT units is expected to reach 20.8 billion by 2020 (USD 3 trillion in revenue terms). Although India began its IoT journey much later than developed economies, it is set to leap-frog the adoption of IoT - IoT units in India are expected to grow ~32X to 1.9 billion by 2020, from its current base of 60 million. This translates to a market size of USD 9 billion by 2020, ~7X growth over 2016.

IoT adoption in India is expected to grow across industries. By 2020, industries such as Utilities, Manufacturing, Automotive and Transportation & Logistics are expected to see highest adoption levels. GoI's planned investment worth USD 1 billion for 100 Smart Cities over the next 5 years is expected to be a key enabler; additionally, industries such as Healthcare, Retail and Agriculture are also expected to make significant progress in IoT adoption.

Cross-functional skill sets and specialized training are needed to enable successful deployment of IoT by the workforce. However, the current workforce lacks exposure across all aspects of IoT technology leading to knowledge in silos and lack of application ability. IoT specific training programs should focus on training in crucial areas such as technology/ solution architecture, cyber security, UI/ UX design, etc. and this courseware development is one such activity towards it.

The primary goal is to provide students with an understanding of IoT which will be helpful in their engineering education and subsequently in their careers. The courseware addresses introduction to IoT and its architecture, industry applications and use cases in various sectors like Aerospace, Agriculture, Automotive, Construction, Energy, Healthcare, Logistics, Manufacturing, Retail and Transportation; course end project work is a mandatory inclusion offering practical exposure.

This book is drafted under the guidance of subject matter specialists from various fields encapsulating but basic important fundamentals regarding this industry that can create employment prospects.

I wish relevant stakeholders and partners all the very best in their endeavor to enable IoT growth in India.

R Chandrasekhar

President

NASSCOM

Acknowledgements

Industry's involvement in developing the 'Internet of Things -IoT' courseware is significant to the ecosystem basis the efforts of IT-ITeS Sector Skills Council NASSCOM (SSC NASSCOM). Developing and subsequently enabling the implementation of the IoT program is relevant to industry's projected needs present and future. This initiative is of importance to stakeholders concerned—industry, academia and students.

SSC NASSCOM thanks NASSCOM member companies, participant to the IoT 'Special Interest Group' (SIG) established to fulfill the goal of enhancing the competency and employability of candidates interested in this field. SIG's strategic direction towards the design and development of content for this courseware is significant.

The contribution of pioneer companies constituting like Axisades, BOSCH, Buoyanci, Caterpillar, CISCO, Eximius Design, Frugal Labs, Intel, LNTTS, Preva Systems, Quest, TCS, Tevatron Technologies, Texas Instruments, UTAS and NASSCOM Center of Excellence – IoT has enhanced the requisite content to the appropriate levels.

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Dr. Sandhya Chintala

Executive Director – Sector Skill Council NASSCOM

Vice President - NASSCOM

Symbols Used



Key Learning Outcomes



Steps



Notes



Objectives



Practical



Exercise



Activity



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1. Introduction to Internet of Things (IoT)

Unit 1.1 - What is IoT and its Evolution over Time

Unit 1.2 - Working of an IoT System

Unit 1.3 - Logical Design of IoT

Unit 1.4 - IoT Setup with Device Connections



Key Learning Outcomes



At the end of this module, you will be able to

1. Define the term 'IoT'
2. List components of an IoT ecosystem
3. Appreciate the impact of IoT in various sectors
4. Explain the working mechanism of an IoT system
5. Interpret principle technologies used in an IoT system
6. State various layers of IoT communication protocol
7. Explain IoT functional block
8. Classify communication models as 'Short-range wireless', 'Long-range wireless' and 'Wired'
9. Explain various communication protocols
10. List some applications of IoT
11. Explain the architecture of an IoT platform
12. List various programming languages used in IDE (Integrated Development Environment)

UNIT 1.1: What is IoT and It's Evolution Over Time

Unit Objectives



At the end of this unit, you will be able to:

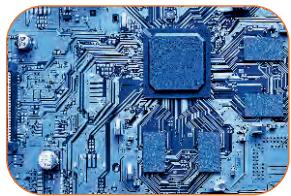
1. Define the term IoT
2. List various components of an IoT ecosystem
3. Classify IoT as 'Consumer IoT' and 'Industrial IoT'
4. Explain evolution of IoT over time
5. List parameters that make IoT system popular
6. Appreciate the importance of an IoT system in industrial growth

1.1.1 What is IoT?

We are living at a time of accelerating change in almost every area, be it political, financial, economic, climatic or technological. The field of Information Technology is witnessing the greatest rate of change. In fact, the advancement in technology and particularly information technology has today brought us to the edge of a revolution that has the potential to completely change the way we all live and work. This revolution is called the **Internet of Things (IoT)**. IoT, which is enabling increased connectivity of everyone, everything, everywhere and every time, is causing a fundamental shift in how we do things.

"So let's understand what IoT does"

The IoT allows objects to be sensed or controlled remotely if they are integrated across existing network infrastructure. This can result in creating opportunities for integration of the physical world into computer-based systems and resulting in improved efficiency, accuracy and economic benefit in addition to a reduced human intervention in managing them.



Electronics Technology (ET)



Network Technology (NT)



Information Technology (IT)

$$\mathbf{ET+NT+IT = IoT}$$

Fig.1.1 – Components of an IoT system

The IoT is not just a technology; it is, in fact, an ecosystem of things such as:

- Devices
- Internet
- Data
- Cloud
- Applications
- Platforms & Products

It offers opportunities for business owners to bring a revolution in their work by increasing productivity, reducing inefficiencies and inaccuracies, reducing costs, providing value added services, etc. It also offers opportunities for a network of other players such as:

- Hardware operators
- Network operators
- System integrators
- Application vendors, etc.

Let's take an example:

Let us imagine a large grocery store owner, who requires a reminder whenever the stock of a category of grocery goes below a predefined level. He needs to decide on the order levels, lead-time and the stock to be maintained. Fast moving items, slow moving items, stagnant items have a direct bearing on this. Ordinarily, the process will be laborious and time-consuming and prone to human errors and delays. Let us look how IoT will work for him.

Let us say that containers of the grocery type are fitted with a sensor, say a load cell, to sense the weight of the container with the contents. Imagine this data is transported through the Internet from a hub which is integrating the sensor data and generating a report on anticipated shortages and giving pointers based on the history to highlight fast moving, slow moving and stagnant items.

This can help him in the investment strategy, ordering periodicity, optimising the stock, avoiding stocks going stale or crossing the date of expiry and so on. What made this possible is IoT.

Let us look at a few more scenarios,

Scenario 1: People are granted access to offices, theatres or even their own homes by waving their wrists at the doorway.

Scenario 2: A home owner can control the temperature and humidity of the rooms of the home, or set the microwave oven to prepare his/her dinner even before reaching home from miles away.

Scenario 3: A car that can pay for its fuel, identify the quickest route to the destination, manoeuvre traffic and locate a parking space at the destination all by itself.

Scenario 4: The refrigerator can take its inventory, knows what to order and sends an automated signal to the local grocery store.

Scenario 5: Our smartphones can receive alerts about the smoke emanating from the kitchen and send a message to the fire department.

Scenario 6: Motors and other machinery in a manufacturing plant can communicate its wear and tear parameters to the maintenance staff on its own.

All these scenarios are in fact already possible.

IoT is broadly classified into **Consumer IoT** and **Industrial IoT**.

- **Consumer IoT**, through home automation, infotainment and popular devices like wearables (fitness, lifestyle) etc. is driving volumes growth
- **Industrial IoT**, through initiatives like smart manufacturing (Industry 4.0), smart cities, smart transportation, smart buildings, smart energy, etc. is driving revenue growth.

1.1.2 Definition of IoT

The Internet of Things (IoT) is the networking of physical devices ("connected devices" or "smart devices") embedded with electronics, softwares, sensors, actuators and network connectivity that enable these objects to collect and exchange data.

The IoT allows objects to be sensed or controlled remotely if they are integrated across existing network infrastructure. This can result in creating opportunities for integration of the physical world into computer-based systems and resulting in improved efficiency, accuracy and economic benefit in addition to a reduced human intervention in managing them.

The International Telecommunication Unit (ITU) defines Internet of Things (IoT) as "A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies". IoT can also be defined as a concept which extends connectivity and computing capabilities to objects and items normally considered computers, allowing these devices to create, communicate, aggregate, analyze and act without human intervention. There is however, no single definition of IoT.

"The Internet of Things (IoT) is the networking of physical devices (also referred to as "connected devices" and "smart devices") embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data"

- as defined by Wikipedia

"A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies."

-as defined by 'The International Telecommunication Unit'

1.1.3 The Evolution of IoT over Time

NASSCOM and Deloitte have published a report titled “IoT – Revolution in the making”. The report states that “The concept of Internet of Things (IoT) has gained traction over the last decade, owing to collective efforts by industry players, associations as well as academia.” It is also mentioned that various consortiums of corporate as well as industry associations such as IPSO alliance, IIC, OIC etc. have been working towards increasing worldwide IoT awareness and adoption as well as increasing number of devices connected to the internet. They have played a significant role in driving IoT adoption. Academia, in collaboration with other industry stakeholders, has further supported the development and deployment of IoT solutions.

IoT, today, is poised for exponential growth globally, with the number of connected devices expected to grow over 5.5x to 20.8 billion and revenue expected to grow over 3x to USD 3 trillion by 2020”.

An interesting question to ask would be - "How did it all start?"

While IoT is relatively new, the concept of combining computers, networks to monitor processes, was known for decades. However, it all started with the Internet.

The telegraph, telephone, radio, and computer had already set the stage for an unprecedented integration of capabilities. However, the Internet has been the instrumental facet in revolutionizing the computer and communications world like nothing before.



Fig.1.2 – Evolution of Internet

The Internet is all of the below at the same time:

- It is a world-wide broadcasting capability.
- It is a mechanism for information dissemination.
- It is a medium for interaction between people and their computers across geographies.

The next big step, in the chain of events leading to the Internet of Things, was the advent of wireless technologies. This gave rise to wireless Internet, the Internet on mobile phones and smartphones. Then started the revolution of the Internet of Things.

The term IoT was coined by Kevin Ashton in 1999. Gradually, the concept gained traction with academia as well as industry promoting its growth.

Fueled by the efforts of academia as well as industry, IoT has gained traction gradually over the years

Figure I.1: Evolution of IoT and its standards

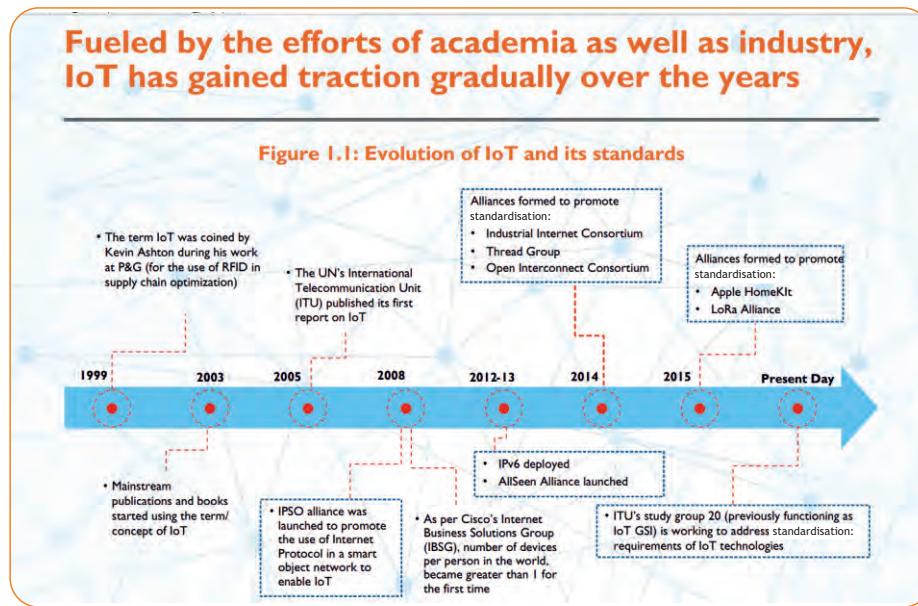


Fig.1.3 – Evolution of IoT and its standards

Source: NASSCOM Deloitte – IoT revolution in the making.

As per Cisco's Internet Business Solutions Group (IBSG), time period between 2008-09 marked a key milestone in IoT growth, when the number of devices connected to the Internet reached 12.5 billion and the world's population became 6.8 billion, thus making number of devices per person more than 1 (i.e. 1.84) for the first time ever.

The rise in adoption of IoT can be attributed to a combination of technology and market trends such as:

1. Technology advancement:

The declining cost of sensors, explosive rise in connectivity including WiFi and cellular, the rise in processing power, miniaturisation of components and development of cloud have been accelerating the demand for IoT by generating and using data in real-time.

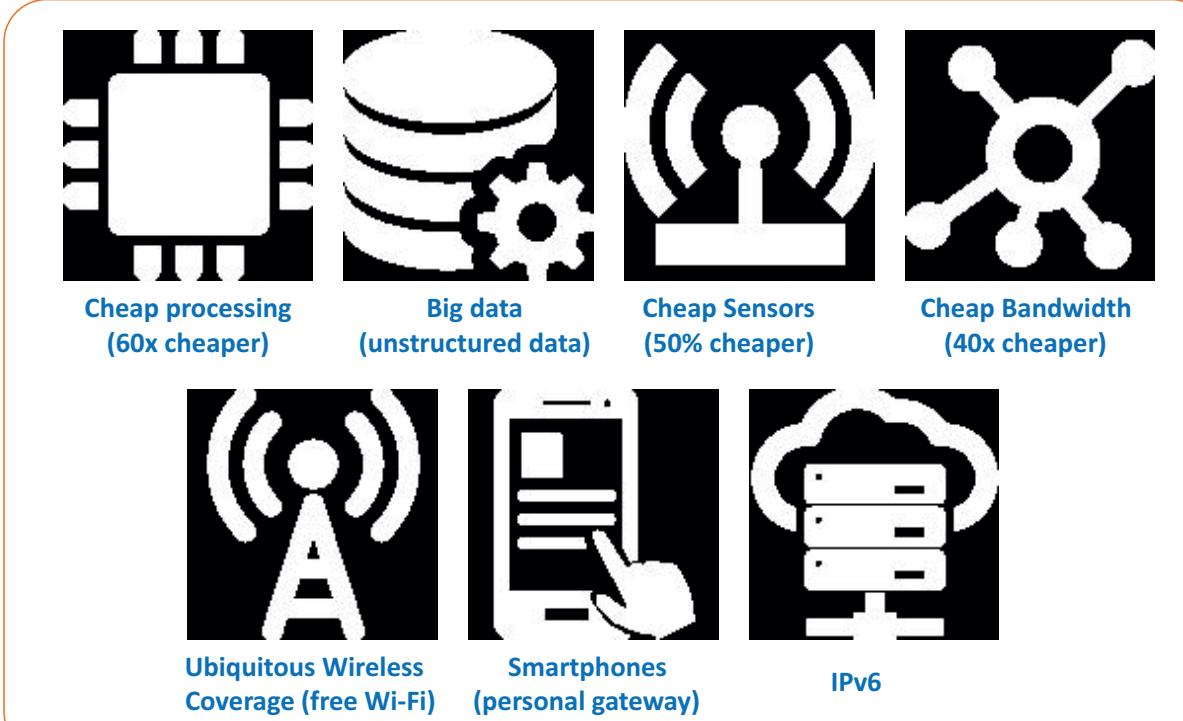


Fig.1.4 – Technological advancement in IoT

- Cheap Sensors – Sensor prices have dropped to an average ₹100/- from ₹1000/- in the past 10 years.
- Cheap Bandwidth – The cost of bandwidth has also declined precipitously, by a factor of nearly 40X over the past 10 years.
- Cheap Processing – Processing costs have declined by nearly 60X over the past 10 years.
- IPv6 – 128 bit address. This enables more devices to connect to the Internet.
- Big Data – As the IoT will, by definition, generate voluminous amounts of unstructured data, the availability of big data analytics is a key enabler.
- Smartphones – Smartphones are now becoming the personal gateway to the IoT, serving as a remote control or hub for the connected home, connected car or the health and fitness devices consumers are increasingly starting to wear.
- Ubiquitous Wireless Coverage – With Wi-Fi coverage being ubiquitous now, wireless connectivity is available for free or at a very low cost, given Wi-Fi utilizes unlicensed spectrum and thus, does not require monthly access fees to a carrier.

2. Investment & Entrepreneurship:

Venture capital investments in IoT have risen almost ten-fold from 2010 to 2015. Even major technology players have been accelerating their investments in this space. For example, IBM recently announced an investment in IoT of USD 3 billion, to be made over the years 2015 to

For example, IBM recently announced an investment in IoT of USD 3 billion, to be made over the years 2015 to 2017. Cisco is investing USD 1 billion in creating a platform for IoT, etc. Along with increase in investments, the pace of mergers and acquisitions in this space is also accelerating.

3. Need for connected consumer and business processes:

With rising device penetration, increasing mobile usage and mobile integration, it is evident that the connected consumer is here to stay – thereby shaping consumer experience road map of leading companies. Companies are converging physical and digital worlds for an integrated and seamless consumer experience, by using sensory data for automation of processes, predictive analytics, etc.

4. IoT Characteristics that are making it popular:

It is very interesting to understand the reason why IoT is gaining such popularity.

IoT has the following characteristics:

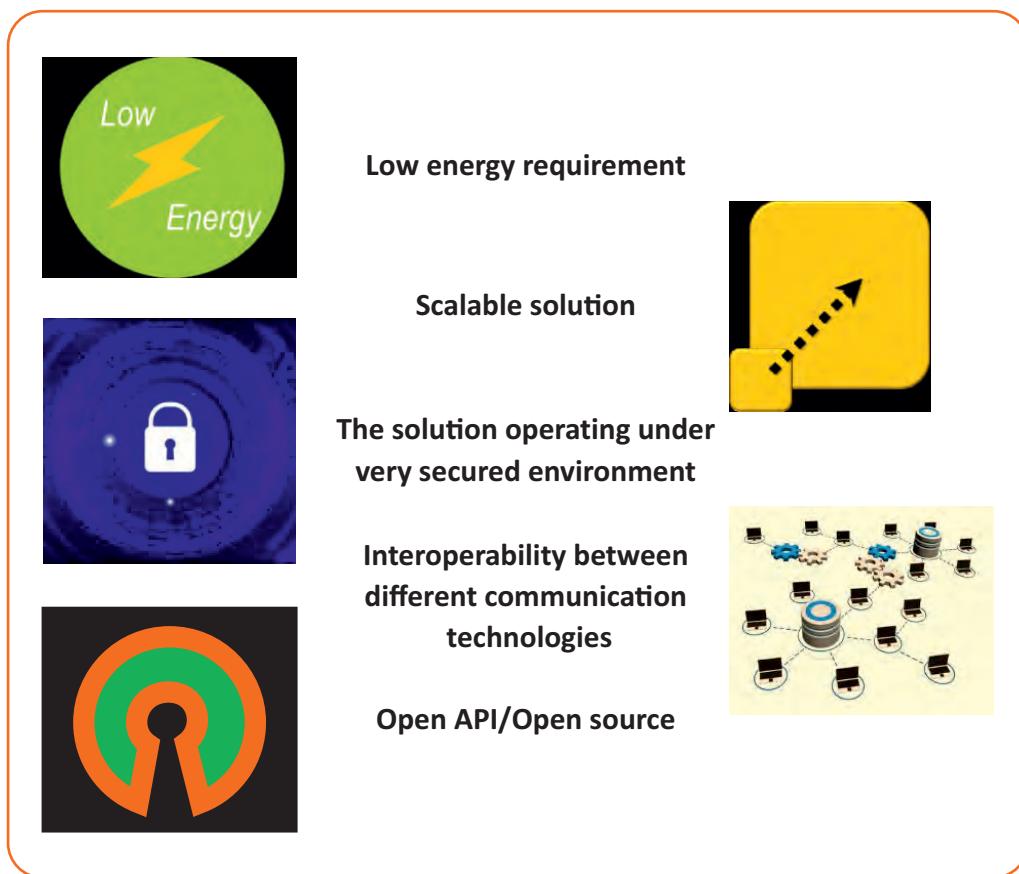


Fig.1.5 – Characteristics of IoT

1.1.4 Market Scenario and Prospects

We have seen how IoT has evolved over time. Let us have a look at its current avatar and also at the future prospects of IoT.

As per the NASSCOM Deloitte report:

The concept of Internet of Things (IoT) has gained traction over the last decade, owing to the collective efforts by industry players, associations as well as academia.

- Various consortiums of corporates as well as industry associations such as IPSO alliance, IIC, OIC etc. have been working towards increasing the worldwide IoT awareness and adoption.
- Increasing the number of devices connected to the internet has played a significant role in driving IoT adoption.
- Academia, in collaboration with other industry stakeholders, has further supported the development and deployment of IoT solutions.

As of today, Internet technology is being used in almost all sectors such as:

- Manufacturing
- Financial Services
- Communication
- Education
- Business
- Transport
- Medical / Health

The communication capabilities have enhanced because of it and the work flow has been simplified. These are also the sectors that are adopting IoT. Smart grids, virtual power plants, smart homes, intelligent transportation and smart cities with remote traffic management and many more are the applications of IoT in these sectors.

Some more current popular uses of IoT include:

- Industrial organizations are using IoT devices such as thermal/pressure/chemical sensors and picking systems to reduce risk and downtime.
- Home automation through the use of smart home devices, that perform control and automation of lighting, heating, ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens or refrigerators/freezers that use Wi-Fi for remote monitoring.
- Office Automation or smart workplaces where IoT devices and sensors are used from air conditioning and lighting systems to personal mobile devices. Important assets can be tracked for their location and can communicate information to other devices around them.
- Healthcare companies are using sensors to monitor and maintain medical devices as well as for remotely tracking assets by location.

"Things" in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, automobiles with built-in sensors, Traffic signals and information boards for speed limit diversion DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist fire fighters in search and rescue operations....the list can be endless!

It is estimated that the IoT application will be the next revolution in the IT sector by 2020. The number of applications can increase in manifold because of the benefits it provides. Automation in nearly all the fields may be the end result.

IoT is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, increased need to index, store, and process them for prompts, alerts, forecasts, futuristic trends, etc. more effectively.

Radio-frequency identification (RFID) may be seen as a prerequisite for the Internet of Things for the creation of local hubs. If all the objects and people in daily life were equipped with identifiers, it would help computers in managing and monitoring. Besides using RFID, the tagging of things may be achieved through such technologies as near field communication, barcodes, QR codes and digital watermarking.

One of the first consequences of implementing the Internet of Things by equipping all objects in the world with minuscule identifying devices or machine-readable identifiers would be to transform them as accessible and interactable devices for the IoT application. A person's ability to interact with objects could be altered remotely based on immediate or present needs, in accordance with existing end-user agreements. As such, it is clear that the IoT will consist of a very large number of devices being connected to the Internet.

However, the application of the IoT is not only restricted to these areas. Other specialized usage cases of the IoT may also exist. Based on an overview of some of the most prominent application areas and based on the application domain, IoT products can be classified broadly into six different categories: **smart devices, smart wearables, smart home, smart city, smart environment, and smart enterprise**. The IoT products and solutions in each of these markets will have different characteristics.

Future Prospects of IoT:

The connectivity of devices is growing exponentially in every field, may it be logistics, manufacturing, healthcare, home automation, automotive, construction, retail, energy, agriculture, aerospace, mining and environment. IoT enhances the system performance.

Currently, the IoT Industry is evaluated at USD 28.4 Billion and expected to touch 50.1 billion mark by 2020.

As per the Nasscom- Deloitte report:

IoT market growth will be driven primarily by connected devices in Manufacturing and Automotive industries, with Transportation & Logistics forming the largest share of industry-specific IoT revenue.

- Among industries, Manufacturing and Automotive are expected to drive the highest volumes in IoT adoption. The installed base of connected devices in both of these industries is expected to be approximately 0.7 billion each by 2020.
- While Manufacturing devices are expected to grow over 2X from 0.32 billion in 2014 to 0.68 billion in 2020, the installed base for Automotive industry will grow 37X from 0.02 billion devices in 2014 to 0.74 billion in 2020.
- In terms of revenue, Automotive industry is expected to see maximum growth to reach USD 303 billion by 2020.
- On the other hand, Transportation & Logistics is expected to drive industry-specific IoT revenue and is likely to reach USD 491 billion by 2020.

IoT usage is gaining traction across business functions such as IT services, Business Process Management (BPM) and Engineering, Research & Development (ER&D).

- IoT applications can be deployed across areas of IT services such as IT consulting, custom software, IT Outsourcing, BPM and Support Services. By integrating IoT based services, IT service providers are expected to increase their portfolio by 10 per cent.
- Integration of IoT with BPM will lead to effective real-time communication between devices and processes, thus enabling accelerated solution deployment, streamlined operations and continuous process improvements.
- IoT in ER&D will empower product engineers and researchers by delivering real-time feedback, enabling quicker design changes to reduce time-to-market and deliver customized products and services.

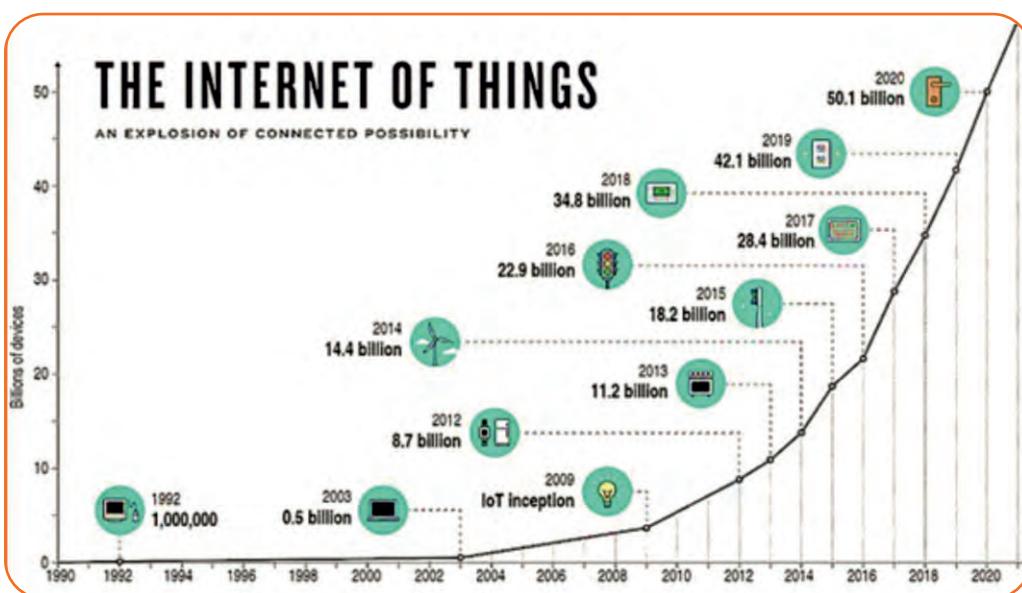


Fig.1.6 – Future prospects of IoT

Source: NASSCOM Deloitte – IoT revolution in the making.

Financial impact of IoT:

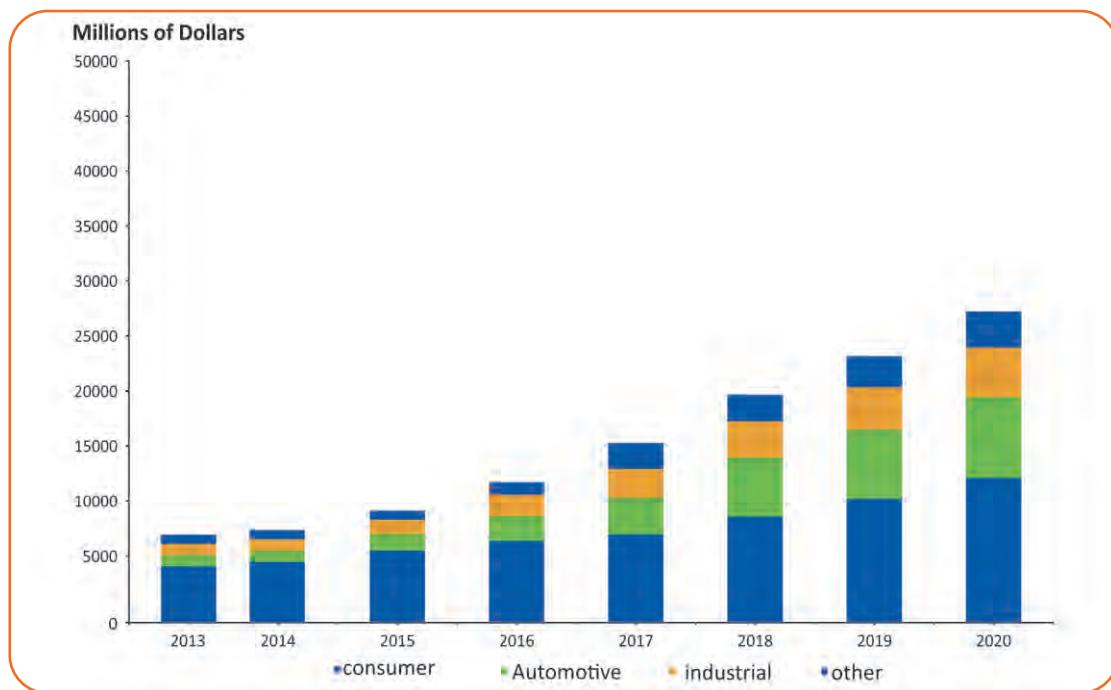


Fig.1.7 – Financial impact of IoT

Source: NASSCOM Deloitte – IoT revolution in the making.

Further reference:

An appreciation of the IoT applications can be seen in the video

<https://www.youtube.com/watch?v=uEsKZGOxNKw>

UNIT 1.2: Working of an IoT System

Unit Objectives



At the end of this unit, you will be able to:

1. Describe the working principle of an IoT system
2. Describe an IoT ecosystem
3. Explain the principle technologies of an IoT eco-system i.e. Wireless Sensor Network, Embedded Systems, Communication Protocols, Cloud Computing and Big Data Analysis
4. Describe various layers of communication protocol

1.2.1 How does IoT Work?

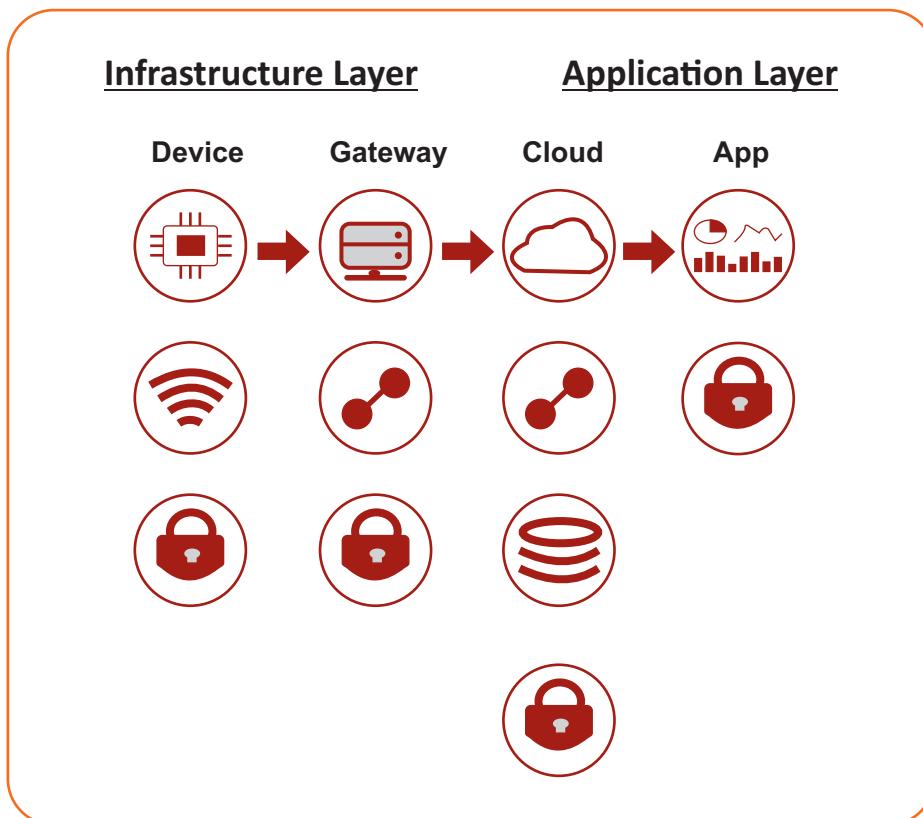


Fig.1.8 – IoT working mechanism

1. Devices consist of Sensors & Sensor Technology. They collect a wide variety of data ranging from temperature, pressure, location, weather/environment conditions, grid parameters, health essentials of a patient, etc.
2. Gateways as the name suggests, are the gateways to the internet for all the devices or things that need to interact with it. They help to connect the sensor nodes in the internal network with the external Internet, by collecting data from the sensor nodes and further transmitting it to the internet infrastructure.
3. The data transmitted through the gateway is then stored and processed securely within the Cloud infrastructure using the Big Data analytics engine. The data thus processed performs intelligent actions. This is what makes the 'Smart Devices'!
4. The Applications help the end users to control and monitor their devices from remote locations. They not only send important information on the hand-held devices or PCs but also help to send commands back to the Smart Devices.

Apart from the above, IP addresses play an important role in the entire IoT ecosystem. The Internet recognizes IP addresses only. IPv6 ensures that we will never run out of IP addresses by providing 3.4×10^{38} IP addresses.

The IoT Ecosystem

To understand the concept of IoT ecosystem further, let's look at the examples in a domestic scenario, as illustrated below:

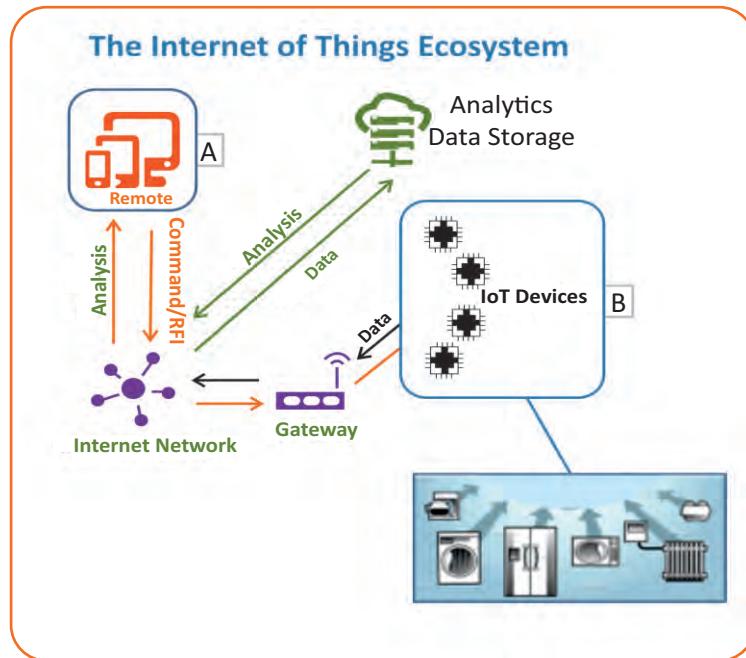


Fig.1.9 – Characteristic general arrangement of IoT

The main objective in this example is to control the loads (*of the AC, refrigerator, washing machine, etc.*) through the Internet network remotely on the basic principle of the Internet of Things (IoT).

- A real-time webpage will be essential with a user configurable front end to control and monitor the load (See A in the figure 1.9).
- The data sent from a password protected webpage returns commands through allotted IP fed to it.
- A Wi-Fi Module is configured with any nearby wireless modem to access internet. The received Internet commands are fed to the Wi-Fi module.
- The program within the Wi-Fi Module executes the commands received based on which the device gets activated through Bluetooth or Zigbee module interfaced to Wi-Fi Module. A Typical interface can be shown as below.

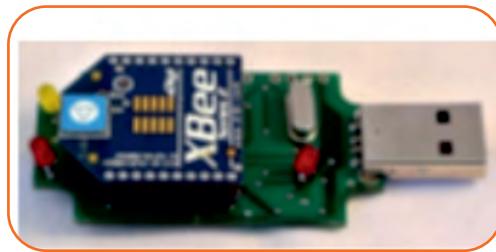


Fig.1.10 – Zigbee Module

- The devices (See B in the Figure) should consist of power management modules and status data report module interfaced to RF modules used for communication. This way the status of the device will also be communicated and displayed on the web page.

The devices to be monitored/controlled communicate through RF modules in their signal processing for WiFi / ZigBee / Bluetooth / radio transceiver (RFID) etc, or through wired LAN.

- The data for control / monitor is harnessed through internet network to a remote control / monitoring centre. A PC system, laptop, tablet or smart phone is used for remote control centres and monitoring. (See A in the figure).

The principal technologies that drive IoT system are:

- Wireless Sensor Networks
- Embedded Systems
- Communication Protocols
- Cloud Computing
- Big Data Analysis



Fig.1.11 – Wireless Sensor Network

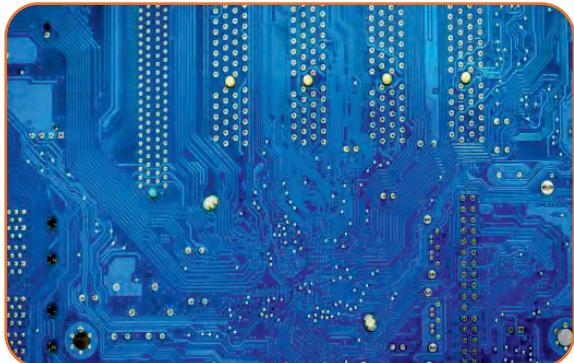


Fig.1.12 – Embedded system

Let's look at each of them individually in the next few sections.

Further reference:

Following videos in the URL can be referred for how IoT works?

<https://www.youtube.com/watch?v=QSIPNhOjMoE> – IoT How it works

<https://www.youtube.com/watch?v=o7VXyolenvU> – IoT Explained easily

1.2.2 Wireless Sensor Networks

A **Wireless Sensor Network (WSN)** is a network formed by a large number of sensor nodes where each node is equipped with a sensor to detect physical phenomenon such as light, heat, pressure, etc. With the rapid technological development of sensors, WSNs will become the key technology for IoT.

A sensor has the ability to capture anything from location to the device orientation. Collectively, these sensors produce a huge amount of data, both in unstructured form (such as picture or videos) as well as structured (such as GPS or acceleration data). These “devices” are perpetually connected to the Internet over WiFi, 3G or 4G.

The simple block diagram of connectivity is illustrated below. The devices can be connected through WiFi, modem, cloud etc.

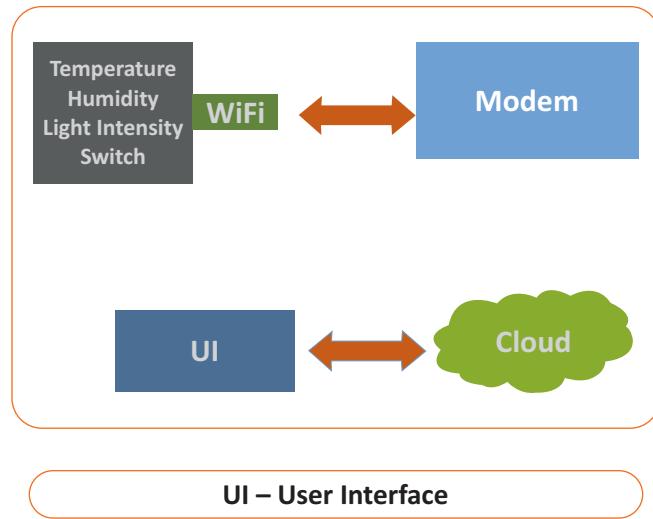


Fig.1.13 – Wi-Fi Module

1.2.3 Embedded Systems

Embedded hardware devices, micro controllers etc, are the ones that process the data. The data from the sensors are not directly usable and a process for using them is implemented by the embedded system. All the connected devices are intelligent devices using a microcontroller or a processor.

Processors are the brain of the IoT system. Their main function is to process the data from the sensors according to an algorithm to extract the valuable information like status, parameter values, alerts etc., and control actuators in some cases in the system. Processors work on a real-time basis. Changes in their operational limits can be set by applications depending on customer requirements. These are also responsible for securing the data i.e. performing encryption and decryption of the data.

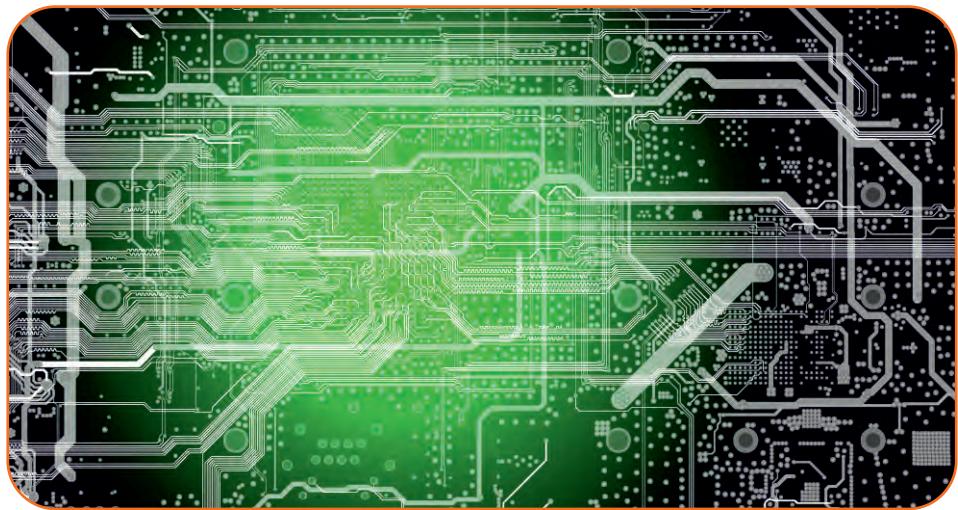


Fig.1.14 – Embedded system

1.2.4 Communication Protocols

The IoT specific protocols cover the wireless protocols like ZigBee, RFID, Bluetooth and BAC net to the next generation protocol standards such as 802.15.4e, 6LoWPAN, RPL, CoAP etc.



Fig.1.15 – Communication with various devices

Let's understand these Communication protocols.

IoT connects various devices through Internet and devices talk to each other through a communication channel. The defined communication channel is called as 'Communication Protocol'.

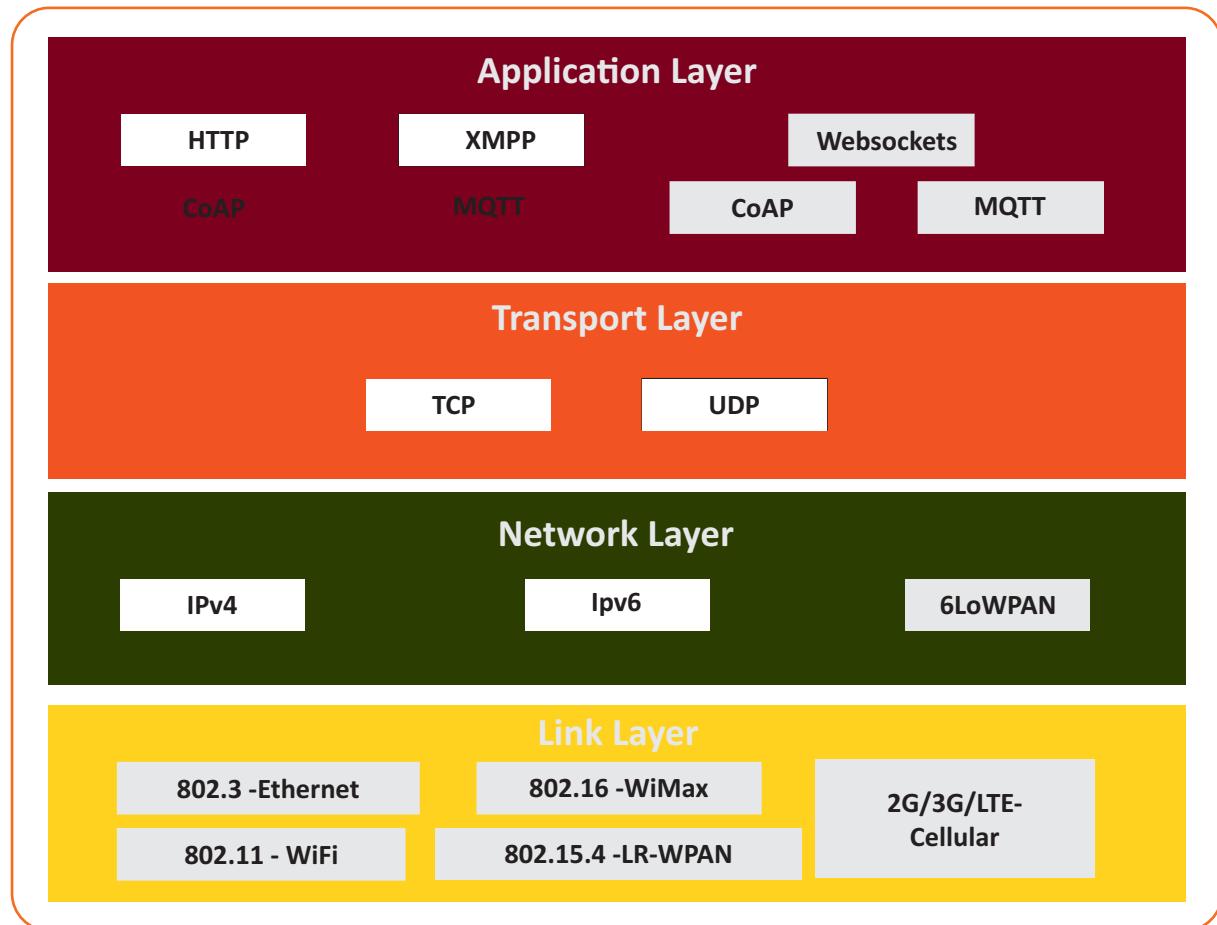


Fig.1.16 – Communication protocol

IoT Protocols:

IoT connects various devices through internet and devices talk to each other through a communication channel. Defined communication channel is called as 'Communication Protocol'.

Communication protocols are broadly categorized as:

- Link layer
- Network layer
- Transport layer and
- Application layer

1. Link Layer

Link Layer determines how the data is physically sent over the network's physical layer.

Ex: copper wire, OFC, radio waves etc.

Some examples are provided below:

802.3 - Ethernet

- Coaxial cables, twisted pair wire or optical fibre as a medium
- 10Mbps to 40Gbps+ data rate

802.3 – Coaxial cable
802.3 i – Copper twisted pair connections
802.3 j – Fibre optics connections
802.3 ae – Fibre
so on.....
Data rate- 10 MB/s to 40Gb/s



Fig.1.17 – Ethernet

802.11 – Wi-Fi

- Wireless LAN; 802.11 b/g/n
- 2.4GHz / 5GHz band
- 1 Mbps to up to 6.75 Gbps data rate

802.11a – operates at 5GHz
 802.11b/g - operates at 2.4GHz
 802.11n - operates at 2.4/5GHz
 802.11ac - operates at 5GHz
 802.11ad - operates at 60GHz
 Data rate- 1 Mb/s to 6.75 Gb/s



Fig.1.18 – WiFi

802.16 – WiMax

- Collection of wireless broadband standards
- 1.5Mbps to 1Gbps data rate

802.15.4 – LR-WPAN

- Low-rate wireless personal area networks
- ex: LoRa
- 40bps to 250Kbps data rate
- Provides low-cost, low-speed communication for low-power devices

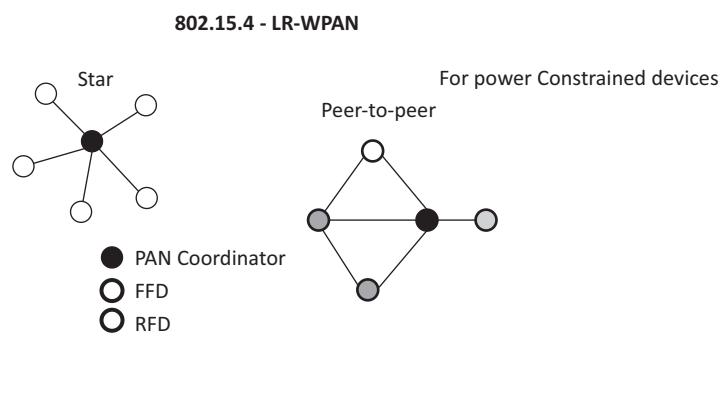


Fig.1.19 – LR-WPAN

2G/3G/4G - Mobile Communication

- Data rates from 9.6Kbps (2G) to up to 100Mbps (4G).



2G - GSM and CDMA
3G - UMTS and CDMA2000
4G - LTE

Date rates - 9.6 kb/s to 100 mb/s

Fig.1.20 – Mobile communication

2. Network Layer

The Network layer is responsible for sending IP datagram from a source network to the destination network. The layer performs host addressing and packet routing.

Some examples are provided below:

Ipv4

- 32 bit address scheme. Total $(2)^{32}$ addresses are available

Network Layer

Ipv4

An Ipv4 address (dotted-decimal notation)

172 . 16 . 254 . 1 32 – bit addressing

↓ ↓ ↓ ↓
10101100.00010000.11111110.00000001
one byte = Eight bytes

Thirtytwo bits (4x8), or 4 bytes

Addresses got exhausted in 2011

Guaranteed Delivery and data integrity handled by upper layer protocols e.g. TCP

Formally described as RFC 791

Fig.1.21 – IPv4

IPv6

- 128 bit address scheme. Total $(2)^{128}$ addresses are available

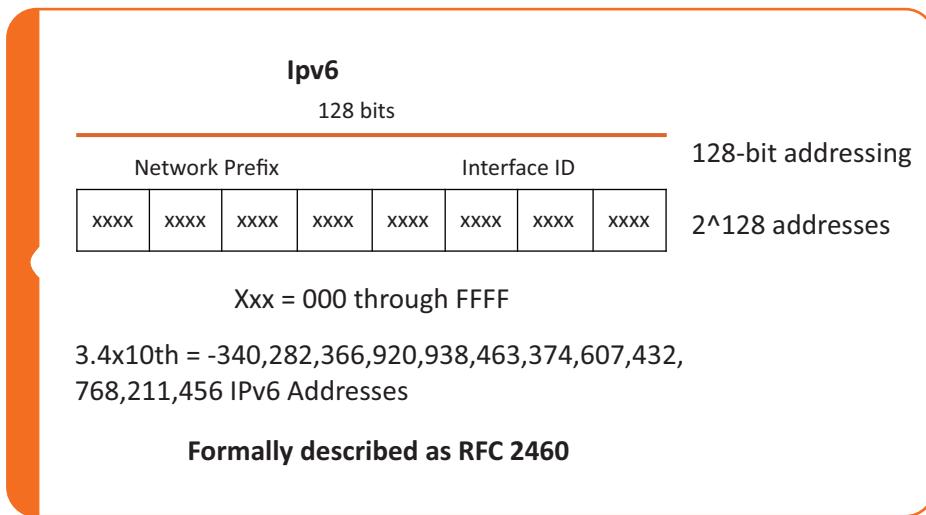


Fig.1.22 – IPv6

6LoWPAN

- IPv6 over Low power Wireless Personal Area Network
- Operates in 2.4GHz range with data transfer rate of 250Kbps

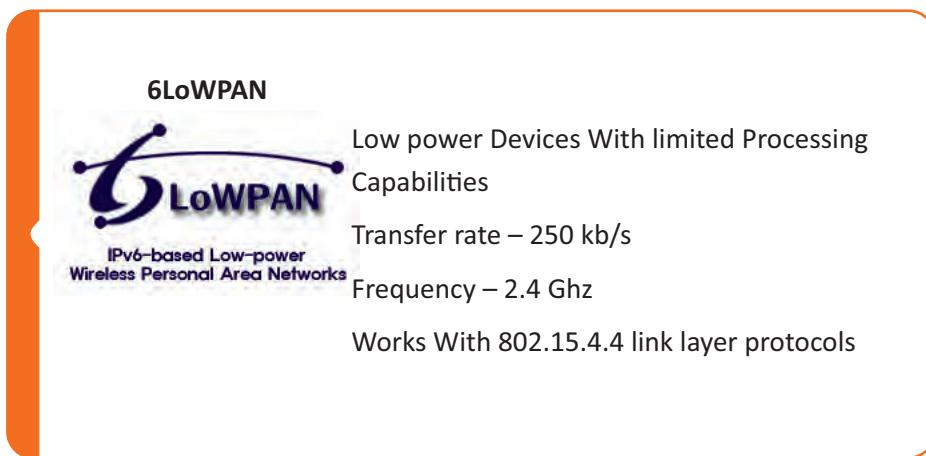


Fig.1.23 – 6LoWPAN

3. Transport Layer

Transport layer protocols provide end-to-end message transfer capability independent of the underlying network.

TCP

- Transmission Control Protocol
- Connection oriented and state full protocol
- Ensures reliable transmission, provides error detection, flow control and congestion control

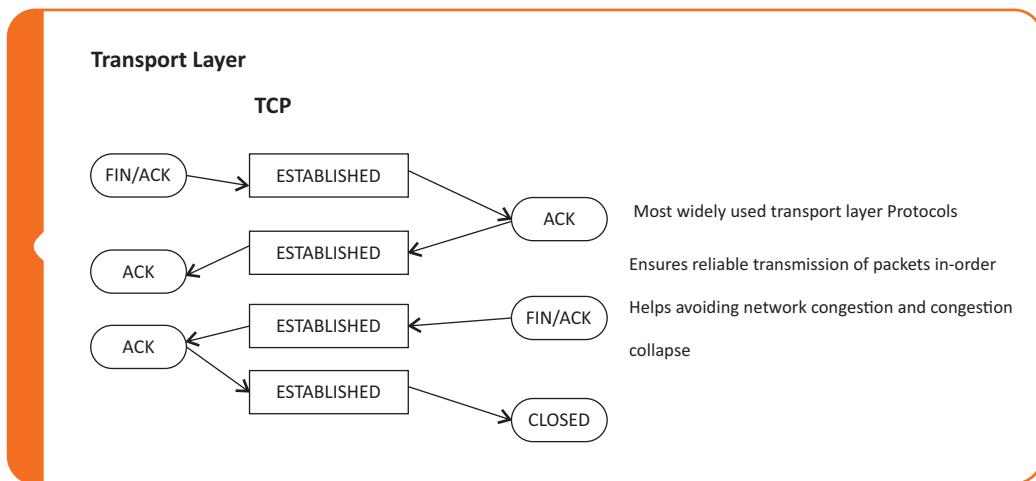


Fig.1.24 – Transmission Control Protocol

UDP

- User Datagram Protocol
- Connectionless and stateless protocol
- Asynchronous protocol

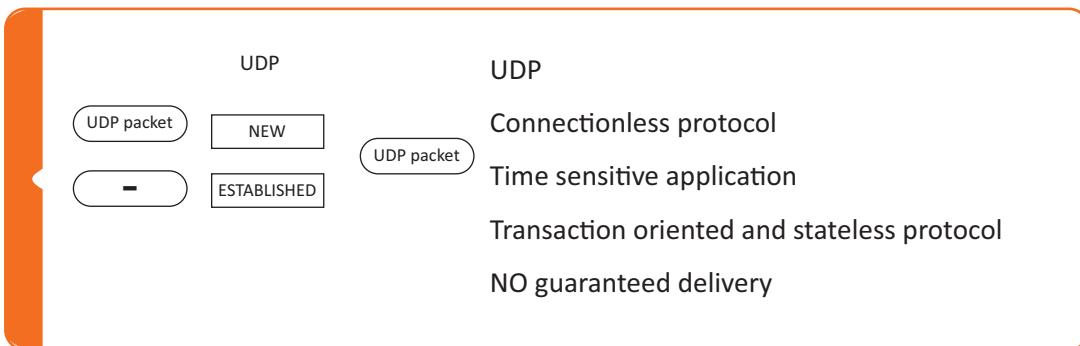


Fig.1.25 – User Datagram Protocol

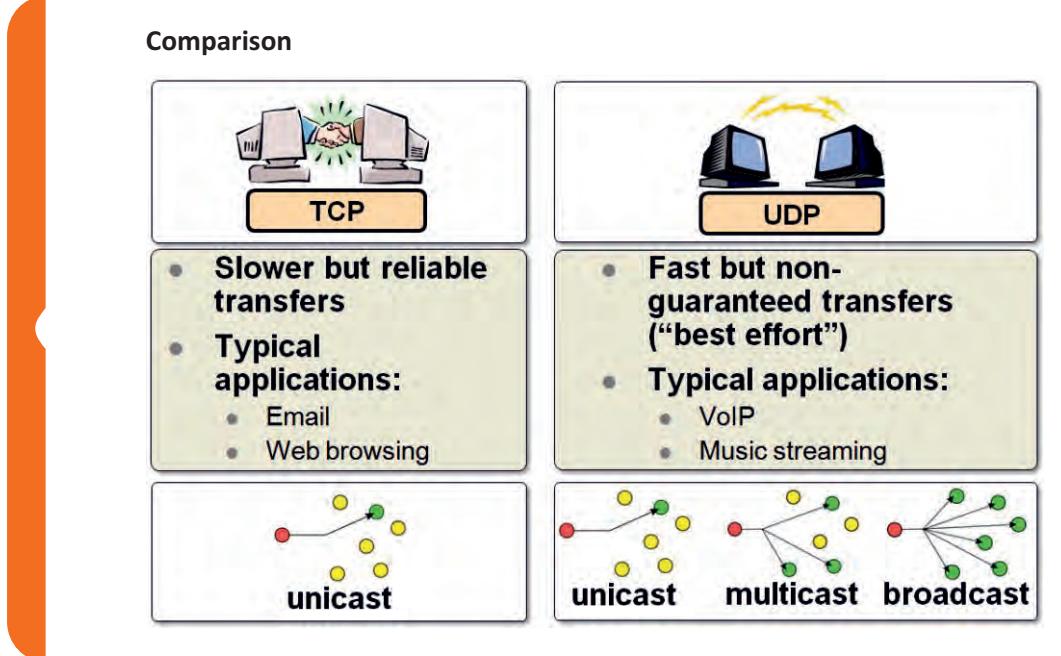


Fig.1.26 – TCP Vs UDP

4. Application Layer

Application layer protocol defines how the applications interface with lower layer protocols to send data over a network.

HTTP

- Hypertext Transfer Protocol
- Follows a request-response model

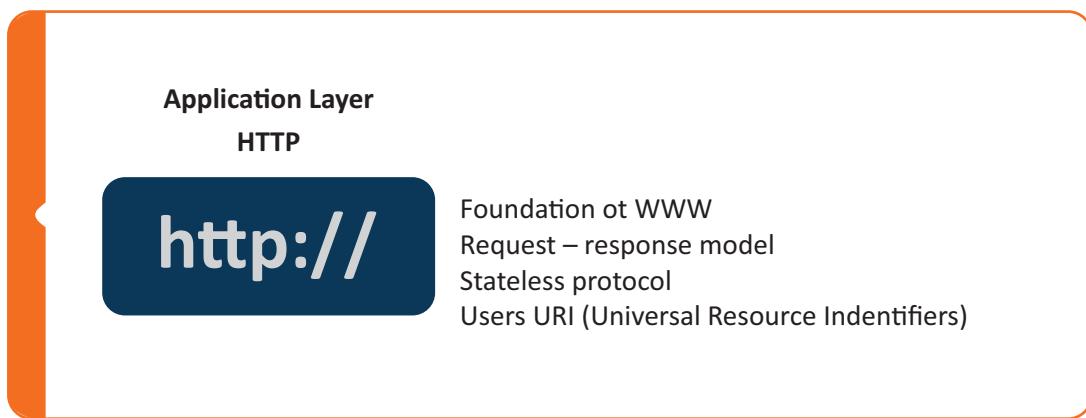


Fig.1.27 – Hypertext Transfer Protocol

CoAP

- Constrained Application Protocol
- Follows a request-response model
- Runs on top of UDP
- Meant for constrained environment

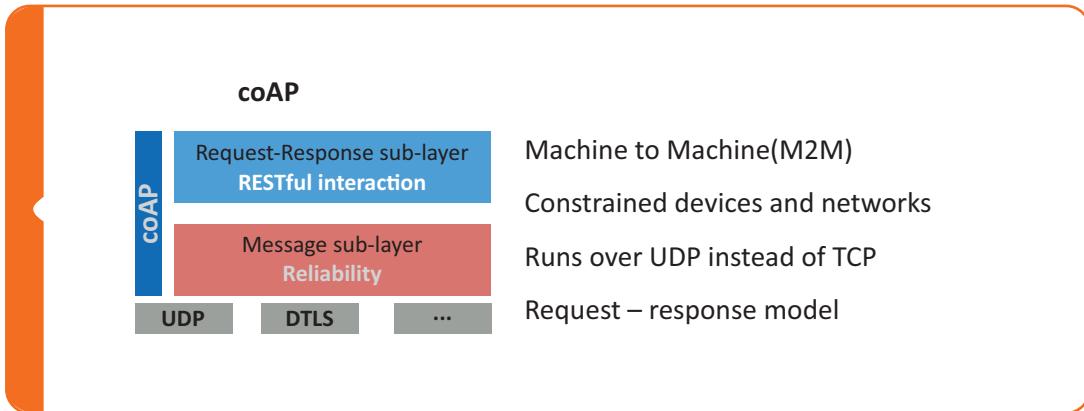


Fig.1.28 – Constrained Application Protocol

Web Sockets

- Based on TCP
- Allows full duplex unique connections

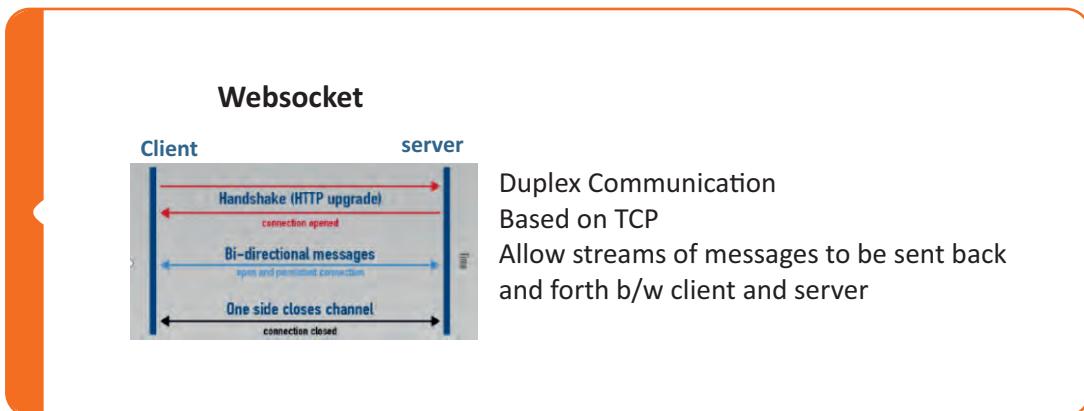


Fig.1.29 – WebSocket Communication Protocol

MQTT

- Message Queue Telemetry Transport
- Based on Publish-Subscribe model
- Low data rate, low packet size, requires low bandwidth



Fig.1.30 – Message Queue Telemetry Protocol

XMPP

- Extensible Messaging and Presence Protocol
- Used for real-time communication and streaming XML data

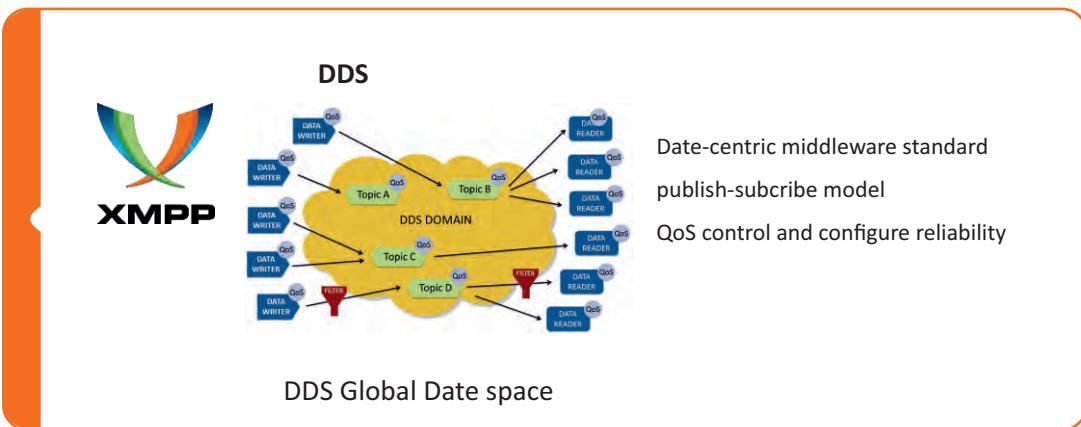


Fig.1.31 – Extensible Messaging and Presence Protocol

DDS

- Data Distributed Service
- Based on publish–subscribe model

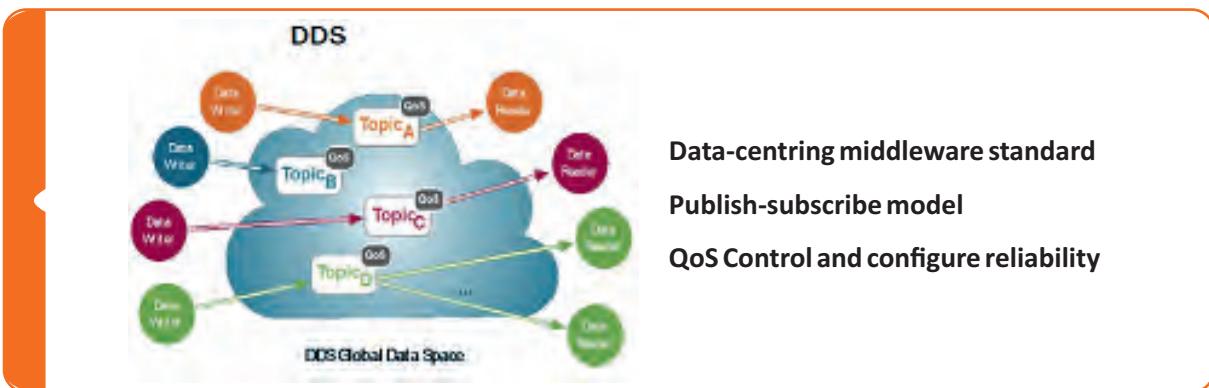


Fig.1.32 – Data Distributed Service

AMQP

- Advanced Message Queuing Protocol
- Supports publish–subscribe model, point-to-point and routing and queuing

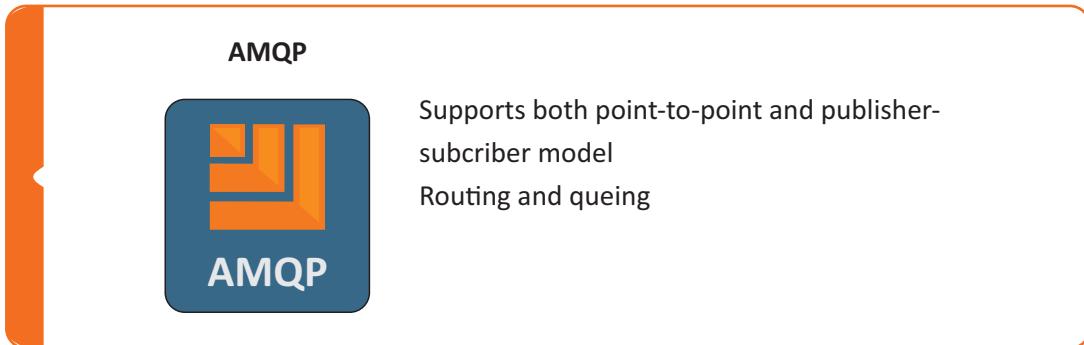


Fig.1.33 – Advanced Message Queuing Protocol

1.2.5 Cloud Computing



A **cloud** refers to a distinct IT environment that is designed for the purpose of remotely provisioning scalable and measured IT resources. It is a means of providing remote access to a set of decentralized IT resources. Mainly it is a type of computing that relies on sharing computing resources rather than having local servers or personal devices to handle applications. In short, cloud computing is a type of Internet-based computing, where different services such as servers, storage and applications are delivered to an organisation's computers and devices through the Internet.

Fig.1.34 – Cloud Computing Architecture

Cloud solution:

The solution in the Cloud can have several levels of complexity:

1. Connectivity:

The solution can enable a remote user to connect to the device remotely (through the Cloud solution).

2. Management:

The management capability can be provided by the Cloud solution whereby the operation and control of the device can be performed through the Cloud solution.

3. Remote user:

Similar to a local user, a remote user equipped with a Smartphone /Tablet/PC wants to interact with the connected device or receive information relating to it. A local user may interact directly with the device, whereas a remote user will need to do so via the cloud solution. A relevant app or application needs to be developed that will connect to the Cloud solution and thereby have access to the device or the information relating to it.



Fig.1.35 – Various devices connected to cloud

1.2.6 Big data Analytics

Big data analytics is the process of examining large and varied data sets i.e., big data to uncover hidden patterns, unknown correlations, market trends, customer preferences and other useful information that can help organizations make more-informed business decisions. Big data analysis and cloud computing go hand in hand, particularly in IoT applications.

Analysis of the data coming from a device or other sources can be used to send information to a remote/local user regarding the device operation, or this analysis can be translated into commands sent to the device to influence its operation. For example, the connected lamp can be turned on from the Cloud when analysis shows that it is dark in the lamp's location and a remote lock shows that someone has entered the house.



Fig.1.36 – Representation of big data analytics

UNIT 1.3: Logical Design of IoT

Unit Objectives



At the end of this unit, you will be able to:

1. Explain various functional blocks of an IoT system
2. State functions of sensors, IoT gateways, Network/wireless and services
3. List various types of sensors used in an IoT application
4. Interpret various communication models
5. Describe REST based and WebSocket based communication API
6. List some applications of IoT
7. Explain IoT security concerns and ways to tackle security threats

1.3.1 IoT Functional Blocks

The IoT system comprises of the following functional blocks:

- Devices
- Communication
- Services
- Management
- Security
- Application

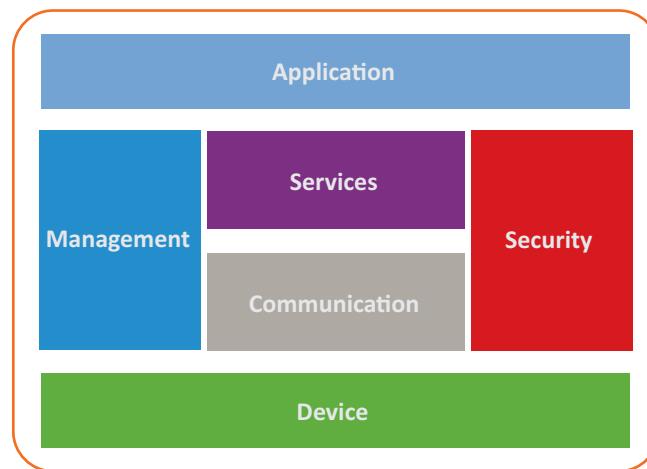


Fig.1.37 – IoT functional blocks

Devices:

An IoT system works on the data received from various devices like sensors, micro controller, powerful gateways etc. All the devices should be registered in the network. The process of registering devices is called as 'Data provisioning'. Each device will have a unique ID, by which they can be identified.

Communication:

Sensor and devices of the network are connected at a signal point, and they communicate with each other as per the defined communication protocol thus making devices and sensor capable of taking real time action.

Management:

Once the network connections are established, the next task is to manage data. The data management includes data collection, aggregation, processing, storage and triggering. Proper connectivity aids in real time data collection, real time processing, big data solution and predictive analysis. With the help of device provisioning, the device can be monitored remotely. The devices should be constantly monitored so as to achieve the desired result.

Services/Application:

An IoT system is designed to achieve a specific task i.e. service. These services can be controlled by users through Applications.

1.3.2 The Basic Constituents of an IoT System

IoT system architecture can be depicted as below:

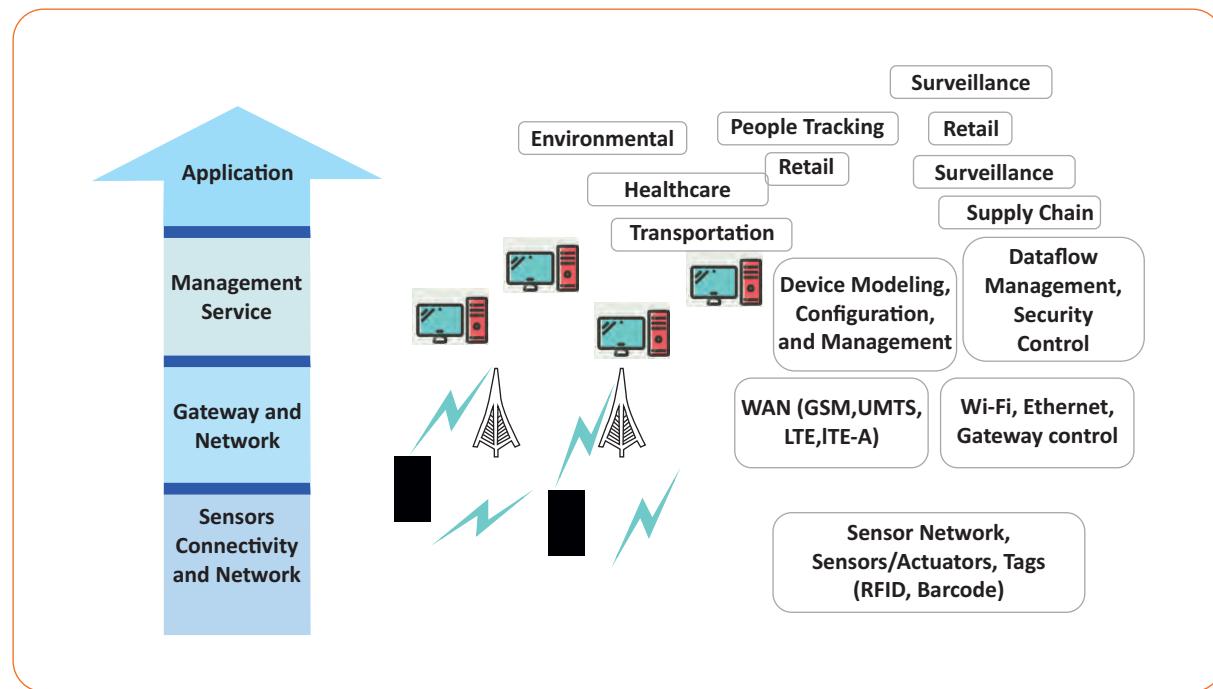
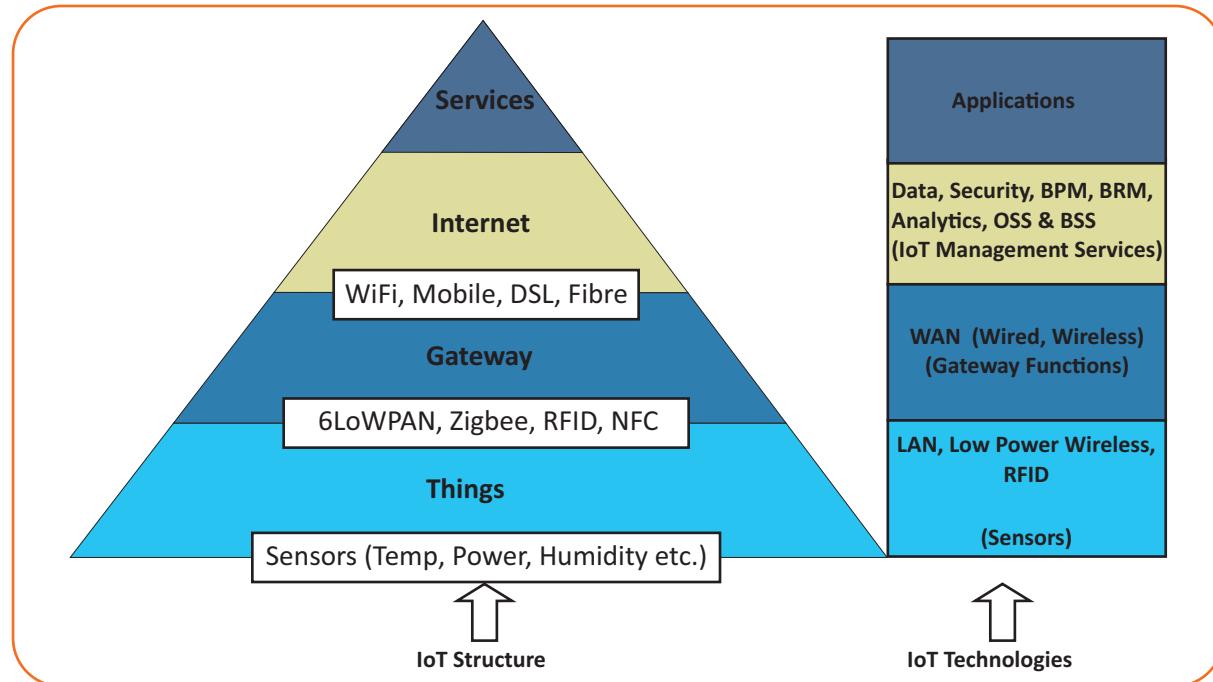


Fig.1.38 – IoT architecture

The basic constituents as shown in the above diagram are as follows:

- Sensors
- IoT Gateways
- Network/wireless services
- Services

1. Sensors (Things)

- These are referred to as things in IoT.
- Sensors collect data and pass on the data to actuators for further processing.
- Sensors will have unique IP address and be easily identifiable over the network.
- Some commonly used are a Humidity sensor, Power sensor, Temperature sensor, water quality sensor etc.

2. Gateways

- Gateways route the proposed data to proper locations to be utilized.
- Facilitate to and fro communication of data.
- Gateways also provide network connectivity to the data which is essential for an IoT system to communicate.
- LAN, WAN, PAN etc, are examples of network gateways.

3. Internet

- Connect devices to the IoT system.
- Different types of modes can be used like WiFi, Mobile, DSL, Fibre etc.

4. Services (Applications)

- An IoT system is designed to achieve a specific task i.e. application.
- Applications can be controlled by users.

Let's have a look at some sensors commonly used in IoT systems.

Mobile processor as a possible IoT connectivity

A modern Smartphone is equipped with sensors such as:

- motion sensors
- accelerometers
- magnetometer and compass
- environmental sensors like thermometers, barometer (pressure sensor)



Fig.1.39 – Mobile WiFi

- cameras
- microphones etc.

With 3 billion Smartphone users and 82% of them using Android, we can safely claim that 2.4 billion IoT-compatible devices are already in the market and this number can only grow higher and higher!

Apart from hundreds and thousands of other devices based on many other technologies, it appears Smartphones can also be the constituent component of the Internet of Things. It can play a very significant role as pathfinders through this new terrain and will be the harbingers of the Internet of Things.

If you have a Smartphone in your pocket, pat it lovingly — it will be your access point for the Internet of Things one day. With the rise of the wearables, such as Android Wear or the Apple Watch it appears increasingly that smart phone can play an additional role.

One example of an actual use of the Internet of Things could be to observe traffic congestion on specific roads with Google Maps. This data is automatically being collected from the motion sensors of hundreds of anonymous Android users as connected devices who are moving along that road at this instant of time, processed for statistical validity and sent to any Google Maps user who is interested.

Here are a few projects that are taking advantage of this trend, turning smart phones (or their silicon guts, at least) into the hardware that can power all sorts of IoT use-cases.

Placemeter:

New York city startup 'Placemeter' was one of the first to see the value in an out-of-date Smartphone hardware. The company's cloud-based analytics platform uses machine vision algorithms to track the number of pedestrians on a street or customers in a store. While any webcam feed will do, old iOS or Android smart phones can also collect data : users install the Placemeter app and place the phone in a window. As the company builds out its platform and refines its algorithms, it has offered to pay up to \$50 a month for video feeds of busy intersections and other public spaces.



Fig.1.40 – Placemeter

Zensors:

Zensors is a proof-of-concept project from computer science graduate students and professors at Carnegie Mellon University. It repurposes unused smart phones as camera-equipped visual sensors and uses a combination of crowd sourcing and machine learning to answer natural-language questions about what the camera sees.

Users place the phone to point its camera at something they want to track, then use a fingertip to circle an “area of interest” in the video feed and type in a question that they’d like to have answered — such as “How many cars are in the parking lot?” or “Is it snowing?” or “How large is the pile of dishes on the kitchen counter?” Images are reviewed first by humans through Amazon’s Mechanical Turk platform, which provides some training so that a machine learning algorithm can eventually take over.

Windows Arduino Libraries:

At the 2015 Build developer conference, Microsoft announced two new software libraries that essentially allow Windows phones (or any hardware running Windows 10) to act as Arduino compatible development boards.

Windows Virtual Shield for Arduino lets any Windows device to connect wirelessly to an Arduino board. That gives the Arduino access to all of the hardware in the phone, from gyroscope to touch screen, just as if those components were hard-wired through an Arduino “shield” module. **Windows Remote Arduino** runs the equation backwards, allowing a Windows application to control and draw on the components of an Arduino device.

With the release of the libraries, Windows 10 became the first operating system to join the Arduino Certified program by making it easy to add an entire Smartphone's worth of hardware components to any Arduino project.

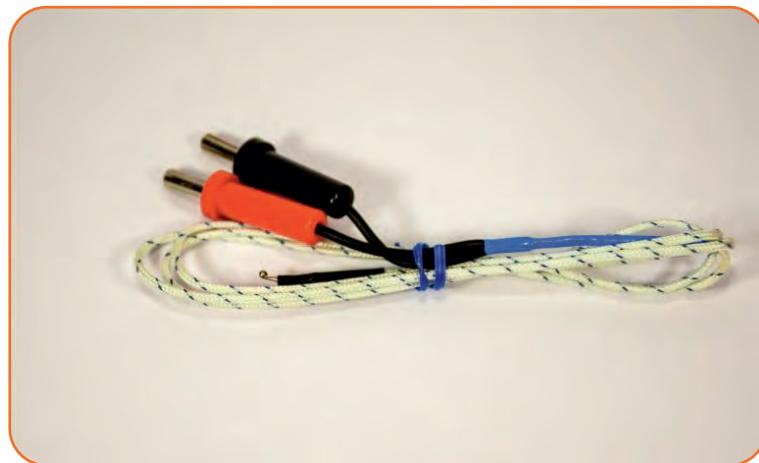


Fig.1.41 – Temperature sensor

1.3.3 Communication Models

There are many technologies that enable IoT. Crucial to the field is the network used to communicate between devices of an IoT installation, a role that several wireless or wired technologies may fulfil. Some better known network solutions are given below.

Communication models are broadly categorized as:

- Short-range wireless
- Long-range wireless
- Wired



Fig.1.42 – Short range wireless



Fig.1.43 – Long range wireless

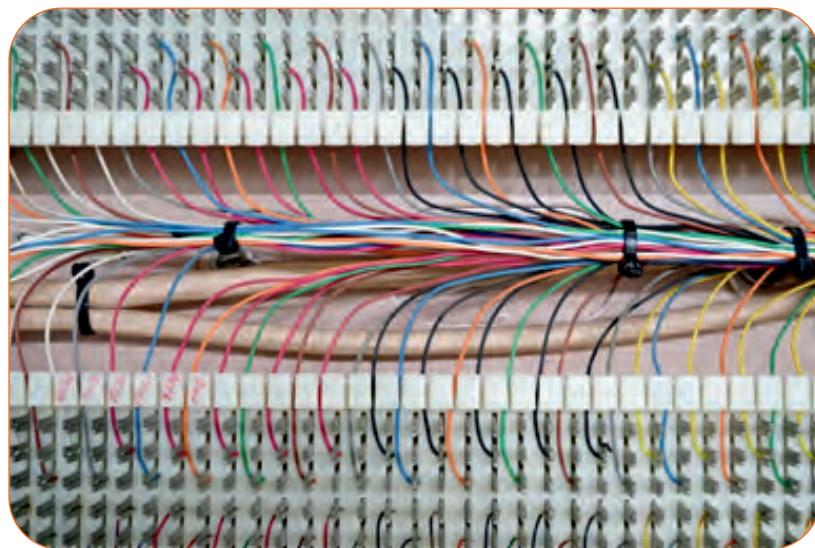


Fig.1.44 – Wired communication

1. Bluetooth low energy (BLE)

An important short-range communications technology is, of course, Bluetooth, which has become very important in computing and many consumer product markets. It is expected to be a key for the wearable products, in particular, again connecting to the IoT albeit probably via a smartphone in many cases. The new Bluetooth Low-Energy (BLE) or Bluetooth Smart, as it is now branded is a significant protocol for IoT applications. Importantly, while it offers a similar range to Bluetooth it has been designed to take up significantly reduced power consumption.

However, Smart/BLE is not really designed for file transfer and is more suitable for small chunks of data. It has a major advantage certainly in a more personal device context over many competing technologies given its widespread integration in smartphones and many other mobile devices. According to Bluetooth SIG, more than 90 percent of Bluetooth enabled smartphones, including iOS, Android and Windows based models, are expected to be 'Smart Ready' by 2018.

Devices that employ Bluetooth Smart features incorporate the Bluetooth Core Specification Version 4.0 (or higher – the latest is version 4.2 announced in late 2014) with a combined basic-data-rate and low-energy core configuration for a RF transceiver, baseband and protocol stack. Importantly, version 4.2 via its Internet Protocol Support Profile will allow Bluetooth Smart sensors to access the Internet directly via 6LoWPAN connectivity. This IP connectivity makes it possible to use existing IP infrastructure to manage Bluetooth Smart 'edge' devices. More information on Bluetooth 4.2 is available here and a wide range of Bluetooth modules are available from RS.

Standard: Bluetooth 4.2 core specification

Frequency: 2.4GHz (ISM)

Range: 50-150m (Smart/BLE)

Data Rates: 1Mbps (Smart/BLE)

2. Light-Fidelity (Li-Fi)

Wireless communication technology similar to the Wi-Fi standard, but uses visible light communication for increased bandwidth.



Fig.1.45 – Bluetooth communication

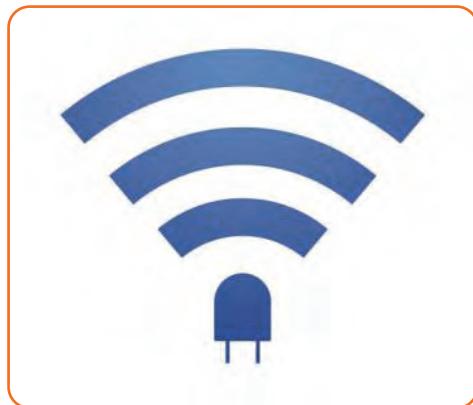


Fig.1.46 – Li-Fi communication

3. Near-field communication (NFC)

Communication protocols enabling two electronic devices to communicate within a 4 cm range.

NFC (Near Field Communication) is a technology that enables simple and safe two-way interactions between electronic devices and especially applicable for smartphones, allowing consumers to perform contactless payment

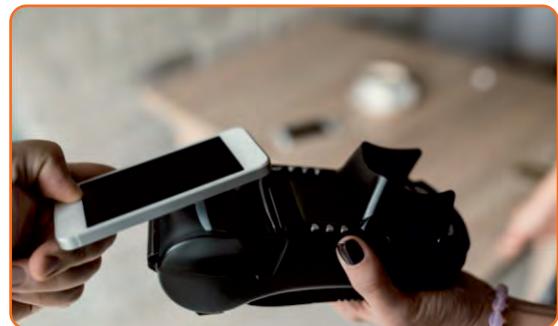


Fig.1.47 – Near Field Communication

transactions, access digital content and connect electronic devices. Essentially it extends the capability of contactless card technology and enables devices to share information at a distance that is less than 4cm.

Standard: ISO/IEC 18000-3

Frequency: 13.56MHz (ISM)

Range: 10cm

Data Rates: 100–420kbps

4. QR codes and barcodes

Machine readable optical tags that store information about the item to which they are attached.



Fig.1.48 – Reading QR code

5. Radio-frequency identification (RFID)

Technology using electromagnetic fields to read data stored in tags embedded in other items.



Fig.1.49 – RFID tagging

6. Thread

Network protocol based on the IEEE 802.15.4 standard, similar to ZigBee, providing IPv6 addressing.

A very new IP-based IPv6 networking protocol aimed at the home automation environment is called as 'Thread'. Based on 6LoWPAN, and also similar, it is not an IoT application protocol like Bluetooth or ZigBee. However, from an application point of view, it is primarily designed as a complement to WiFi as it recognises that while WiFi is good for many consumer devices, it has limitations for use in a home automation setup.

Launched in mid-2014 by the Thread Group, the royalty-free protocol is based on various standards including IEEE802.15.4 (as the wireless air-interface protocol), IPv6 and 6LoWPAN and offers a resilient IP-based solution for the IoT. Designed to work on existing IEEE802.15.4 wireless silicon from chip vendors such as Freescale and Silicon Labs, Thread supports a mesh network using IEEE802.15.4 radio transceivers and is capable of handling up to 250 nodes with high levels of authentication and encryption. A relatively simple software upgrade should allow users to run a thread on existing IEEE802.15.4-enabled devices.

Standard: Thread, based on IEEE802.15.4 and 6LoWPAN

Frequency: 2.4GHz (ISM)

Range: N/A

Data Rates: N/A

Further reference:

<https://www.cheatography.com/davidpol/cheat-sheets/understanding-thread-protocol/>

Transport Layer Security (network protocol) TLS

1. Wi-Fi

Widely used technology for local area networking based on the IEEE 802.11 standards, where devices may communicate through a shared access point.

WiFi connectivity is often an obvious choice for many developers, especially given the pervasiveness of WiFi within the home environment within LANs. It requires little further explanation except to state the obvious that clearly there is a wide existing infrastructure as well as offering fast data transfer and the ability to handle high quantities of data.

Currently, the most common WiFi standard used in homes and many businesses is 802.11n, which offers serious throughput in the range of hundreds of megabit per second, which is fine for file transfers but may be too power-consuming for many IoT applications. A series of RF development kits designed for building WiFi-based applications are available from RS.

Standard: Based on 802.11n (most common usage in homes today)

Frequencies: 2.4GHz and 5GHz bands

Range: Approximately 50m

Data Rates: 600 Mbps maximum, but 150-200Mbps is more typical, depending on channel frequency used and number of antennas (latest 802.11-ac standard should offer 500Mbps to 1Gbps)

2. Wi-Fi Direct

A Variant of the Wi-Fi standard for peer-to-peer communication, eliminating the need for an access point.

3. Z-Wave

Communication protocol providing short-range, low-latency data transfer at rates and power consumption lower than Wi-Fi. Used primarily for home automation.

Z-Wave is a low-power RF communications technology that is primarily designed for home automation for products such as lamp controllers and sensors among many others. Optimized for reliable and low-latency communication of small data packets with data rates up to 100kbit/s, it operates in the sub-1GHz band and is impervious to interference from WiFi and other wireless technologies in the 2.4-GHz range such as Bluetooth or ZigBee. It supports full mesh networks without the need for a coordinator node and is very scalable, enabling control of up to 232 devices. Z-Wave uses a simpler protocol than some others, which can enable faster and simpler development, but the only maker of chips is Sigma Designs compared to multiple sources for other wireless technologies such as ZigBee and others.

Standard: Z-Wave Alliance ZAD12837 / ITU-T G.9959

Frequency: 900MHz (ISM)

Range: 30m

Data Rates: 9.6/40/100kbit/s

4. ZigBee

Communication protocols for personal area networking based on the IEEE 802.15.4 standard, providing low power consumption, low data rate, low cost, and high throughput.

ZigBee, like Bluetooth, has a large installed base of operation, although perhaps traditionally more in industrial settings. ZigBee PRO and ZigBee Remote Control (RF4CE), among other available ZigBee

profiles, are based on the IEEE802.15.4 protocol, which is an industry-standard wireless networking technology operating at 2.4GHz targeting applications that require relatively infrequent data exchanges at low data-rates over a restricted area and within a 100m range such as in a home or a building.

ZigBee/RF4CE has some significant advantages in complex systems offering low-power operation, high security, robustness and high scalability with high node counts and is well positioned to take advantage of wireless control and sensor networks in M2M and IoT applications. The latest version of ZigBee is the recently launched 3.0, which is essentially the unification of the various ZigBee wireless standards into a single standard. An example product and kit for ZigBee development are TI's CC2538SF53RTQT ZigBee System-On-Chip IC and CC2538 ZigBee Development Kit.

Standard: ZigBee 3.0 based on IEEE802.15.4

Frequency: 2.4GHz

Range: 10-100m

Data Rates: 250kbps

5. HaLow

A Variant of the Wi-Fi standard providing extended range for low-power communication at a lower data rate.

6. LTE-Advanced

High-speed communication specification for mobile networks. Provides enhancements to the LTE standard with extended coverage, higher throughput, and lower latency.

7. 6LoWPAN

A key IP (Internet Protocol)-based technology is 6LoWPAN (IPv6 Low-power Wireless Personal Area Network). Rather than being an IoT application protocols technology like Bluetooth or ZigBee, 6LoWPAN is a network protocol that defines encapsulation and header compression mechanisms. The standard has the freedom of frequency band and physical layer and can also be used across multiple communications platforms, including Ethernet, Wi-Fi, 802.15.4 and sub-1GHz ISM. A key attribute is the IPv6 (Internet Protocol version 6) stack, which has been a very important introduction in recent years to enable the IoT. IPv6 is the successor to IPv4 and offers approximately 5×1028 addresses for every person in the world, enabling any embedded object or device in the world to have its own unique IP address and connect to the Internet. Especially designed for a home or building automation, for example, IPv6 provides a basic transport mechanism to produce complex control systems and to communicate with devices in a cost-effective manner via a low-power wireless network.

Designed to send IPv6 packets over IEEE802.15.4-based networks and implementing open IP

standards including TCP, UDP, HTTP, COAP, MQTT, and websockets, the standard offers end-to-end addressable nodes, allowing a router to connect the network to IP. 6LoWPAN is a mesh network that is robust, scalable and self-healing. Mesh router devices can route data destined for other devices, while hosts are able to sleep for long periods of time.

Standard: RFC6282

Frequency: Adapted and used over a variety of other networking media including Bluetooth Smart (2.4GHz) or ZigBee or low-power RF (sub-1GHz).

Range: N/A

Data Rates: N/A

Further reference: 

http://www.cisco.com/c/en/us/td/docs/voice_ip_comm/cucm/srnd/ipv6/ipv6srnd/basic_s.pdf

<http://www.txv6tf.org/wp-content/uploads/2010/08/Muhummad-Tutorial-ipv6-basics.pdf>

8. Sigfox

An alternative wide-range technology is Sigfox, which in terms of range comes between WiFi and cellular. It uses the ISM bands, which are free to use without the need to acquire licenses, to transmit data over a very narrow spectrum to and from connected objects. The idea for Sigfox is that for many M2M applications that run on a small battery and only require low levels of data transfer, then Wi-Fi's range is too short while cellular is too expensive and also consumes too much power. Sigfox uses a technology called Ultra Narrow Band (UNB) and is only designed to handle low data-transfer speeds of 10 to 1,000 bits per second. It consumes only 50 microwatts compared to 5000 microwatts for cellular communication or can deliver a typical stand-by time of 20 years with a 2.5Ah battery while it is only 0.2 years for cellular.

Already deployed in tens of thousands of connected objects, the network is currently being rolled out in major cities across Europe, including ten cities in the UK for example. The network offers a robust, power-efficient and scalable network that can communicate with millions of battery-operated devices across areas of several square kilometers, making it suitable for various M2M applications that are expected to include smart meters, patient monitors, security devices, street lighting and environmental sensors. The Sigfox system uses silicon such as the EZRadioPro wireless transceivers from Silicon Labs, which deliver industry-leading wireless performance, extended range and ultra-low power consumption for wireless networking applications operating in the sub-1GHz band.

Standard: Sigfox

Frequency: 900MHz

Range: 30-50km (rural environments), 3-10km (urban environments)

Data Rates: 10-1000bps

9. Neul

Similar to Sigfox in concept and operating in the sub-1GHz band, 'Neul' leverages very small slices of the TV White Space spectrum to deliver high scalability, high coverage, low power and low-cost wireless networks. Systems are based on the Iceni chip, which communicates using the white space radio to access the high-quality UHF spectrum, now available due to analogue to digital TV transition. The communications technology is called Weightless, which is a new wide-area wireless networking technology designed for the IoT that largely competes against existing GPRS, 3G, CDMA and LTE WAN solutions. Data rates can be anything from a few bits per second up to 100kbps over the same single link; and devices can consume as little as 20 to 30mA from 2xAA batteries, meaning 10 to 15 years in the field.

Standard: Neul

Frequency: 900MHz (ISM), 458MHz (UK), 470-790MHz (White Space)

Range: 10km

Data Rates: Few bps up to 100kbps

10. LoRaWAN

Similar in some respects to Sigfox and Neul, LoRaWAN targets wide-area network (WAN) applications and is designed to provide low-power WANs with features specifically needed to support low-cost mobile secure bi-directional communication in IoT, M2M, smart city and industrial applications. Optimized for low-power consumption and supporting large networks with millions and millions of devices, data rates range from 0.3 kbps to 50 kbps.

Standard: LoRaWAN

Frequency: Various

Range: 2-5km (urban environment), 15km (suburban environment)

Data Rates: 0.3-50 kbps.

Long-range wireless:

1. Low-power wide-area networking (LPWAN)

Wireless networks are designed to allow long-range communication at a low data rate, reducing power and cost for transmission.

2. Very small aperture terminal (VSAT)

Satellite communication technology using small dish antennas for narrowband and broadband data.



Fig.1.50 – VSAT communication

Wired:

1. Ethernet

General purpose networking standard using twisted pair and fibre optic links in conjunction with hubs or switches.



Fig.1.51 – Wired communication

2. Multimedia over Coax Alliance (MoCA)

Specification enabling whole-home distribution of high definition video and content over existing coaxial cabling.

3. Power-line communication (PLC)

Communication technology using electrical wiring to carry power and data. Specifications such as HomePlug utilize PLC for networking IoT devices.

Further reference:

<https://people.eecs.berkeley.edu/~prabal/teaching/cs294-11-f05/slides/day21.pdf>

<https://www.youtube.com/watch?v=h8xPUfTpGU&list=PLw5h0DiJ-9PCxDZkP8pbgyiDweF3DJ8c&index=6> (Part 1 to 4) for detailed understanding of Networking protocols.

[https://www.youtube.com/watch?v=oc_qzTj26-k&list=PLw5h0DiJ-9PCxDZkP8pbgyiDweF3DJ8c-IoT tutorial](https://www.youtube.com/watch?v=oc_qzTj26-k&list=PLw5h0DiJ-9PCxDZkP8pbgyiDweF3DJ8c-IoT%20tutorial)

IoT Communication models:

In the previous section, we have seen various technologies that are being used for communication.

In this section, we will look at various established models of communication.

There are various models of communication namely:

- Request – Response
- Publish Subscribe
- Push-Pull
- Exclusive -Pair

Request – Response communication model:

Request – Response type of communication is most commonly used. This system consists of a client also called as the caller. The client requests a service from a server or a responder. This is best suited for HTTP . This pattern is useful for a client – server or master slave architecture.

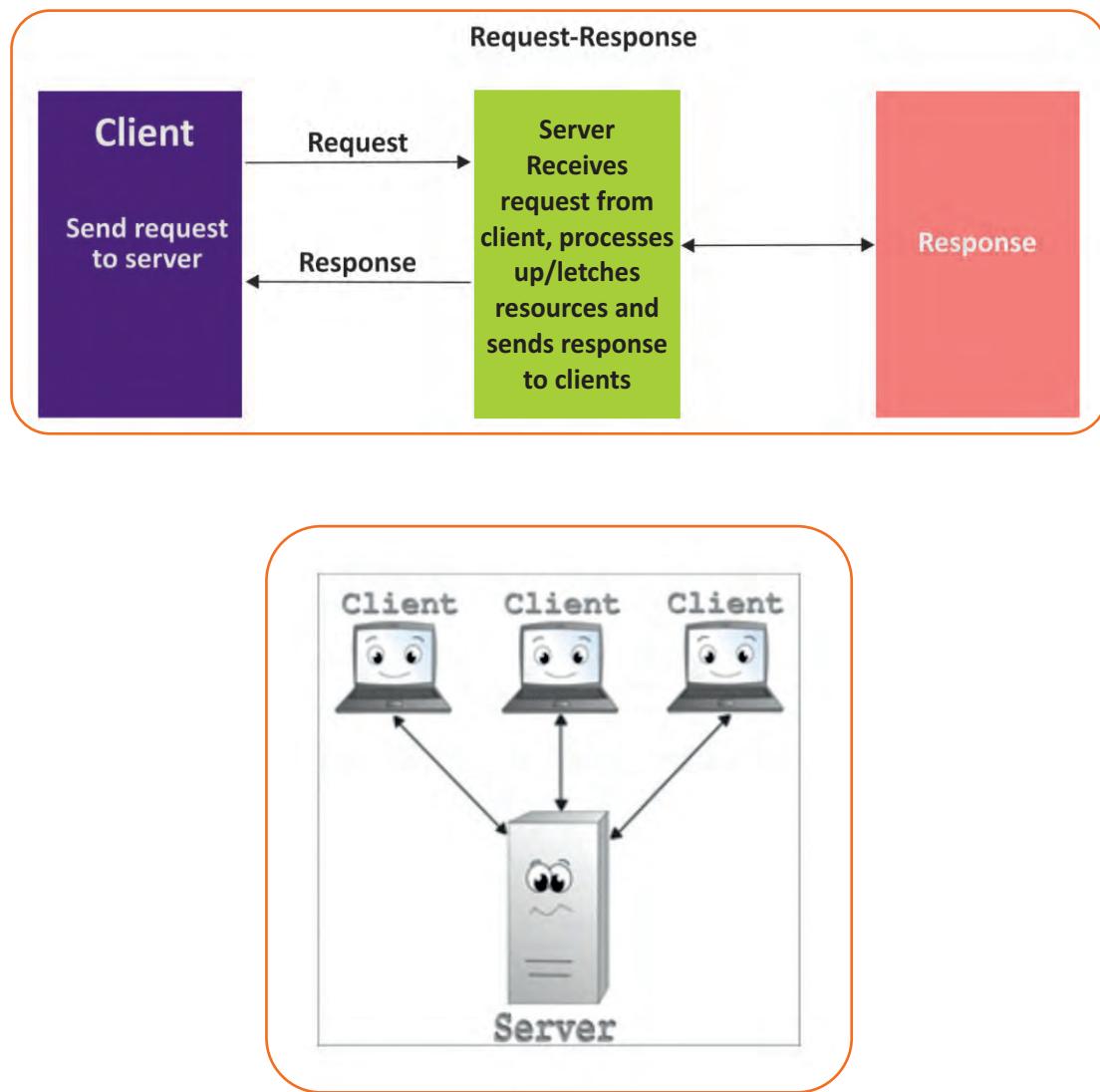


Fig.1.52 – Request-Response communication model

Publish - Subscribe communication model:

A more robust communication model is required if more entities are involved in the communication process. In this system, the communication can be sent to a multiple entities at the same time. The messages are stored and distributed to the corresponding subscribers based on the protocol. The performance of the system is dependent on the consumed bandwidth. MQTT, AMQP, and XMPP support Publish-Subscribe pattern.

8. 6LoWPAN

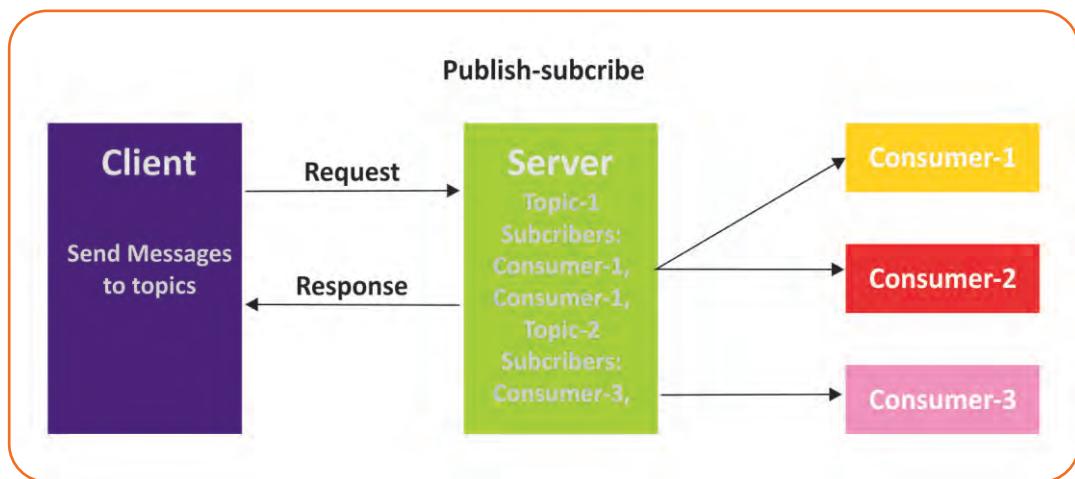


Fig.1.53 – Publish-subscribe communication model

Publish-Pull communication model:

It is a type of internet based communication. A Request for a transaction is initiated by the publisher or a central server. A Request for the transmission of information is initiated by the receiver or client.

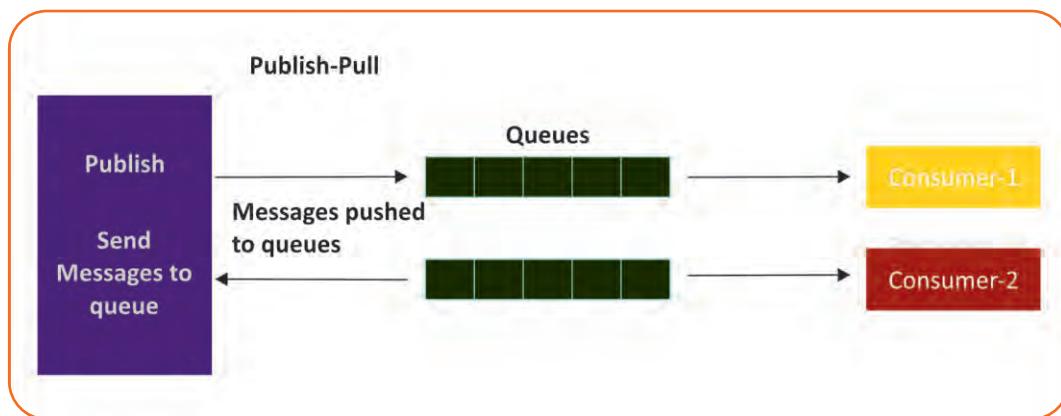


Fig.1.54 – Publish-pull communication model

Exclusive -Pair communication model:

The communication happens only between the client and the server.

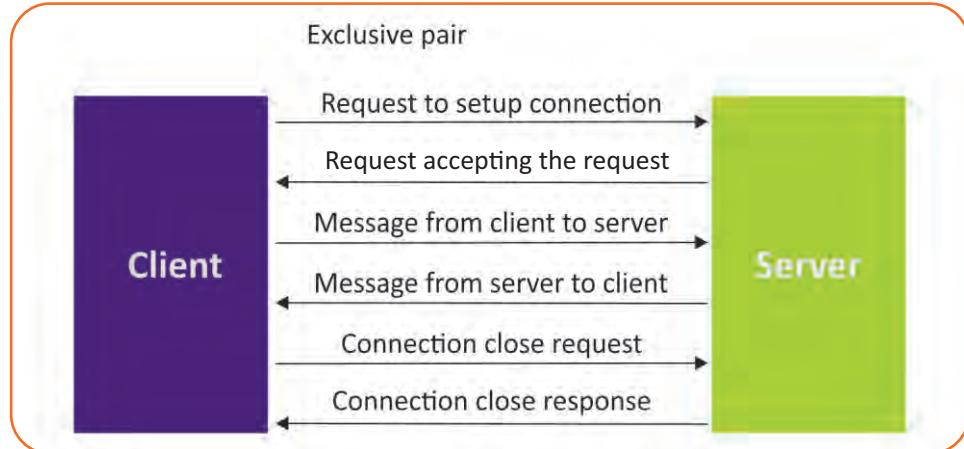


Fig.1.55 – Exclusive-pair communication model

1.3.4 Communication APIs

Application Programming Interface (API) is created for a specific application. APIs are necessary to control devices. APIs hold together connected 'things' in an IoT system. APIs aid in transferring information between programs from one application to another. An API should be developed keeping in mind reusable patterns and automated deployment.

An application programming interface or API is a software interface that enables backend communication between programs and applications.

Communication APIs are broadly classified as:

- REST based Communication API
- WebSocket based Communication API

REST Based Communication API:

REST (REpresentational State Transfer) is an architectural style and an approach to communications that is often used in the development of Web services.

This style of communication API is preferred over SOAP (Simple Object Access Protocol) as it consumes less bandwidth.

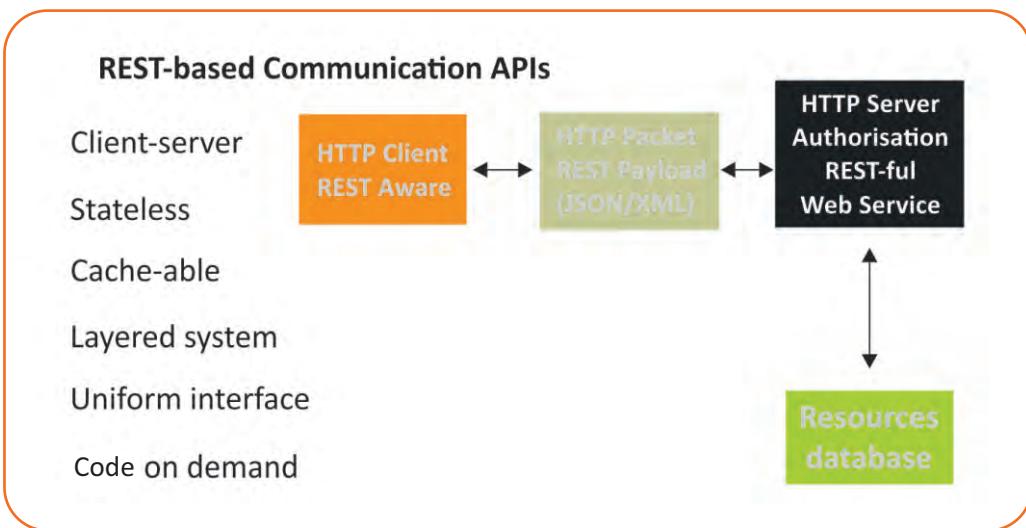


Fig.1.56 – REST based communication API

WebSocket based Communication API:

WebSocket is a computer communications protocol, providing full-duplex communication channels over a single TCP connection. WebSocket is designed to be implemented in web browsers and web servers, but it can be used by any client or server application.

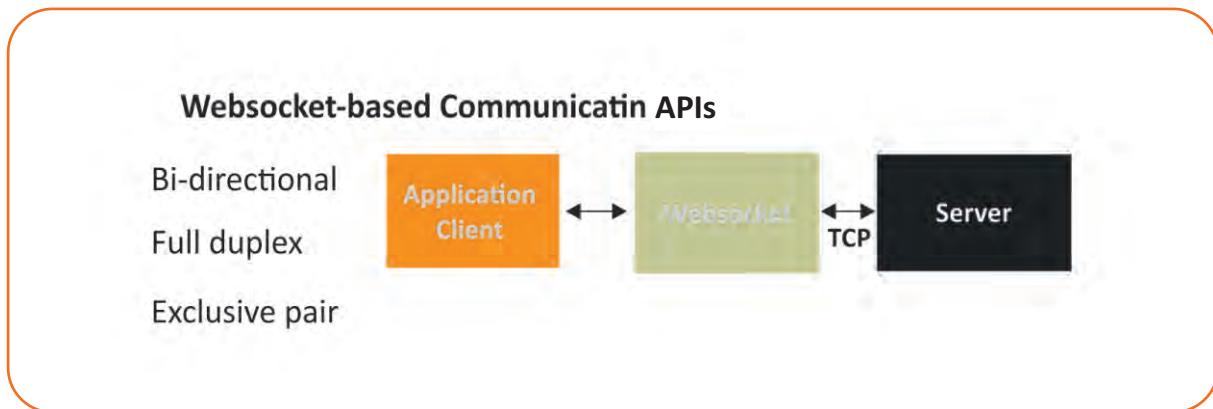


Fig.1.57 – WebSocket based communication API

1.3.5 Applications

Some of the applications of IoT are listed below:

Home

- Smart lighting
- Smart appliance
- Security and access

Cities

- Smart parking
- Smart roads
- Waste management
- Traffic management



Fig.1.58 – Smart city

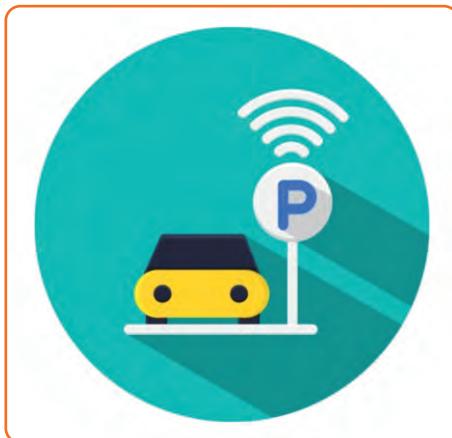


Fig.1.59 – Automated parking

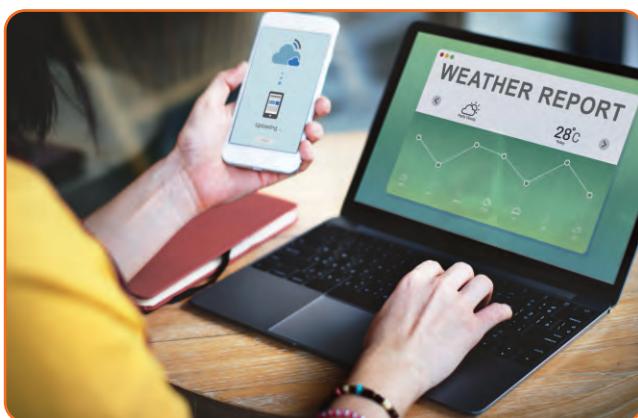


Fig.1.60 – Weather monitoring

Environment

- Weather monitoring
- Air quality monitoring
- Forest fire detection
- Water quality management

Retail

- Inventory management
- Smart payments
- Smart vending machines



Fig.1.61 – Inventory management

Energy

- Smart grids with IoT
- Renewable energy monitoring
- Extending battery life in smart locks

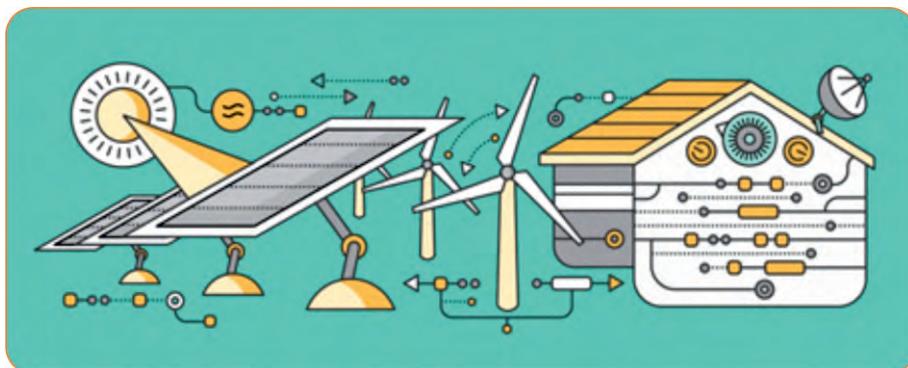


Fig.1.62 – Energy monitoring

Industry

- Making factories smarter, more productive through predictive maintenance
- Indoor air quality monitoring
- Smart energy management



Fig.1.63 – Logistics tracking

Agriculture

- Smart irrigation
- Greenhouse control
- Precision planting
- Smart crop monitoring



Fig.1.64 – Smart irrigation

Health

- Health and Fitness monitoring
- Wearable technology
- Automated BP monitor



Fig.1.65 – IoT application in healthcare

Auto

- Google maps and other navigation tools
- Music apps
- Solar roofs with integrated battery storage
- Self driving car technology
- Health monitoring of fleet of tractors



Fig.1.66 – GPS tracking

Aviation

- Real time intelligence to enhance operations
- Aircraft communications
- System Wide Information Management (SWIM)
- Control data linking and monitoring of Unmanned Aerial Vehicles (UAV) and drones



Fig.1.67 – Aviation controls

1.3.6 Security

IoT Security Concerns and ways to resolve them

While the benefits of IoT are undeniable, the security can be an issue which has to keep up with the pace of IoT deployment. As increasingly network integrated connections arise, important processes that once were performed manually are now vulnerable to cyber threats. Many IoT devices will require the collection, analysis and transmission of potentially sensitive data. It is essential that this data is adequately protected at all times and that the user is aware what private data is being processed. These issues need to be addressed from a security point of view.

- Preservation of privacy or secrecy of the data
- Integrity of the data for safety
- Staleness or latency permissible in the data share
- Level of restriction of access to or control of the device
- Updating of the software on the device
- Ownership of the device whether to be managed or transferred in a secure manner
- Necessity for the data to be audited

Risks include malicious actors manipulating the flow of information to and from network-connected devices or tampering with devices themselves, which can lead to the theft of sensitive data and loss of

consumer privacy, interruption of business operations, the slowdown of internet functionality through large-scale denial-of-service attacks, and potential disruptions to critical infrastructure. It is imperative that IoT ecosystem is built on a foundation that is trustworthy and secure. These need to be addressed at access level, encryption in the data transactions and failures ensured for failsafe and securely. Many of the vulnerabilities in IoT could be mitigated through recognized security best practices.

- Enable security by default through unique, hard to crack default user names and passwords typically as used in secure bank transactions starting from the mandatory first change when the device and the integrated set up is commissioned and periodic change in the life cycle. Automatic closure of the access beyond specific time of inactivity.
- Use hardware that incorporates security features to strengthen the protection and integrity of the device. For example, use computer chips that integrate security at the module/component level, embedded in the processor and provide encryption and anonymity. This is to enable encrypted transaction.

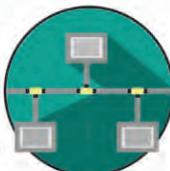
Design the IoT ecosystem keeping in mind system and operational disruption. Understand what consequences could flow from the failure of a device and implement features in devices to fail safely and securely so that the failure does not lead to greater disruption.

THE RISKS

how can cybercriminals attack the internet of everything?

SNIFFER ATTACKS

An attack which involves a program called a 'sniffer'. which sniffs out any unencrypted information being passed through a network and then steals it.



MAN-IN-THE-MIDDLE

An attack where cybercriminals break into a network and/or a device connected to a specific network by guessing or stealing its password



DENIAL OF SERVICE

An attack where cybercriminals prevent or slow down the use of certain networks and/or devices



MAN-IN-THE-MIDDLE

An attack where a third entity steals the data being transmitted between two parties and/or device



Fig.1.68 – Security risks

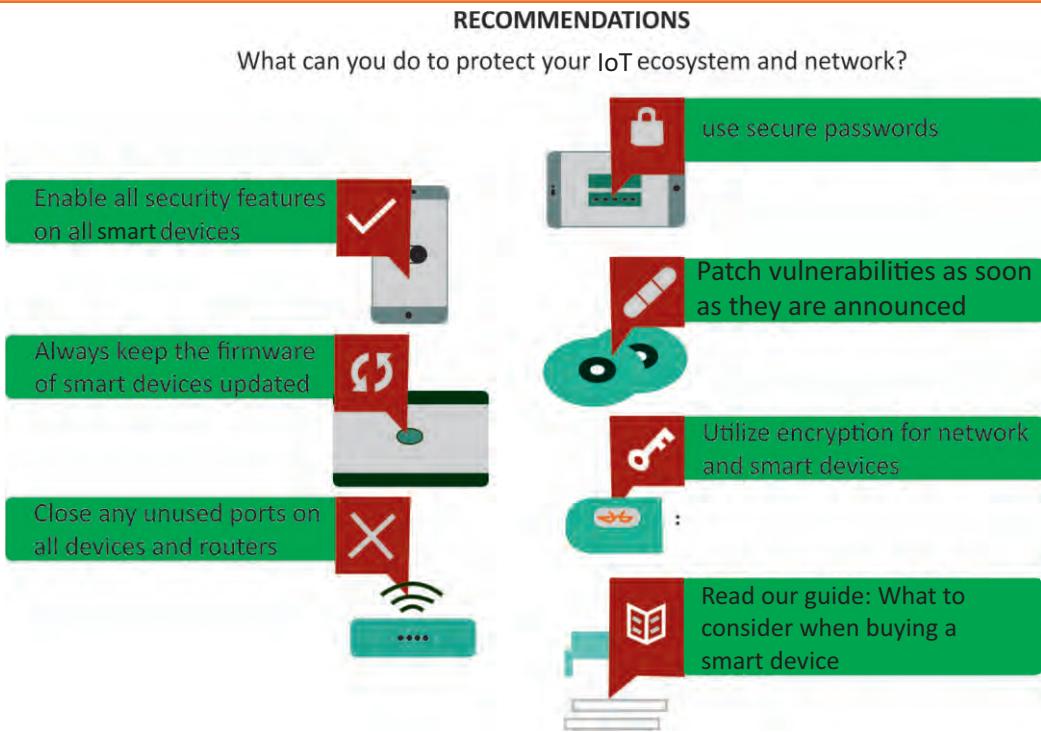


Fig.1.69 – Tips for secured transaction

UNIT 1.4: IoT Setup with Device Connections

Unit Objectives



At the end of this unit, you will be able to:

1. State the purpose of IoT platforms
2. State the importance of IDE
3. Identify various components of a microcontroller based boards
4. Describe Arduino and ARMbed platforms
5. Explain Linux based platforms
6. Differentiate between 'Input' and 'Output'
7. Explain 'Analogue' and 'Digital' signals
8. Check the continuity in a board using a multimeter
9. Measure 'Resistance' using a multimeter
10. Explain features of some commonly used programming languages
11. Interpret Python codes

1.4.1 Introduction to IoT Platforms

As we have discussed in the earlier sections, an IoT system is a combination of hardware and software components designed to achieve a specific task.

- The components interact with each other through a defined communication channel called as 'communication protocol'
- Processors act as the brain of an IoT system and the main function of a processor is to process the data received from the sensors according to an algorithm and extract useful information
- Gateways route the processed data to proper locations for further utilization. Gateways help in to and fro communication of the data and provide network connectivity to the data

An IoT Platform is referred to as IoT middleware. It acts as a mediator between application layer and hardware.

IoT platform facilitates the following:

- Communication
- Data flow

- Device management
- Functionality of applications

To begin embedded development, a platform is required which has the following components:

- Development board
- IDE (Integrated Development Environment)

A microcontroller development board is a printed circuit board (PCB) with circuitry and hardware. The development board will have a processor, memory, chip set and on board peripherals. The microcontroller development board is also called as 'Single board microcontroller'.

For example: Arduino, ARM mbed etc.

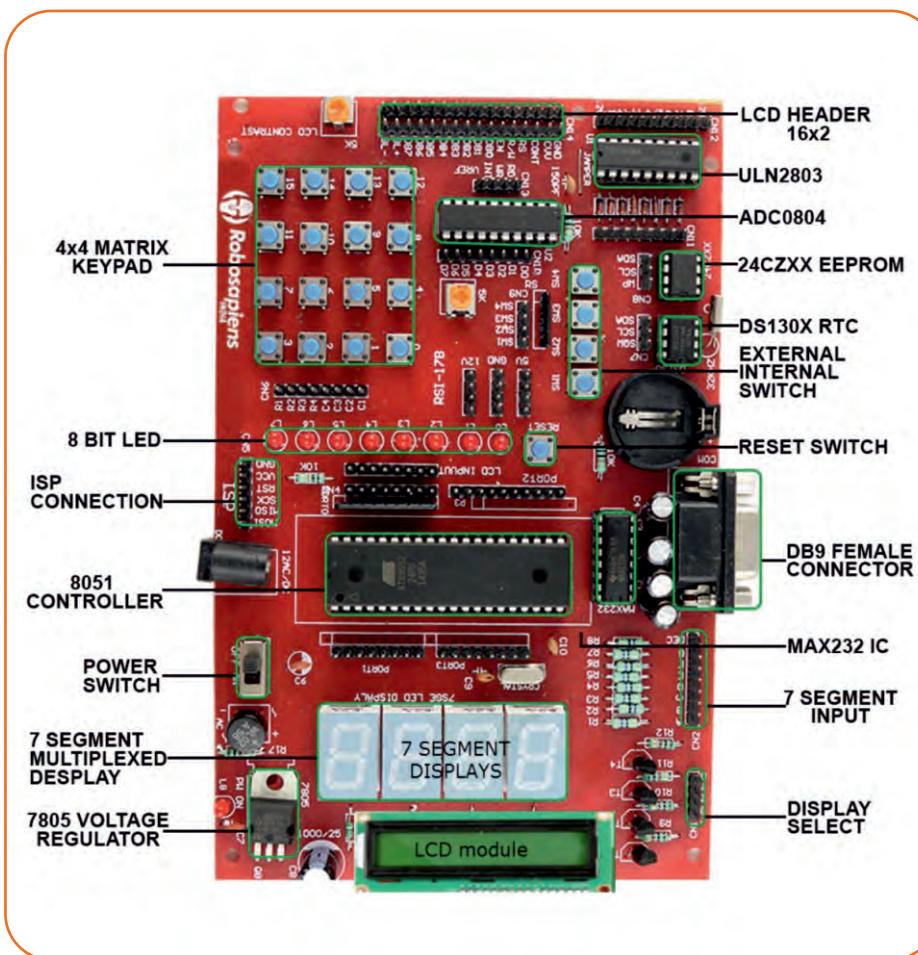


Fig.1.70 – Representative microcontroller based board

There are many open source software (IDE) available to develop microcontroller boards to develop real time applications.

Arduino:

An Arduino is an open source microcontroller development board. This can be used to read sensors and control devices. A program can be uploaded on this board to interact with things in the real world.

There are various types of Arduino boards. Care should be taken to select right kind of Arduino board based on the application.

Some common types of Arduino boards are:

- Arduino Uno
- Arduino NG, Diecimila, and the Duemilanove (Legacy Versions)
- Arduino Mega 2560
- Arduino Mega ADK
- Arduino LilyPad

As an example, we will study some features of Arduino UNO.

Arduino UNO:

It is an open source electronics prototyping platform for developing interactive electronic applications.

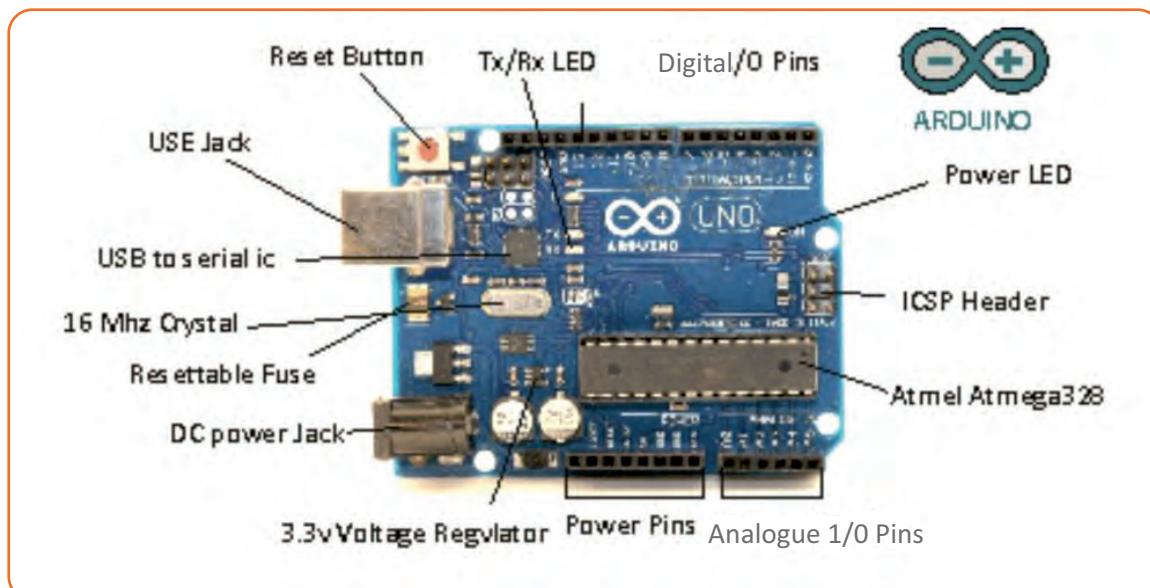


Fig.1.71 – Arduino Uno R3 platform

Some features of Arduino UNO R3 are:

- Microcontroller: ATmega328P
- 32 KB of Flash memory
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (6 pins provide PWM output)
- Analogue Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA

IDE sketches (programs) can be developed using syntax based on 'C' .

Some applications of Arduino UNO are:

- RFID sensed device access
- Industrial appliances control systems
- Home automation etc.

There are many types of boards compatible with Arduino. Some of them are listed below:

- YUN
- ETHERNET
- TIAN
- INDUSTRIAL IoT
- LEONARDO ETH
- YUN MINI
- WiFi SHIELD
- YUN SHIELD
- WIRELESS PROTO SHIELD etc.

Some flavors of Arduino are:

- Arduino Leonardo Microcontroller (Headers)
- Arduino Leonardo (No Headers)
- Arduino Uno USB Microcontroller Rev 3
- Arduino Duemilanove USB Microcontroller module
- Arduino Ethernet Microcontroller (No PoE)
- Arduino Ethernet Microcontroller With PoE
- Arduino Ethernet Microcontroller With PoE + USB2SERIAL Kit

- Arduino Ethernet Microcontroller (No PoE) + USB2SERIAL Kit
- Freeduino SB Microcontroller Kit
- Seeedstudio Freeduino USB Arduino Compatible Microcontroller Kit
- Arduino LEDHead Arduino Compatible Microcontroller

ARM mbed Platform:

This also uses microcontroller based IoT platform. This type of IoT platform provides the operating system, cloud services, tools and developer ecosystem to make the creation and deployment of commercial, standards-based IoT solutions.

The IDE can be developed using online code editor and compiler. A web browser needs to be installed on the local PC since the IDE is developed on the cloud. The mbed IDE provides private workspaces with ability to import, export and share code with distributed Mercurial version control.

The mbed platform provides software libraries and hardware designs. **Software Development Kit (SDK)** is an open source **C/C++** microcontroller software platform. This can be used to build projects.

Hardware Development Kit (HDK) provides full microcontroller sub-system design files and firmware for building development boards and custom products.

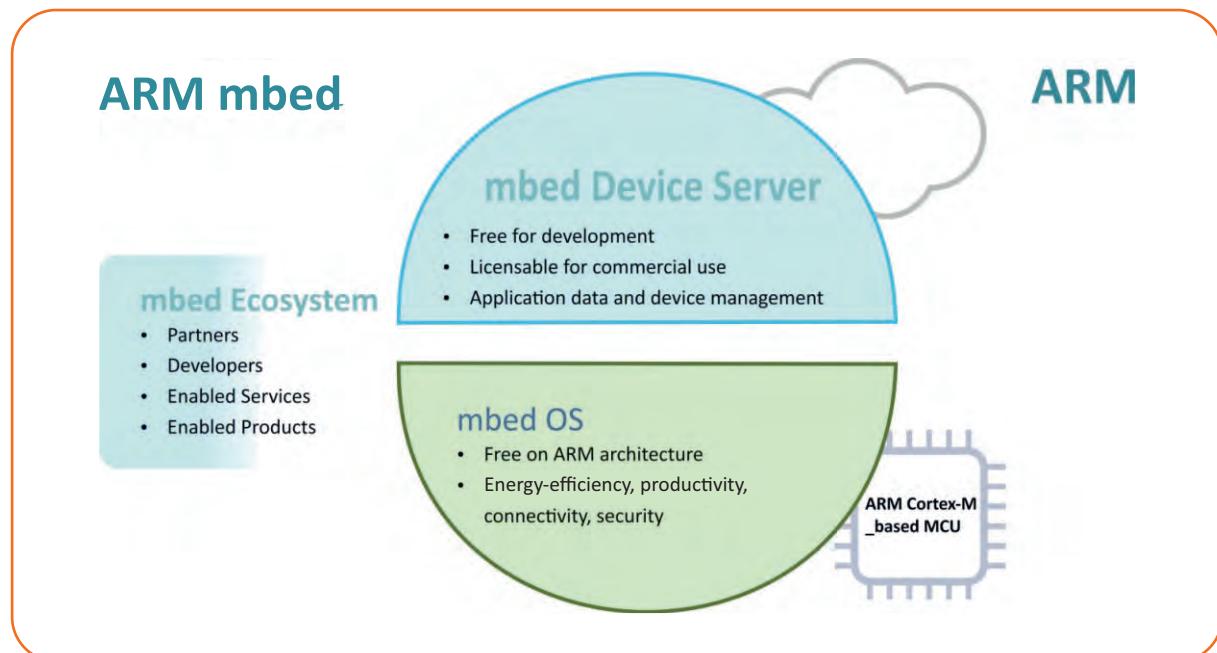


Fig.1.72 – ARM mbed platform

Some examples of mbed compatible boards are:

- mbed LPC1768
- mbed LPC11U24
- Seeduino-Arch
- FRDM KL25Z
- NXP LPC800-MAX etc.

Linux based IoT Platforms:

Higher end IoT nodes require application processors running Linux, Windows Embedded, and Windows 10. Linux based end points are used when there is a need for local processing and also run a web version or HMI screen.

A typical example of Linux OS development board is Raspberry Pi.

Raspberry pi Development Board:

Raspberry Pi is a small platform and runs on Linux platform. It is a small board and can be easily plugged into monitor, computer or TV. It is a series of small single board computers developed in the UK.

An SD card is inserted into the slot on the board. This SD card acts as the hard drive for the Raspberry Pi. Raspberry Pi is powered by USB and the video output can be hooked up to a traditional RCA TV set, a more modern monitor, or even a TV using the HDMI port.

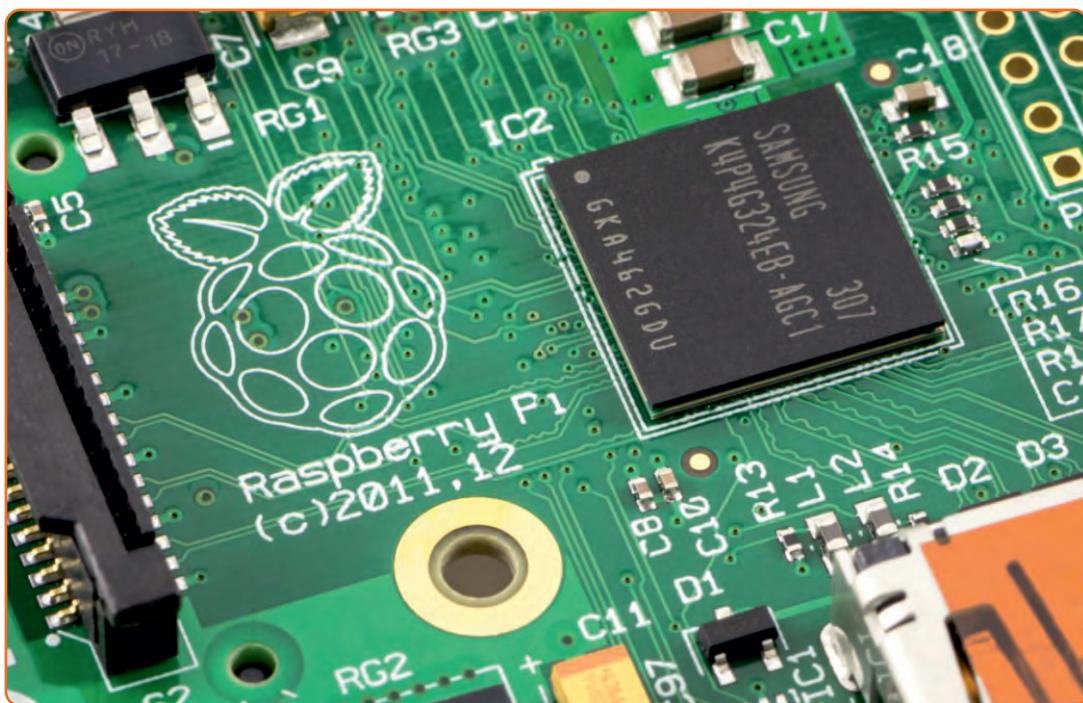


Fig.1.73 – Raspberry Pi development board

Some important Concepts regarding IoT boards:

Input Vs Output:

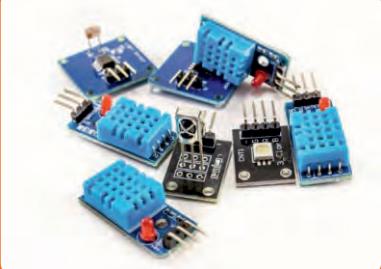
Input	Output
<ul style="list-style-type: none"> Information provided to the board is called as 'Input' <p>Example:</p> <ul style="list-style-type: none"> Buttons, Switches, Light Sensors, Flex Sensors, Humidity Sensors, Temperature Sensors etc. 	<ul style="list-style-type: none"> Any signal going from the board is called as 'Output' <p>Example:</p> <ul style="list-style-type: none"> LED, DC motor, Servo motor, Piezo buzzer, Relay etc. 

Fig.1.74 – Humidity sensor

Fig.1.75 – Relay

Analogue Vs Digital:

Analogue	Digital
Analogue signal is a continuous signal which represents physical measurements.	Digital signals are discrete time signals generated by digital modulation.
Analogue signals are denoted by sine waves.	Digital signals are denoted by square waves.
Analogue signals use a continuous range of values to represent the information.	Digital signals use discrete or discontinuous values to represent the information.
Example: Human voice in air, analogue electronic devices.	Example: Computers, CDs, DVDs, and other digital electronic devices

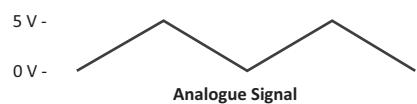


Fig.1.76 – Analogue Signal

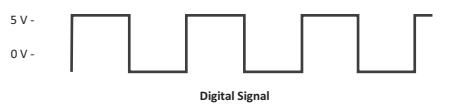


Fig.1.77 – Digital Signal

Continuity testing and measurement of resistance:

Continuity Testing:

A 'Circuit' is defined as the path between two or more points through which electric current flows. A circuit should have continuous LOOP from power (V_{cc}) to ground.

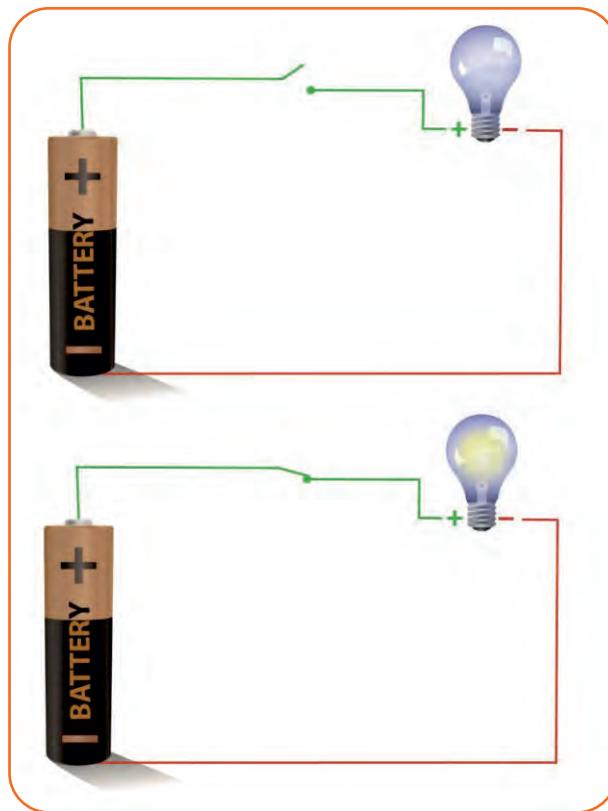


Fig.1.78 – Representation of a simple circuit

Continuity testing is carried out to check the flow of electric current in the circuit. This test can be carried out using a multimeter.



Fig.1.79 – Multimeter

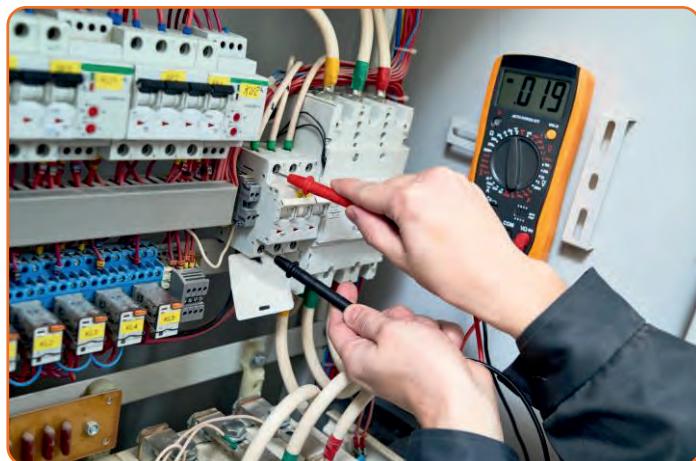


Fig.1.80 – Continuity testing

Make sure that all components will have a common ground with the Arduino

Measurement of 'Resistance':

Resistance is defined as the opposition offered to the flow of electric current. The opposition offered to the flow of electrons depends on the following:

- Type of materials
- Cross sectional area
- Temperature

A multimeter may be used to measure the resistance of circuit components.

How to measure Resistance?

Step1:

Remove components entirely from the circuit

Step 2:

Set the multimeter for appropriate range



Fig.1.81 – Resistance range setting

Step 3:

Measure resistance using probes of a multimeter



Fig.1.82 – Resistance measurement

IDE (Integrated Development Environment):

In the previous section, we have discussed various platforms with a focus on hardware (boards). It is also very clear that an IoT platform is a combination of 'Hardware' and 'Integrated Development Environment (IDE)'.

In this section, we will discuss various programming languages.

The range of IoT programming language varies from general purpose programming like C++ and Java to embedded specific programs.

Some of the programming languages are:

- Python
- C and C++
- Java
- Node.js and Java script

Python:

- High level programming for general purpose programming
- It is an interpreted language – flexible, easy to read, quick to write
- Open source software
- Support multiple programming paradigms like object oriented, imperative and functional programming
- Most suited for embedded control and IoT world

Advantages of Python:

- Lesser time is required to develop Python compared to Java
- Python has built in high level data types
- Can be used to prototype components
- Strong in data structures
- Supports multiple systems and platforms
- Python has built in testing framework for debugging

Disadvantages:

- Not suitable for mobile development
- May not be used in memory intensive tasks
- Not suitable for multi processor/multi core work



Fig.1.83 – Various programming languages

Some common Python codes:

OPERATOR PRECEDENCE IN EXPRESSIONS		
Operator	Description	A
`expr,...`	String conversion	NA
{key:expr,...}	Dictionary creation	NA
[expr,...]	List creation	NA
(expr,...)	Tuple creation or simple parentheses	NA
f(expr,...)	Function call	L
x[index:index]	Slicing	L
x[index]	Indexing	L
x.attr	Attribute reference	L
x**y	Exponentiation (x to yth power)	R
~x	Bitwise NOT	NA
+x, -x	Unary plus and minus	NA
x*y, x/y, x//y, x%y	Multiplication, division, remainder	L
x+y, x-y	Addition, subtraction	L
x< _l y, x> _l y	Left-shift, right-shift	L
x&y	Bitwise AND	L
x^y	Bitwise XOR	L
x y	Bitwise OR	L
x<y, x<=y, x>y, x>=y	Comparisons	C
x<>y, x!=y, x==y	Equality/inequality tests*	C
x is y, x is not y	Identity tests	C

x in y, x not in y	Membership tests	C
not x	not x Boolean NOT	NA
x and y	Boolean AND	L
x or y	Boolean OR	L
lambda arg,...: expr	Anonymous simple function	NA
* x!=y and x<>y are the same inequality test (!= is the preferred form, <> obsolete)		
A ◊ Associativity L ◊ Left R ◊ Right C ◊ Chaining NA ◊ Not associative		

COMMON FILE OPERATIONS	
Operation	Interpretation
output = open('/tmp/spam', 'w')	Create output file ('w' means write).
input = open('data', 'r')	Create input file ('r' means read).
S = input.read()	Read entire file into a single string.
S = input.read(N)	Read N bytes (1 or more).
S = input.readline()	Read next line (through end-line marker).
L = input.readlines()	Read entire file into list of line strings.
output.write(S)	Write string S into file.
output.writelines(L)	Write all line strings in list L into file.
output.close()	Manual close (done for you when file is collected).

C & C++:

- C++ is object oriented version of C
- Can be used for both Linux OS and Arduino embedded IoT software system
- Ideal for embedded systems
- Codes can be written specifically for Hardware

Java:

- Code is not specific to hardware and more portable
- Library is required to run different hardware
- Java is like a write once and run anywhere language

Node.js and Java Script:

- Node.js code will run a complete IoT system
- It is an interpreted language
- DeviceJS is a JavaScript based development platform for programming sensors and controlling devices

Acronyms used in this Unit:

AMQP	Advanced Message Queuing Protocol
API	Application Programming Interface
BLE	Bluetooth Low Energy
BPM	Business Process Management
CoAP	Constrained Application Protocol
ER&D	Engineering Research and Design
HDK	Hardware Development Kit
HTTP	Hypertext Transfer Protocol
IDE	Integrated Development Environment
IoT	Internet of Things
ITU	International Telecommunication Unit
Li-Fi	Light Fidelity
LoWPAN	Lower Power Wireless Personal Area Network
MQTT	Message Queue Telemetry Transport
NFC	Near Field Communication
PLC	Power Line Control

REST	RE-presentational State Transfer
RFID	Radio Frequency Identification
SDK	Software Development Kit
TCP	Transmission Control Protocol
UPD	User Diagram Protocol
VSAT	Very Small Aperture Terminal
WSN	Wireless Sensor Network
XMPP	Extensible Messaging and Presence Protocol

During this you will also be carrying out some interesting projects.

- Energy Sector
 - Smart Lighting
- Mining Sector
 - Safety and Availability of Construction and Heavy Equipment
- Medical/Healthcare Sector
 - Automated BP Monitor
 - Remote Patient Monitoring
- Aerospace Sector
 - Control, data link and Monitoring (Unmanned Aerial Vehicle)
- Automotive Sector
 - Breath Alcohol Ignition Interlock Device

And many more.....

Summary



1. The Internet of things (IoT) is the networking of physical devices ("connected devices" or "smart devices") embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data.
2. IoT Characteristics that are making it popular are:
 - Low energy requirement
 - Scalable solution
 - Secured environment
 - Inter operability between different communication technologies
 - Open API/Open source
3. The connectivity of devices is growing exponentially in every field may it be logistics, manufacturing, healthcare, home automation, automotive, construction, retail, energy, agriculture, aerospace, mining and environment. IoT enhances the system performance.
4. The principle technologies that drive IoT system are:
 - Wireless Sensor Networks
 - Embedded systems
 - Communication protocols
 - Cloud Computing
 - Big Data Analysis
5. IoT connects various devices through internet and devices interact with each other through a communication channel.
6. Communication protocols are broadly categorized as:
 - Link layer
 - Network layer
 - Transport layer
 - Application layer
7. A **cloud** refers to a distinct IT environment that is designed for the purpose of remotely provisioning scalable and measured IT resources.
8. Big data analytics is the process of examining large and varied data sets i.e., big data to uncover hidden patterns, unknown correlations, market trends, customer preferences and other useful information that can help organizations make more-informed business decisions.
9. The IoT system comprises of the following functional blocks:
 - Devices
 - Communication
 - Services

- Management
- Security
- Application

10. Communication models are broadly categorized as:

- Short-range wireless
- Long-range wireless
- Wired

11. There are various models of communication namely:

- Request – Response
- Publish - Subscribe
- Push-Pull
- Exclusive – Pair

12. Application Programming Interfaces (API) are created for a specific application.

13. APIs are necessary to control devices.

14. Communication APIs are broadly classified as:

- REST based Communication API
- WebSocket based Communication API

15. An IoT Platform is referred to as IoT middleware. It acts as a mediator between application layer and hardware.

16. IoT platform facilitates the following:

- Communication
- Data flow
- Device management
- Functionality of applications

17. To begin embedded development, a platform is required which has the following components:

- Development board
- IDE (Integrated Development Environment)

18. A microcontroller development board is a printed circuit board (PCB) with circuitry and hardware.

19. An Arduino is an open source microcontroller development board. This can be used to read sensors and control devices. A program can be uploaded on this board to interact with things in the real world.

20. ARM mbed platform provides the operating system, cloud services, tools and developer ecosystem to make the creation and deployment of commercial, standards-based IoT solutions.
21. Software Development Kit (SDK) is an open source C/C++ microcontroller software platform. This can be used to build projects.
22. Hardware Development Kit (HDK) provides full microcontroller sub-system design files and firmware for building development boards and custom products.
23. Higher end IoT nodes require application processors running Linux, Windows Embedded and Windows 10.
24. Linux based end points are used when there is a need for local processing and also run a web version or HMI screen.
25. Raspberry Pi is a small platform and runs on Linux platform.
26. A 'Circuit' is defined as the path between two or more points through which electric current flows.
27. A circuit should have continuous LOOP from power (V_{cc}) to ground.
28. Continuity testing is carried out to check the flow of electric current in the circuit. This test can be carried out using a multimeter.
29. Resistance is defined as the opposition offered to the flow of electric current.
30. Some of the programming languages are:
 - Python
 - C and C++
 - Java
 - Node.js and Java script

Exercise



1. Define the term 'IoT'

2. List few characteristics of an IoT system

3. Explain the working mechanism of an IoT system

4. Name principle technologies that drive IoT system

5. Name various layers of a communication protocol

6. List types of communication APIs

7. List some applications of IoT in Retail segment

8. List some functions of an IoT platform

9. Name some of the IDE development languages

(Four lines for writing)

10. Expand the following terms

I. WSN

(One line for writing)

II. UI

(One line for writing)

III. BLE

(One line for writing)

IV. HTTP

(One line for writing)

V. TCP

(One line for writing)

VI. PLC

(One line for writing)

VII. NFC

(One line for writing)

VIII. ITU

(One line for writing)

IX. IDE

(One line for writing)

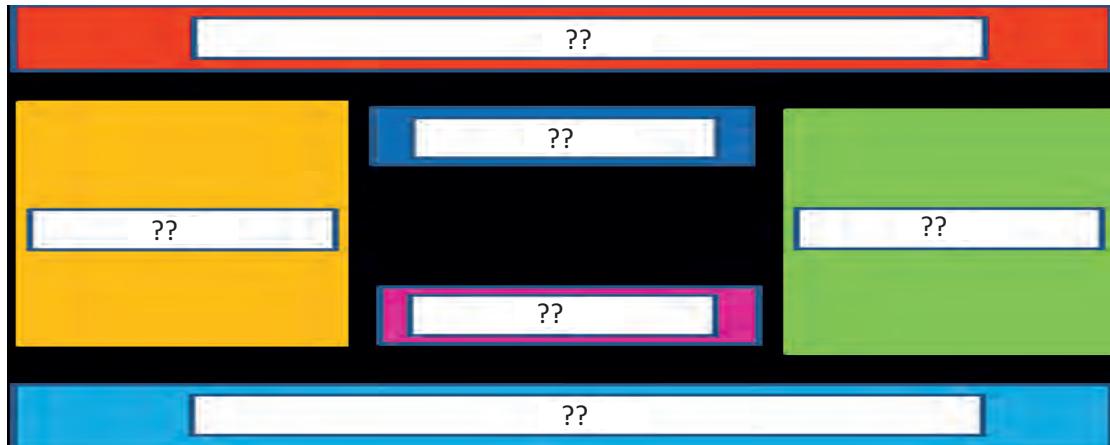
X. API

(One line for writing)

XI. REST

(One line for writing)

11. Identify elements of IoT functional blocks



1. Say True (T) or False (F)

- I. Sensors and devices are connected to the network ()
- II. Services are controlled by users through application ()
- III. Gateways process data ()
- IV. Internet connects devices to the IoT system ()
- V. The hardware component of an IoT system is called as IoT platform ()
- VI. Arduino is an open source microcontroller board ()
- VII. Raspberry Pi development board runs on Windows ()
- VIII. Discrete time signals are categorized under Analogue signals ()

2. Choose the most appropriate answer**I. BLE' is categorized under**

- a. Short-range wireless
- b. Long-range wireless
- c. Wired communication
- d. None of the above

II. NFC is categorized under

- a. Short-range wireless
- b. Long-range wireless
- c. Wired communication
- d. None of the above

III. Very small aperture terminal technology is categorized under

- a. Short-range wireless
- b. Long-range wireless
- c. Wired communication
- d. None of the above



IV. Ethernet is categorized under

- a. Short-range wireless
- b. Long-range wireless
- c. Wired communication
- d. None of the above



V. Identify the type of communication model most commonly used in IoT application

- a. Request-Response communication model
- b. Publish-Subscribe communication model
- c. Publish-Pull communication model
- d. Exclusive-pair communication model



VI. Name the communication model in which the communication can be sent to a multiple entities at the same time

- a. Request-Response communication model
- b. Publish-Subscribe communication model
- c. Publish-Pull communication model
- d. Exclusive-pair communication model



VII. Identify the type of communication model, where the request for a transaction is initiated by a central server

- a. Request- Response communication model
- b. Publish –Subscribe communication model
- c. Publish-Pull communication model
- d. Exclusive-pair communication model



VIII. Identify the type of communication API used in the development of web services

- a. REST based communication API
- b. WebSocket based communication API
- c. Both (a) and (b)
- d. None of the above



IX. Which type of communication API provides full duplex communication channels?

- a. REST based communication API
- b. WebSocket based communication API
- c. Both (a) and (b)
- d. None of the above



14. Match column 'A' with column 'B'

Column A	Column B	Answer
1. Link Layer	a. Responsible for sending IP datagram from source network to destination network	

2. Network Layer	b. provide end-to-end message transfer capability independent of underlying network	
3. Transport layer	c. determines how the data is physically sent over the network's physical layer	
4. Application layer	d. defines how the applications interface with lower layer protocols to send data over a network	

14. Match column 'A' with column 'B'

Column A	Column B	Answer
1. Ethernet	a. Application layer	
2. IPV4	b. Transport layer	
3. TCP	c. Network Layer	
4. HTTP	d. Link layer	

Further reference:

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- <https://www.youtube.com/watch?v=QSIPNhOiMoE> – IoT How it works
- <https://www.youtube.com/watch?v=o7VXyolenvU> – IoT explained easily
- https://www.youtube.com/watch?v=oC_qzTj26-k&list=PLw5h0DiJ-9PCxDZkP8pbgyiDweF3DJ8c – IoT tutorial
- <https://www.youtube.com/watch?v=h8xPUfTpGU&list=PLw5h0DiJ-9PCxDZkP8pbgyiDweF3DJ8c&index=6> – Networking protocols Part 1 to part 4
- <https://www.youtube.com/watch?v=jYrkujWlbt0> – IoT protocols need to know
- https://www.youtube.com/watch?v=z72G4WXQ_IY – IoT benefits and risks
- https://www.youtube.com/watch?v=7D1CQ_LOizA – Big data
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- <https://www.youtube.com/watch?v=riSLyE57IdA> – Connected Aviation Solution at Dubai IoT World Forum
- <https://www.youtube.com/watch?v=emAJwuwvstw> – Internet of Aircraft Things: aircraft data management solutions
- <https://www.youtube.com/watch?v=Q8Cn47L8FRQ> – Connected Vehicle: The Future of Transportation
- <https://www.youtube.com/watch?v=aOFZqecYk2g> – Intelligent Transportation System

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[https://www.postscapes.com/internetofthingsprotocols/ - IoT Standards & Protocols Guide | 2017 Comparisons on Network, Wireless Comms, Security, Industrial](#)

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**IT - ITeS SSC
NASSCOM**

2. Catalogue of Applications

Unit 2.1 – Catalogue of Applications



Key Learning Outcomes



At the end of this module, you will be able to

1. Appreciate the impact of IoT in various sectors

UNIT 2.1: Catalogue of Applications

Unit Objectives



At the end of this unit, you will be able to:

1. List IoT applications in various sectors like, Logistics, Manufacturing, Medical/Healthcare, Smart home, Automotive, Construction/Infrastructure/Smart city, Retail, Energy, Agriculture, Aerospace, Mining, Environment

2.1.1 Introduction

In the previous sections, we have discussed various aspects of an IoT system including devices, sensors, communication protocol, networking and architecture. Basically an IoT system has 'Hardware components' and 'IDE (Integrated Development Environment)'. All devices communicate with each other through a defined communication protocol. Data is collected from various nodes, processed and input is given to various devices to act.

An IoT concept can be implemented in almost all sectors. An effort is made to list some applications of IoT covering some fast moving sectors like:

- Logistics
- Manufacturing
- Medical/Healthcare
- Smart Home
- Automotive
- Construction / Infrastructure/Smart city
- Retail
- Energy
- Agriculture
- Aerospace
- Mining
- Environment



Fig.2.1 – Applications of IoT

2.1.2 Logistics

The technology of IoT can be implemented in various fields to achieve desired results like smoother operation, hassle free communication, enhanced productivity, energy conservation etc.

One of the major tasks in Logistics sector is to manage traffic and fleet to enhance the operational efficiency. This can be achieved by reducing human intervention and adapting technological solutions. IoT technology can be effectively utilized.

Some applications are listed below:

1. Traffic and Fleet management

IoT adds value in optimum utilization of assets and enhance operational efficiency. Vehicles are among the assets most ripe for improved efficiency, especially in terms of traffic and fleet

management. Vehicle telematics and vehicle-infrastructure integration have been vanguard applications in the use of sensor data.

2. Resource and Energy management

IoT sensors are best suited to track all kinds of resources like petroleum, natural gas, electricity, water etc. Implementation of IoT technology reduces waste and prevent disasters. IoT can be a critical component of the smart energy grid of the future.

3. Safety and Security

IoT technology can be used to monitor equipment and personnel. Union pacific has implemented IoT technology to monitor track failure using sensors. This technology predicts equipment failure and reduces the risk of derailment.

4. Health monitoring

This technology can be used to prevent industrial accidents and monitor health of individuals by using wearable technologies like smart watches.



Fig.2.2 – Traffic and Fleet Management

2.1.3 Manufacturing

Network control and management of manufacturing equipment, asset and situation management or manufacturing process control bring the IoT within the realm of industrial applications and smart manufacturing as well. The IoT intelligent systems enable rapid manufacturing of new products, dynamic response to product demands and real-time optimization of manufacturing production and supply chain networks, by networking machinery, sensors and control systems together.



Fig.2.3 – Use of IoT in manufacturing

Some applications are listed below:

1. Automated process controls

Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IoT.

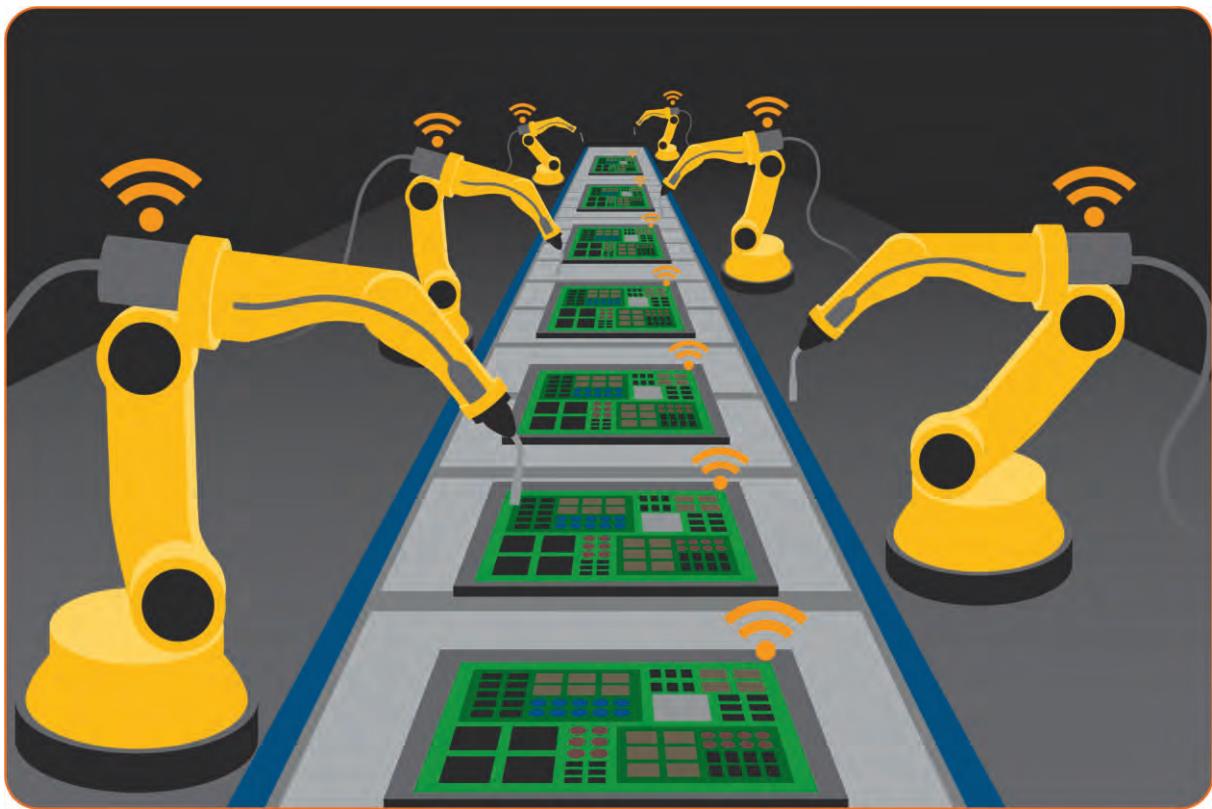


Fig.2.4 –Automated process

2. Asset management

This can also be used in asset management via predictive maintenance, statistical evaluation and measurements to maximize reliability.

3. Energy optimization

Smart industrial management systems can also be integrated with the Smart Grid, thereby enabling real-time energy optimization. Measurements, automated controls, plant optimization, health and safety management, and other functions are provided by a large number of networked sensors.

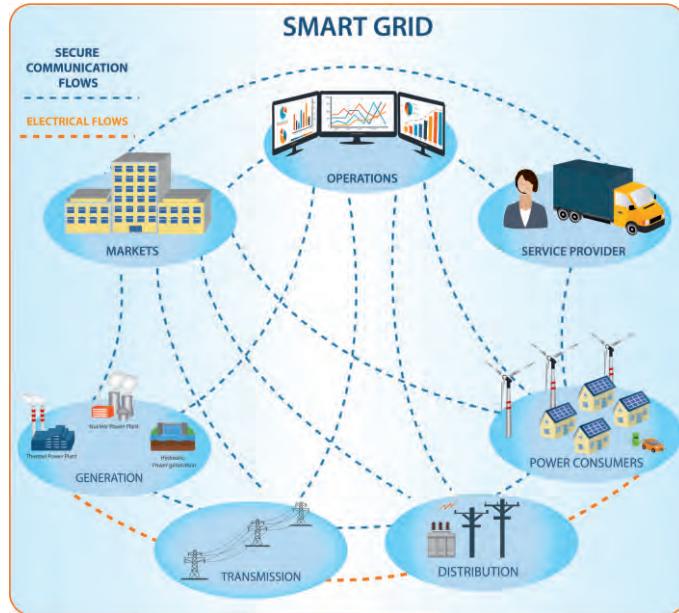


Fig.2.5—Energy conservation using smart grid

4. Intelligent maintenance system

IoT-based predictive analytics technologies are used to monitor connected machines and to predict machine degradation and further to prevent potential failures. The vision to achieve near-zero breakdown using IoT-based predictive analytics are the trends for future development of e-manufacturing and e-maintenance activities.



Fig.2.6 – Benefits of IoT

The term **IIoT (Industrial Internet of Things)** is often encountered in the manufacturing industries, referring to the industrial subset of the IoT. IIoT in manufacturing would probably generate so much business value that it will eventually lead to the fourth industrial revolution. It is likely that in the future, successful companies will be able to increase their revenue through Internet of things by creating new business models and improve productivity, exploit analytics for innovation, and transform workforce. The potential of growth by implementing IIoT is unimaginable.

While the connectivity and data acquisition are imperative for IIoT, predictive maintenance is probably a relatively "easier win" since it is applicable to existing assets and management systems. The objective of intelligent maintenance systems is to reduce unexpected downtime and increase productivity and can generate big saving over total maintenance costs. Industrial big data analytics will play a vital role in manufacturing asset predictive maintenance.

2.1.4 Medical/ Healthcare

IoT devices can be used to enable remote health monitoring and emergency notification systems.

We will study some applications of IoT being used in Healthcare sector.



Fig.2.7 – Use of IoT in Medical/Healthcare

Some applications are listed below:

1. Remote health monitoring and Emergency Notification system

Health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fitbit electronic wristbands or advanced hearing aids.

Some hospitals have begun implementing "smart beds" that can detect when they are occupied and when a patient is attempting to get up. It can also adjust itself to ensure appropriate pressure and support is applied to the patient without the manual interaction of nurses.

Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well.

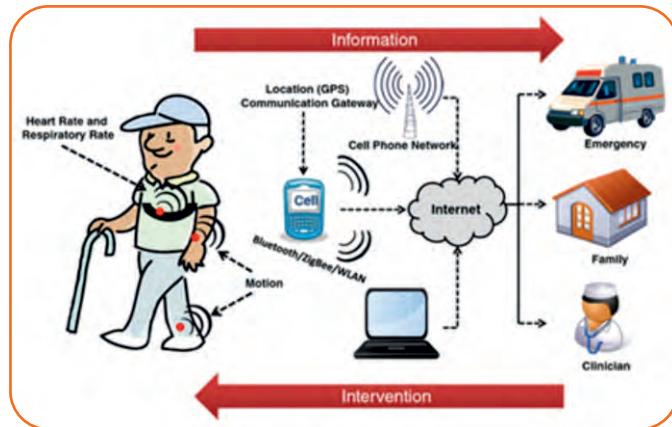
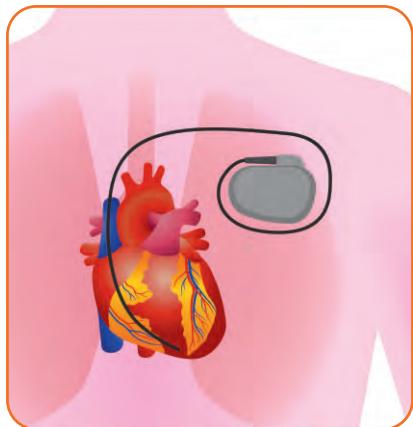


Fig.2.8 – Remote patient monitoring

2. Encourage Healthy living

Some consumer devices like connected scales or wearable heart monitors encourage healthy living. More and more end-to-end health monitoring IoT platforms are coming up for antenatal and chronic patients, helping one manage health vitals and recurring medication requirements.



Fig.2.9 – Wearable technology

Advantages of IoT:

1. Reduced costs

With IoT, patients can be monitored in real time, thereby cutting down unnecessary physician visits. Advanced monitoring techniques will help pinpoint the health problem thereby eliminating conducting huge tests and procedures to just find the problem.

2. Improved treatment outcome

Connected health enables caregivers to get access to real-time information resulting in data-driven, informed decisions and evidence-based treatments can help provide timely care and boost treatment outcomes.

3. Real time disease management

With continuous monitoring of patients and access to real-time data, diseases can be treated proactively before their condition worsens.

4. Minimizing errors

Automated workflow, accurate data collection and data-driven decisions cut down wastes, minimise errors and reduce system costs.

5. Improved patient experience

Connected health genuinely focuses on patient centricity. Better accuracy in diagnosis, proactive treatment, timely physician intervention and improved treatment outcome lead to accountable care resulting in high trust among patients.

2.1.5 Smart Home Application

An IoT system finds applications in homes. The objective is to control various appliances remotely to conserve energy and enhance security.

One example would be a connected lamp that can have Wi-Fi embedded into it so that it can then be turned on/off and dimmed via a Smartphone app or remotely via a Cloud solution.

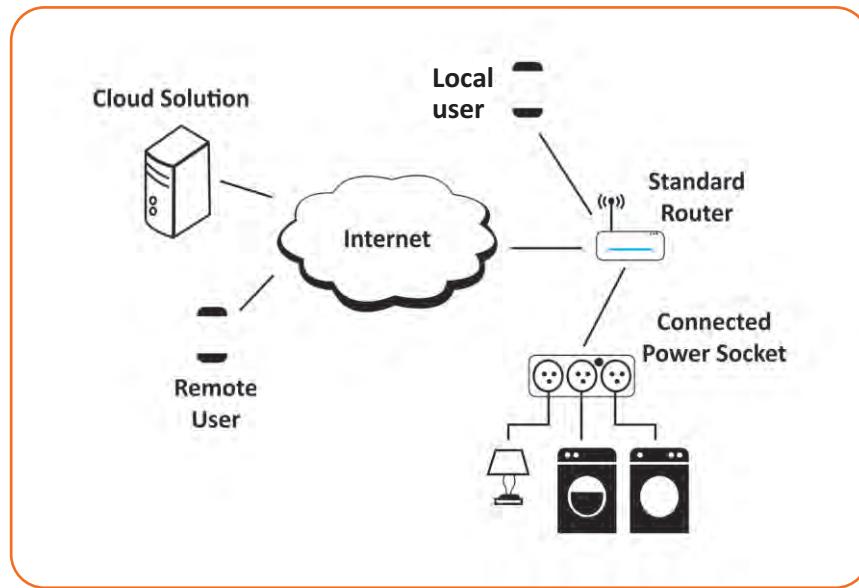


Fig.2.10 – Home scenario of IoT

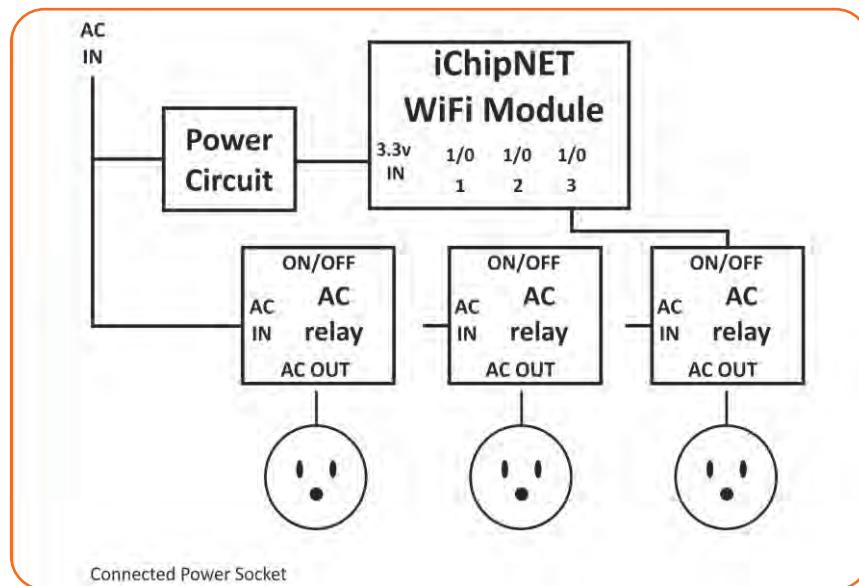


Fig.2.11 – Home automation example

The feature of the WiFi Module used in this connected outlet can be that one doesn't have to do any programming at all at the device level and one doesn't have to add an application CPU to the design.



Fig.2.12 – App in the smart phone

WiFi module with microcontroller

The module connects to Cloud Solution automatically and becomes accessible for the purpose of control and management. Since the data from the WiFi module regarding the state of the power sockets goes to Cloud solution and the app accesses the connected power socket through the Cloud Solution, the app can be used by both a local user in the proximity of the connected power socket, as well as by a remote user in some other location.

From the above example it can be seen that for IoT implementation one has to know all the components required. Simple to use building blocks for meeting the requirements and developing IoT applications can be a faster approach to reach the goal of getting everything connected.

There exists an almost bewildering choice of connectivity options for electronics engineers and application developers working on products and systems for the Internet of Things (IoT).



Fig.2.13 – WiFi module with controller

2.1.6 Automotive

It will not be a surprise that in the year 2020, 82% of all cars marketed will be IoT connected. Automakers have correctly noticed a growing trend and a significant business opportunity for connecting their cars. The manner in which public transportation, such as buses and trains are operated, will also transform because of the IoT.

Some applications are listed below:

1. Software update in real time

Currently automakers are connecting their vehicles in two ways:

- Embedded
- Tethered

Embedded cars use a built-in antenna and chipset, while tethered connections use hardware to allow drivers to connect to their cars via their smart phones. Internet connectivity in vehicles allows car companies to release software updates in real time, which is extremely important during the recall.

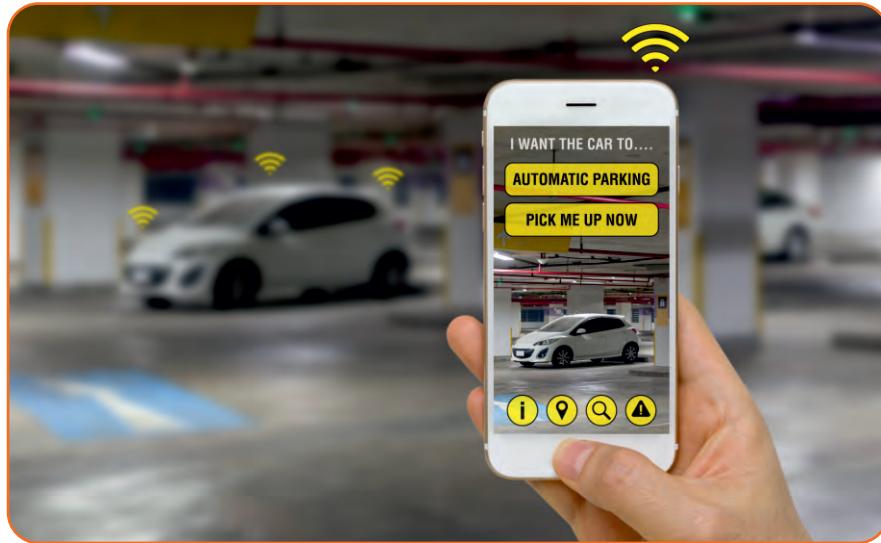


Fig.2.14 – Connecting automotive with smart phone

2. Vehicle performance analysis

Automotive companies can use data from the car to analyse its performance and obtain valuable data on how drivers use their cars.



Fig.2.15 – Software updation using IoT

3. Cross selling

More connectivity provides more ways for automakers to cross-sell their products and services to customers. Typical example is the Mahindra e2O car (EV) which is monitored and the customer is promptly alerted and supported on his driving performance and car care including the battery status.

4. RFID (Radio Frequency Identification)

RFID system is often seen as a prerequisite for an IoT particularly in automobiles. RFID is an automatic technology and aids machines or computers to identify objects, record metadata or control individual target through radio waves. Connecting RFID reader to the terminal of Internet, the readers can identify, track and monitor the objects attached with tags globally, automatically and in real time, if needed. This is the so-called Internet of Things (IoT).

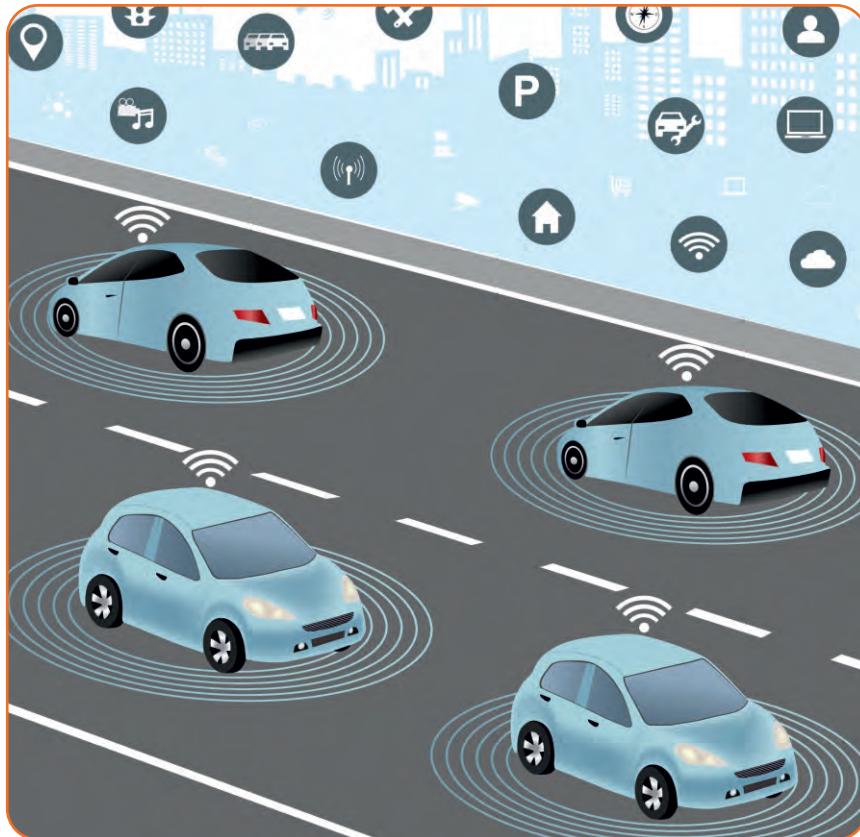


Fig.2.16 – RFID application

Further reference:

<https://www.youtube.com/watch?v=Q8Cn47L8FRQ> - Connected Vehicle: The Future of Transportation

<https://www.youtube.com/watch?v=aOFZqecYk2g> - Intelligent Transportation System

2.1.7 Construction/Infrastructure/Smart city

Greater promises are in the field of **Smart homes** and **Smart cities** where **reduced energy use, access to care, improved quality of life, safety, reduced environment risks and efficient commuting** in the city transport system can be achieved with IoT systems.



Fig.2.17 – Smart city concept

Some applications are listed below:

1. Lighting, Asset tracking and Smart energy

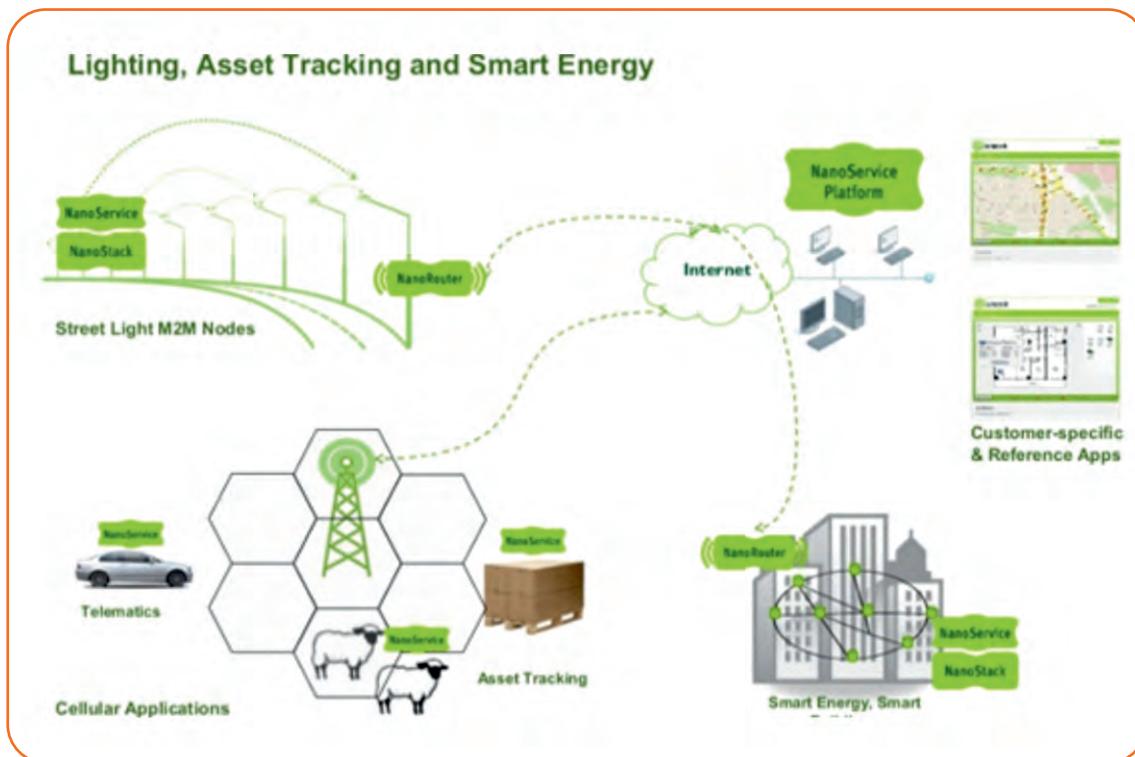


Fig.2.18 – Lighting, asset tracking and smart energy

2. IoT Applications in smart city

Few applications of IoT in Smart city are listed below:

- Environmental monitoring
- Smart waste management
- Smart citizen
- Traffic intensity monitoring
- River monitoring
- Outdoor parking management

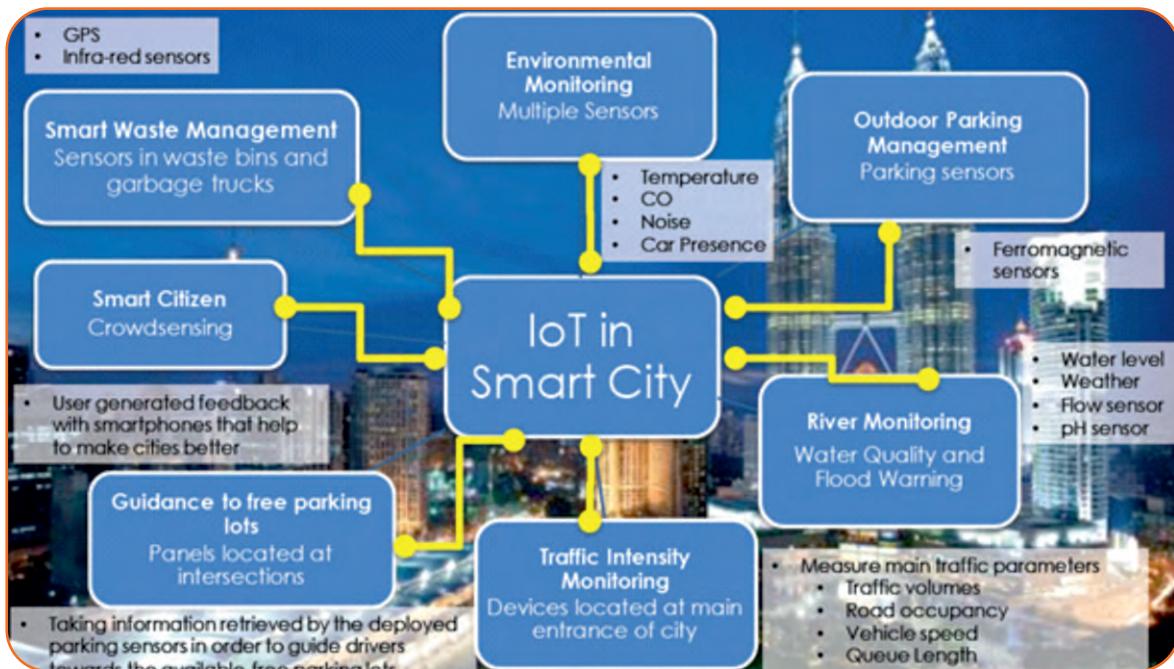


Fig.2.19 – IoT in smart city



Fig.2.20 – Smart waste management



Fig.2.21 – Smart parking

Infrastructure management:

Monitoring and controlling operations of urban and rural infrastructures like **bridges, railway tracks, on- and offshore- wind-farms** is another application of IoT. An IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk.

It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination and quality of service, up-times and reduced costs of operation in all infrastructure related areas.

2.1.8 Retail

The way forward in Retail segment is to automate processes that can enhance store operations and aid in smooth management. There are various applications where IoT can be implemented. In this section, we will discuss some applications of IoT in Retail stores.

1. Predictive equipment maintenance

Every retail store will have a lot of equipment which is utilized in store operations. Every care should be taken to maintain equipment in good working condition. IoT technology is utilized to manage energy or predict equipment failure or detect issues relating to equipment.

2. Smart Transportation

Moving merchandise from one location to another more efficiently is the main objective of Smart Transportation. IoT Technology can be utilized for maintenance of transport, tracking and optimization of route.

3. Connected consumer

The consumer can find products, offers and best prices using their cell phone. Customized offers can be provided to consumers and an alert can be sent to their mobile number. This is possible by using IoT Technology.

4. Smart Store

The IoT technology can be utilized to analyse traffic at various retail stores. This helps in understanding the entire shopping journey and experience of consumers at various retail stores. The store associate can also collect feedback from consumers.



Fig.2.22 – Inventory management

2.1.9 Energy

Integration of sensing and actuation systems, connected to the Internet, is likely to optimize energy consumption as a whole.



Fig.2.23 – Smart energy management

It requires IoT devices to be integrated into **all forms of energy consuming devices (switches, power outlets, bulbs, televisions, etc.)** and be able to communicate with the **utility supply company** in order to effectively balance power generation and energy usage. Such devices would also offer the opportunity for users to remotely control their devices, or centrally manage them via a cloud based interface and enable advanced functions like **scheduling (e.g., remotely powering on or off heating systems, controlling ovens, changing lighting conditions etc.).**



Fig.2.24 – Smart home

Besides home based energy management, the IoT is especially relevant to the **Smart Grid** since it provides systems to gather and act on energy and power-related information in an automated fashion with a goal to improve the **efficiency, reliability, economics, and sustainability** of the production and distribution of electricity. Using advanced metering infrastructure (AMI) devices connected to the Internet backbone, electric utilities can not only collect data from end-user connections, but also manage other distribution automation devices like transformers and switching controls.

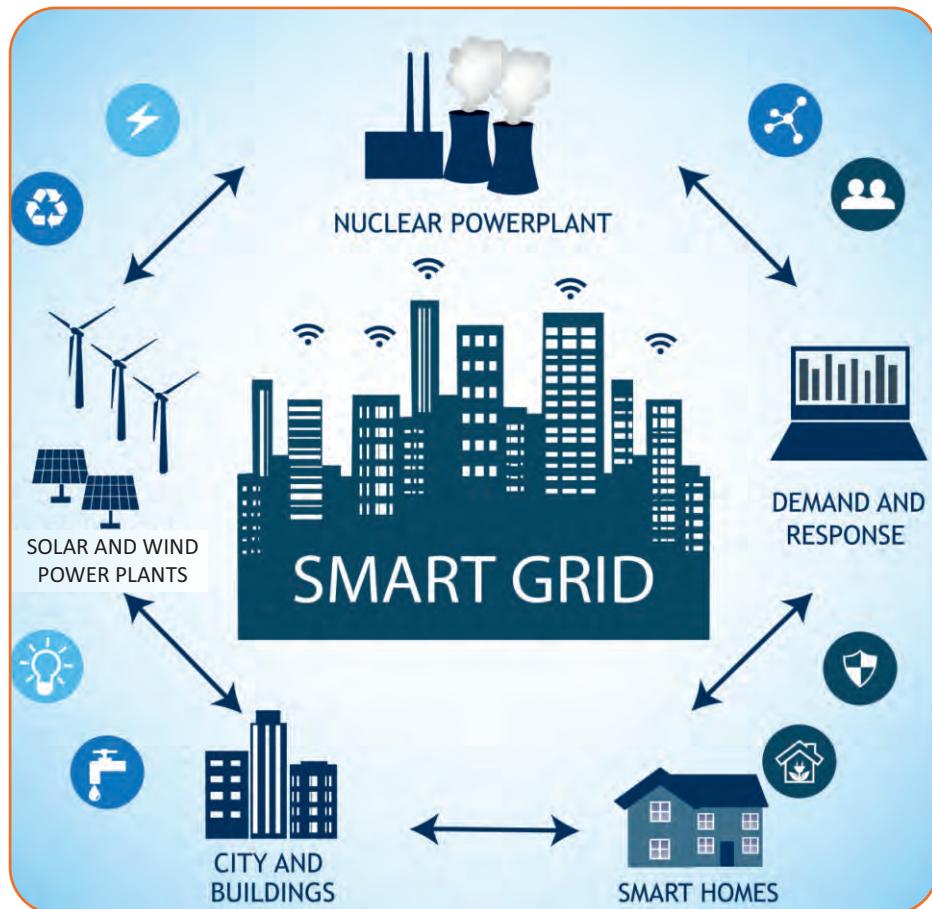


Fig.2.25 – Smart grid

2.1.10 Agriculture

The Food and Agricultural Organisation of the UN (FAO) predicts that the global population will reach 9.6 billion people by 2050. In order to keep pace, food production must increase by 70% by 2050.

Current Barriers:

- Slowing down of productivity
- Limited availability of arable land
- Climate changes
- Increasing need of fresh water

Solutions:

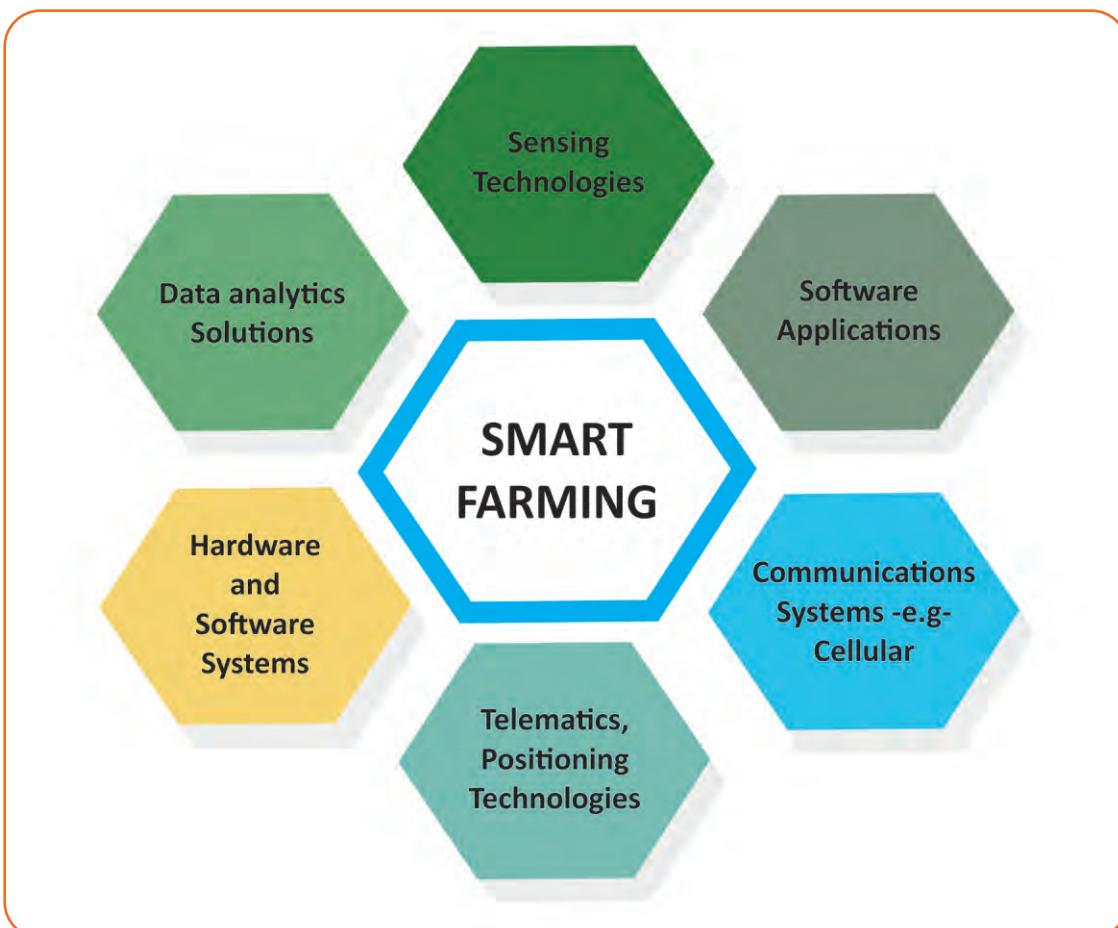




Fig.2.26 – Smart farming

Key benefits of IoT in Agriculture:

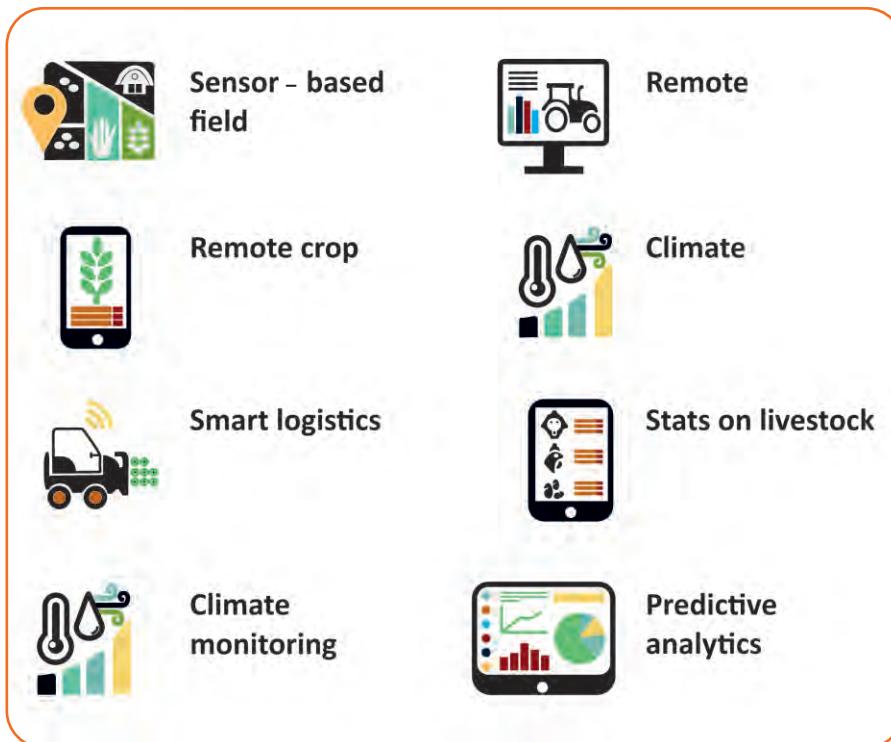


Fig.2.27 – Benefits of IoT in agriculture

2.1.11 Aerospace

Commercial aviation covers many segments such as:

- Transportation
- Business aviation
- Autonomous unmanned aircraft of the future

Operation and maintenance of these sectors need to subscribe to governmental control of airspace and airspace operations and as such it is a highly-regulated domain.

The IoT model uses data collected from devices and transmitted through the network to cloud services, where the real-time intelligence drives productivity and operational gains. There is no single owner who controls the entire solution, or system of systems.

Airlines typically own the aircraft and the associated ground maintenance facilities; communications have to go through avionics radios, the Aircraft Communications Addressing and Reporting System (ACARS) data link, or commercial broadband services; and in flight the operations are controlled by the airspace operators, typically run by government agencies such as the FAA or EUROCONTROL or DGCA in India.

This multi-owner, multi-tenant environment makes it particularly challenging to implement system-of-system efficiencies and to exploit data in the emerging concepts of IoT. Although the automation provided by IoT allows for more efficient operations, new security and safety requirements to ensure that the excellent safety record of commercial aerospace is not compromised is needed.

One of such schemes is implemented through an open, internationally agreed-upon cloud service: **System Wide Information Management (SWIM)**. SWIM aggregates data about all aspects of aircraft operations, including flight paths, coordination in take-off and landing, weather information, and operational data about airspace and airports. By combining data from various sources, additional benefits can be provided. For example, an aircraft encountering turbulence can report that information through SWIM to allow other air space users to avoid that area. Use of IoT concepts in the Management and Operation of individual devices in this frame work need to obtain an aircraft type certificate, which in turn means that devices within the aircraft have to be safety-certified, typically following the RTCA DO-178 and EUROCAE ED-12 standard for software, and RTCA DO-274 and EUROCAE ED-80 for hardware.



Fig.2.28 – System Wide Information Management (SWIM) requirement for IoT

Some of the IoT benefits have been already put to use in the aircraft. For example, Sensor packages that monitor an engine's usage and collect performance, vibration and fuel consumption data have been in existence for a number of years. This data enables the engine manufacturer to advise the carrier on corrective measures, usually during scheduled maintenance phases and has been used to predict and optimize when maintenance is required based on analysing this data over many years of operation.

With the advent of IoT, greater connectivity to the aircraft has enabled engine manufacturers to exploit this data just in time for allowing prompter servicing as well as advising on operational changes, such as those that would result in fuel savings or other advantageous operations (for example, changing a landing sequence to put less stress on the engine).

Using IoT intelligence also have driven business model changes. For example, IoT systems give engine manufacturers the ability to lease engines to carriers based on actual usage in flight, rather than selling them outright, reducing capital expenses (CAPEX) for operators. Under this business model, the engine

manufacturer takes responsibility for maintaining and optimizing the engine, which can be of significant value to the carrier. In the past, carriers could mitigate the risk of equipment failure only by taking an aircraft out of service for inspection at scheduled intervals; nevertheless, in some cases equipment failure could still lead to unscheduled out-of-service aircraft, which is very expensive and disruptive for the airlines.

Predictive maintenance, along with synchronized logistics—made possible by interconnected smart sensors and data analytics linked to the logistics system—reduces not only the risk of in-flight failure but also the number of aircraft sitting idle in hangars, awaiting parts and service.

With a worldwide fleet, it's essential to have the right parts and engineering resources when and where they're needed. Real-time IoT systems that can match maintenance repair and overhaul (MRO) requirements with parts availability can help ensure the timely delivery of parts and service engineers.

Further reference:

<https://www.youtube.com/watch?v=riSLyE57IdA> - Connected Aviation Solution at Dubai IoT World Forum

<https://www.youtube.com/watch?v=emAJwuwvstw> - Internet of Aircraft Things: aircraft data management solutions

2.1.12 Mining

The biggest drivers for the use of technology are **operator safety** and **comfort** because it helps keep operators away from hazardous areas.

Mine sites that put technologies to work have also experienced a number of other valuable benefits such as:

- Increased productivity
- Higher equipment utilization
- Less machine damage



Fig.2.29 – Mining operations

Applications of IoT for improving safety

1. Vision

Includes multiple cameras configurable for machines from any manufacturer. The in-cab display can show up to four cameras, with manual or automatic rotation.

2. Personnel

For underground long wall applications, the system uses RFID tags to locate and identify workers long the face.

Protections include shield advancement prevention, while allowing equipment to keep working in the presence of cleared maintenance technicians.

3. Proximity Awareness

Proximity awareness adds GNSS capabilities for surface operations. It allows to detect and display the locations of other equipment beyond the reach of its radars and allows pre-programmed information such as avoidance zones, haul road maps and more to be displayed in the cab.

4. Object Direction

Adds radar capabilities to mobile surface equipment. Automatically detects hazards such as other equipment or vehicles within critical zones around the machine.

Can be added as an aftermarket solution and is available for any brand of equipment.

5. Driver Safety System

An in-cab camera system measures operator eye movements to spot distraction events and determine the onset of fatigue. Used with an operator training and awareness program, it is a powerful tool for mitigating the root causes of many site accidents.

6. Machine to Machine Communication

Eliminates data gaps and the need for site-wide radio coverage. The system stores data on the on-board display and sends it to the office whenever they come within range of hot spots located around the site.

7. Capture and Playback

Records incidents for playback, analysis and training opportunities. Enhanced reporting helps identify the best operators by comparing incidents to productivity.



Fig.2.30 – Safety application using IoT

8. Avoidance Zones: Building Virtual Fences

Mine sites can be dangerous places both to the people who work there and to the equipment they operate. Mining companies are committed to preventing as many risks as possible, yet dangers remain on even the safest sites.

Mines keep people and equipment out of harm's way by restricting the most dangerous areas. These areas may feature hazardous terrain or contain fixed assets like buildings and power lines that pose a collision risk to large mining equipment. There also may be the portions of the site that are hazardous to operators, such as areas where there is excessive noise, dust or other potential threats to health and safety.

One approach to managing these restricted areas is to put up fencing that keeps people and equipment away and to install signage that warns of the potential danger which involves cost. A better solution is to use the latest technologies to create "virtual" fences that warn machine operators when they are approaching a restricted space.

Avoidance zone systems use global positioning, wireless radio technology and office software to map the mines and create electronic fences that identify worksite boundaries. Machine operators and mine controllers can view avoidance zones on a digital display either in the cab or in the control room. Displays also show the position of other equipment in the area to give the operator complete awareness of the work environment. Multiple avoidance zones can be configured and some systems also provide operators with an audible message that they are nearing an avoidance zone. These systems work on a wide variety of equipment, including trucks, dozers, graders, loaders, scrapers, drills, draglines, shovels and medium and light vehicles.



Fig.2.31 – Virtual fence

9. Smart Routing and Lane Maintenance:

Lane maintenance is one of the most important things in mining as it results in high maintenance costs for equipment such as Tire wear and tear. Equipment uses global positioning, wireless radio technology and office software to map mines and sends real time information about the health of the lanes based on sensor data feed of pressure changes on wheels being on route. Machine operators and mine controllers can view lane status on a digital display either in the cab or in the control room. Displays also show the position of other equipment in the lane and area to give the operator complete awareness of the work environment. These systems work on a wide variety of equipment, including trucks, dozers, graders, loaders, scrapers, drills, draglines, shovels and medium and light vehicles by integrating the data feed from all the equipment and systems and feeding back into the equipment.

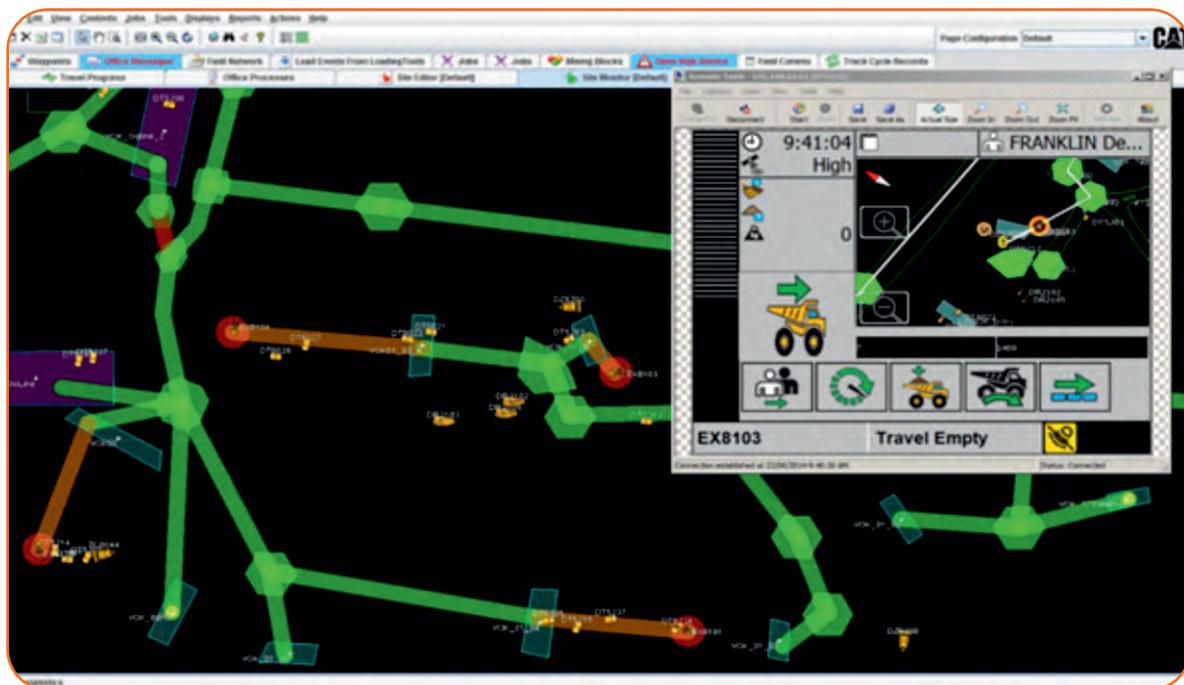


Fig.2.32 – Smart routing and lane maintenance

2.1.13 Environment

Environmental monitoring applications of an IoT system typically use **sensors to assist in environmental protection for monitoring**:

- Air quality
- Water quality
- Atmospheric or soil conditions
- Movement of wildlife and their habitats

Development of resource constrained devices connected to the Internet also mean that other applications like **earthquake or tsunami early-warning systems** can also be used by emergency services to provide more effective aid. IoT devices in this application typically span a large geographic area and can also be mobile. It has been argued that the standardization of IoT brought to wireless sensing will revolutionize this area.



Fig.2.33 – Earthquake or tsunami warning system

Acronyms used in this unit:

ACARS	Aircraft Communications Addressing and Reporting System
DGCA	Directorate General of Civil Aviation
FAA	Federal Aviation Administration
FAO	Food and Agricultural Organization
IDE	Integrated Development Environment
IIoT	Industrial Internet of Things
RFID	Radio Frequency Identification
SWIM	System Wide Information Management

Summary



We have briefly discussed various applications of IoT in various sectors. The applications are listed below.

Logistics:

1. Traffic and fleet management
2. Resource and energy management
3. Safety and security
4. Health monitoring

Manufacturing:

1. Automated process controls
2. Asset management
3. Energy optimization
4. Intelligent maintenance system

Medical / Healthcare:

1. Remote health monitoring and emergency notification system
2. Encourage healthy living

Automotive:

1. Software update in real time
2. Vehicle performance analysis
3. Cross selling
4. RFID (Radio Frequency Identification)

Construction/Infrastructure/Smart city:

1. Lighting, asset tracking and smart energy
2. Environmental monitoring
3. Smart waste management
4. Smart citizen
5. Traffic intensity monitoring
6. River monitoring
7. Outdoor parking management

Retail:

1. Predictive equipment maintenance
2. Smart transportation

- 3. Connected consumer
- 4. Smart store

Energy:

- 1. Smart grid
- 2. Smart home

Agriculture:

- 1. Smart farming

Aerospace:

- 1. System Wide Information Management (SWIM)

Mining:

- 1. Improving safety
- 2. Building virtual fences
- 3. Smart routing and lane maintenance

Environment:

- 1. Environmental protection



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3. Use Cases - Automotive

Unit 3.1 - Breath Alcohol Ignition Interlock Device

Unit 3.2 - Health Monitoring of Tractors



Key Learning Outcomes



At the end of this module, you will be able to

1. State the importance and benefits of 'Breath Alcohol Ignition Interlock Device' IoT application
2. Describe various features of 'Breath Alcohol Ignition Interlock Device'
3. Describe how the 'Breath Alcohol Ignition Interlock Device' works
4. State the importance and benefits of 'Health Monitoring of Tractors' IoT application
5. Describe various features of 'Health Monitoring of Tractors'
6. Describe how the 'Health Monitoring of Tractors' works

UNIT 3.1: Use Case 1 – Breath Alcohol Ignition Interlock Device

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Breath Alcohol Ignition Interlock Device' IoT application
2. Describe various features of 'Breath Alcohol Ignition Interlock Device'
3. Describe how the 'Breath Alcohol Ignition Interlock Device' works

3.1.1 Scenario

Drinking and driving is one of the main causes of road accidents. It is also important to know that more than 70% of road accidents are due to drunk driving.

The US National Highway Traffic Safety Administration (NHTSA) has mandated the installation of an Ignition Interlock System in vehicles to control to drunk driving.

Breath Alcohol Ignition Interlock Device (BAIID) employs sensors to test the breath sample and the vehicle will start only if the alcohol concentration (Breath Alcohol Concentration) is below the set point. Thus, these devices will help in controlling accidents due to drunk driving.

This use case describes **handheld** and **base unit** to meet the Requirement of NHTSA guidelines.

3.1.2 Design

This system uses a **handheld unit**, a **base unit** and a **cloud base data collection** and an **analysis unit**. BAIID system is remotely connected to the base unit through GPRS/GPS/Wi-Fi interface.

The system can store the data for three months with a driving usage limit of 24 hours of driving per day as per the NHTSA guidelines. The driver has to visit the nearest service station once in every 3 months for data collection, analysis and scrutiny for a defaulter driver.

The main tasks of a 'handheld' unit are:

- Handle user inputs via switches
- Perform BAC (Breath Alcohol Concentration) test
- Notify the status
- Transfer the data to the base unit

- Rolling retest features
- Generate snapshot of the face
- jpeg encoding of the image
- Storage in the local system
- Monitor various temperature sensors
- Handle the heat management as and when needed

The main tasks of a 'base' unit are:

- Communication with the 'handheld' unit
- Transferring BAC test results for controlling the car ignition control unit
- Storage of BAC results into Flash
- Tamper switch monitoring and recording information related to it into Flash
- Monitor battery fuel gauge
- Temperature and Axis sensor monitoring

3.1.3 Data Gathering

Software Architecture:

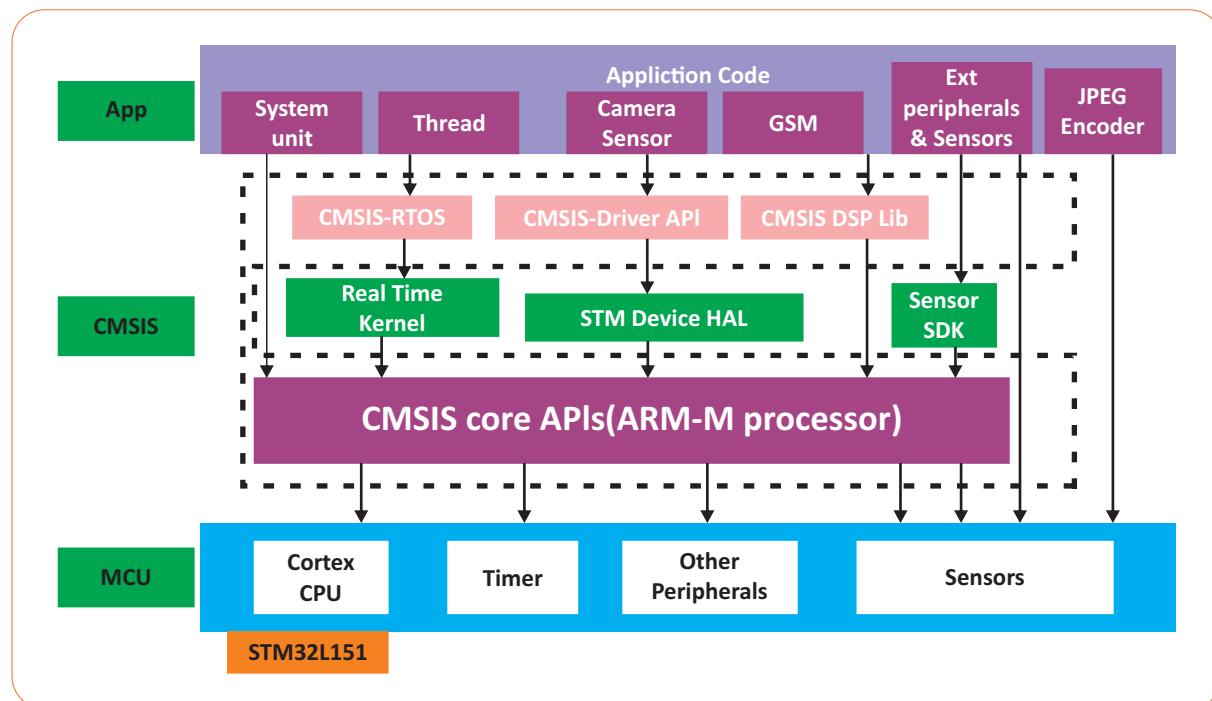


Fig.3.1 – Software architecture

Handheld Unit state diagram:

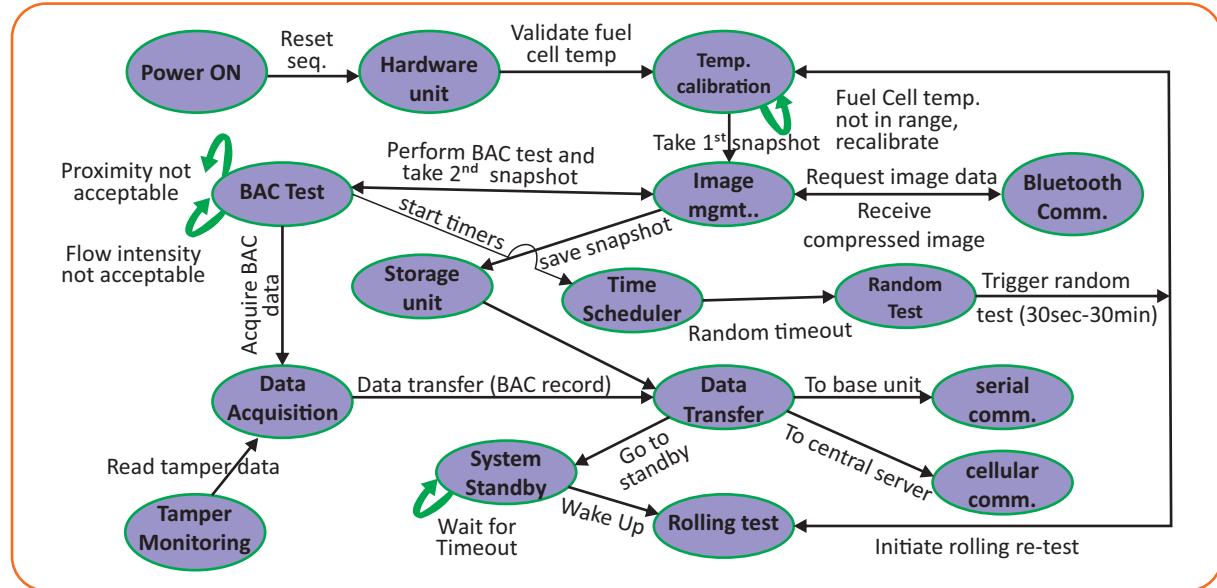


Fig. 3.2 – State diagram of handheld unit

Handheld Unit Flow Chart:

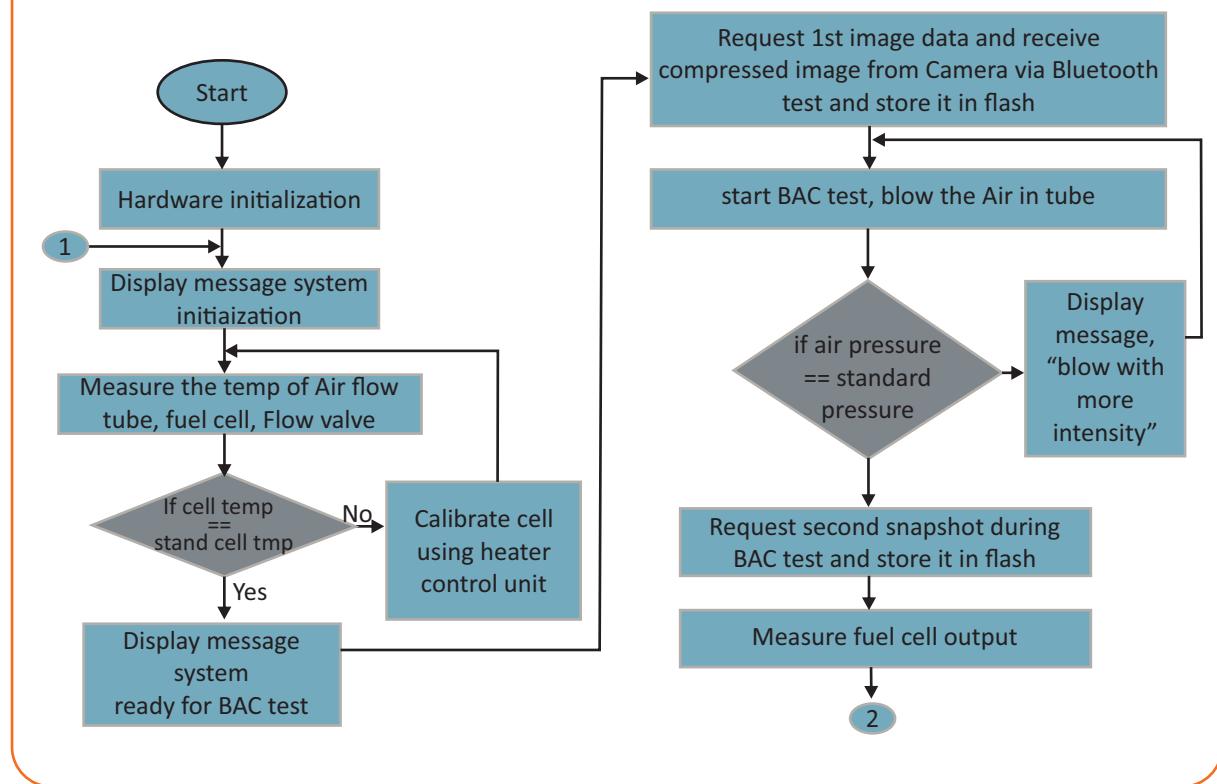


Fig. 3.3 – Flow chart of handheld unit

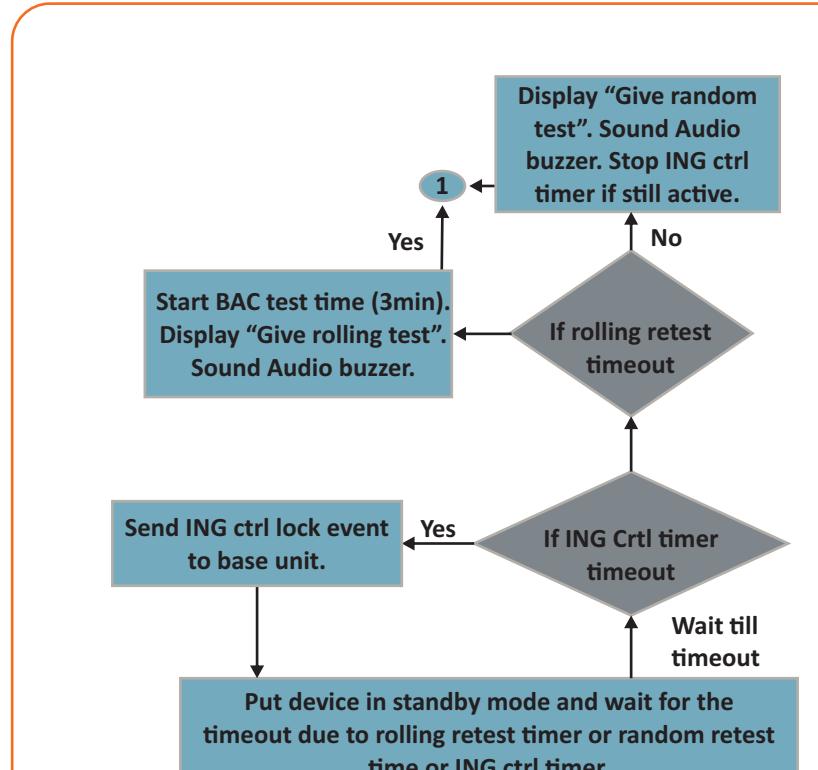


Fig. 3.3 – Flow chart of handheld unit (contd)

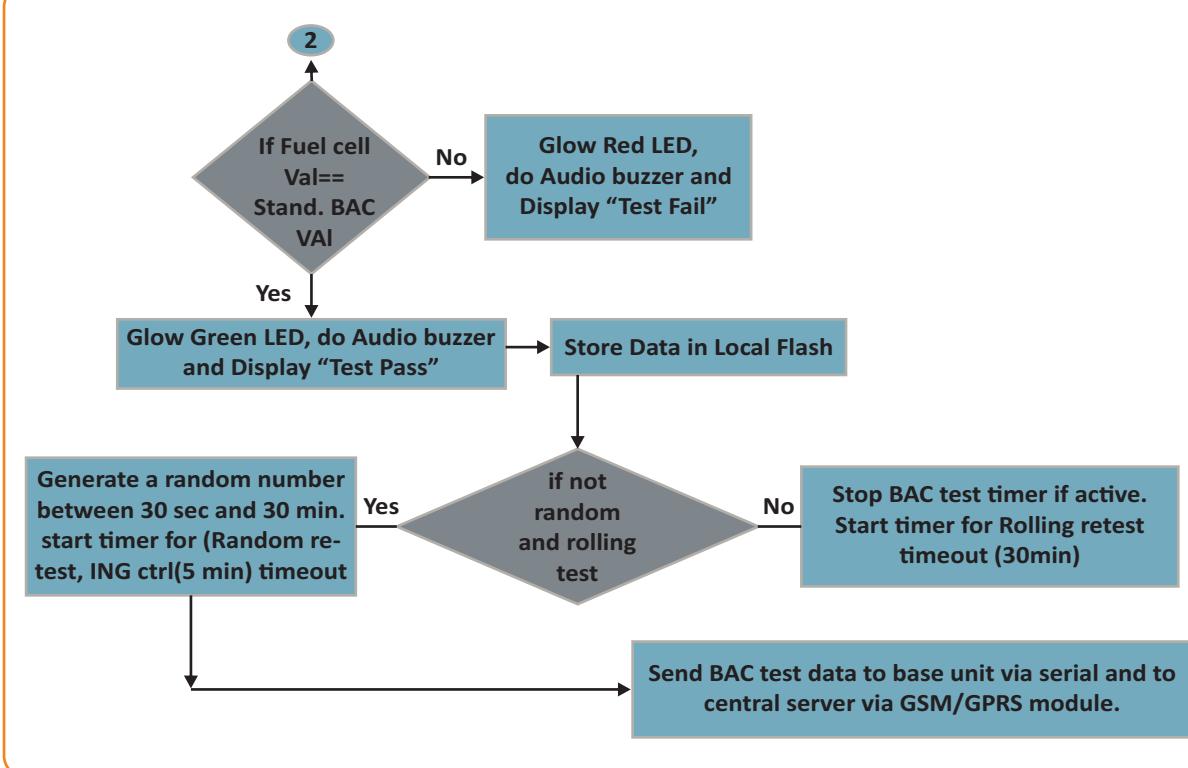


Fig. 3.3 – Flow chart of handheld unit (contd)

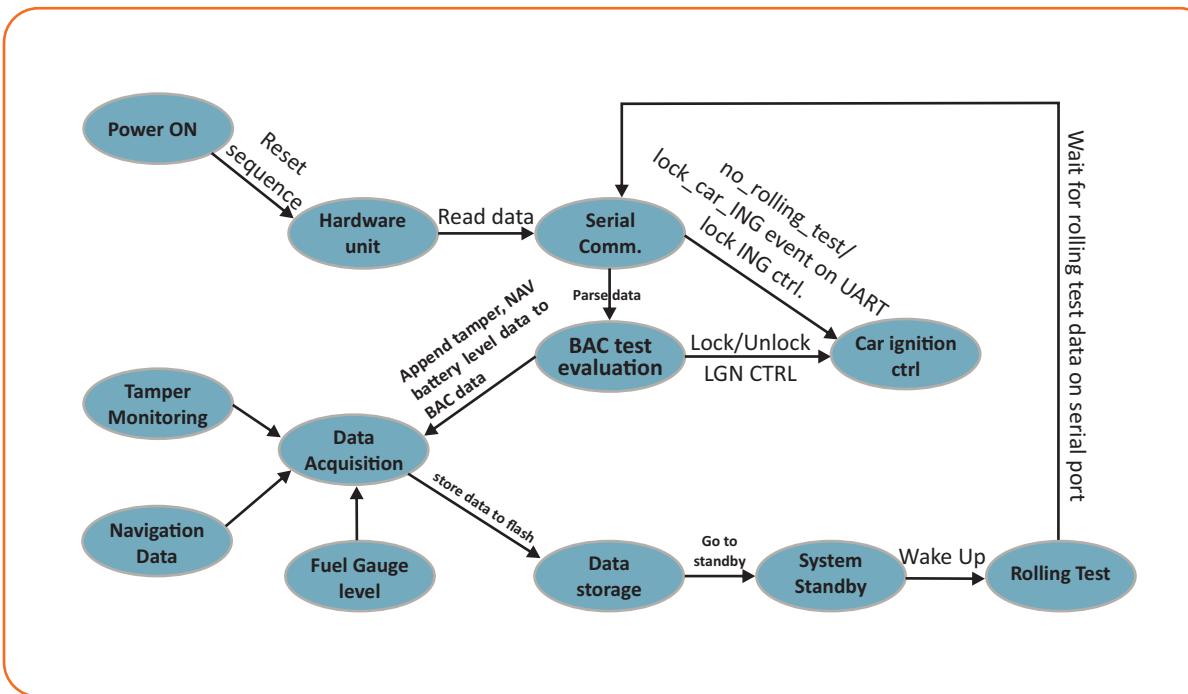
Base Unit State Diagram:

Fig. 3.4 - Base unit state diagram

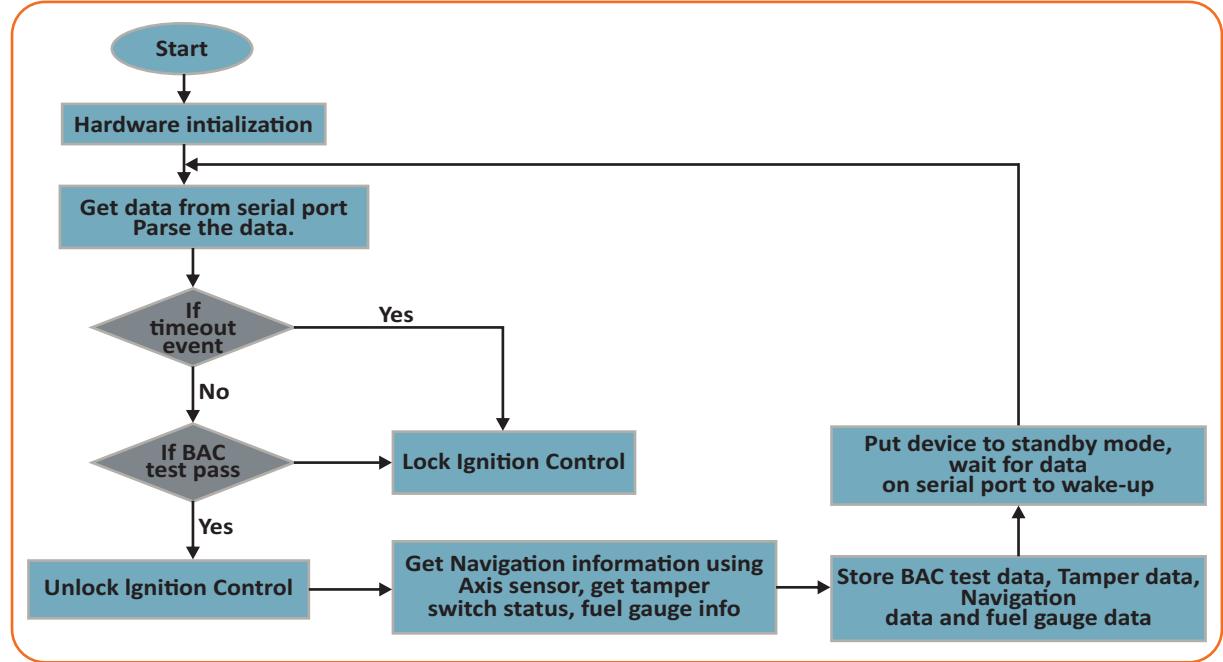
Base Unit Flow Chart:

Fig.3.5 – Base unit flow chart

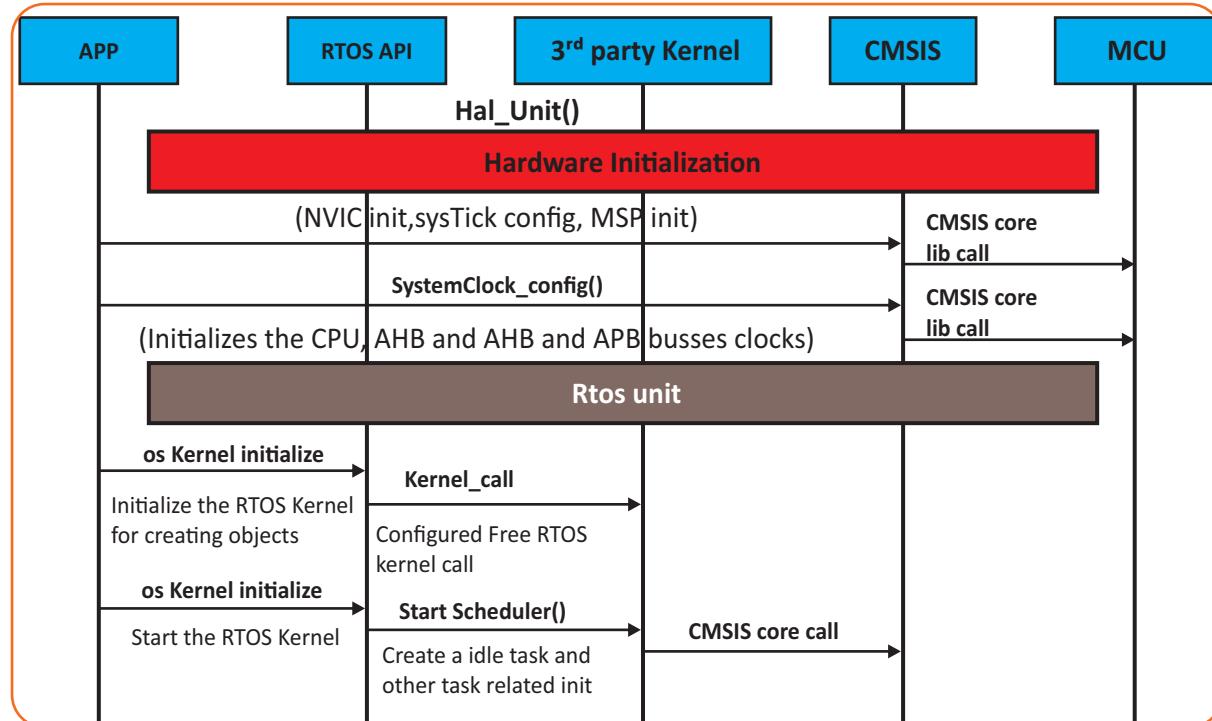
System Initialization Flow:

Fig. 3.6 – System initialization flow

Use case for Temperature Sensor:

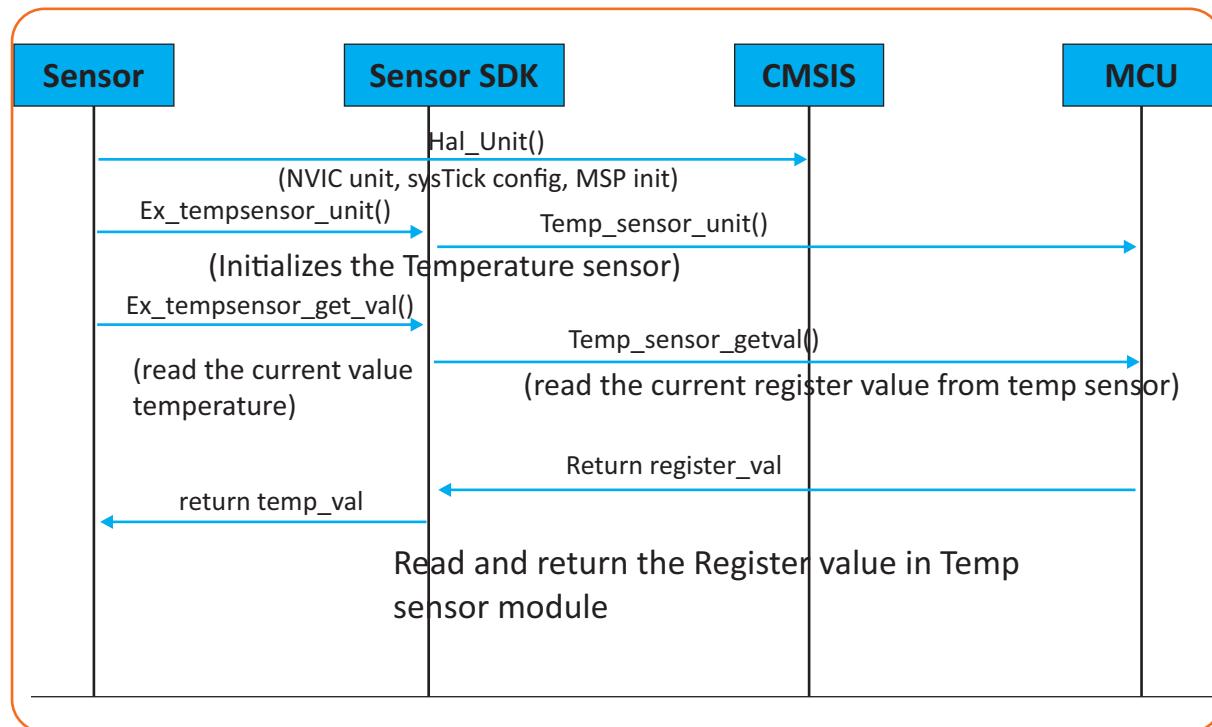


Fig.3.7 – Use case of temperature sensor

3.1.4 Security

Security is handled multifold in this case at multiple cases and points:

- A **handshake protocol** is implemented at the boot time with a unique code stored in the SD card that allows the system to boot up with registered hardware only.
- **Tamper proofing:** The unit is tamper proof at the cabinet level by sensing the tamper switch on one of the GPIO pin. If the GPIO pin gets disconnected, the unit will stop functioning and would not even reboot again.
- **System level handshake security with the service station server interface:** Here each system checks the unique ID of the car unit before accessing the data from the system on Wi-Fi.
- **AWS data security:** The cloud data is maintained with unique access code and system password for both write operation and system level read operations.

3.1.5 Basic Equipment Required for Model

The basic requirements for this application are:

- STM321251 unit
- Temperature sensor
- BAC test unit
- Fuel cell
- Heater Control Unit
- Data Acquisition Unit
- Data Storage Unit

UNIT 3.2: Use Case 2 – Health Monitoring of Tractors

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Health Monitoring of Tractors' IoT application
2. Describe various features of 'Health Monitoring of Tractors'
3. Describe how the 'Health Monitoring of Tractors' works

3.2.1 Scenario

A very interesting application of IoT in the automotive domain is the monitoring health of the off-road vehicles like tractors and earth moving equipment.

These vehicles are very expensive pieces of equipment and are put to use at far-off locations that are not very easy to access. In case of break down at the work-site, it is very difficult to get the fault repair teams to the location. The cost of loss of business due to off-time of the vehicles is very high.

Hence it is important for the stakeholders to be able to monitor the health of the vehicles regularly from remote locations on an on-going basis.

IoT facilitates remote monitoring of the vehicle for various stake holders and enables proactive support to keep the machines in operational condition and also provide data for design improvements to achieve better performance. The application requires use of sensors and instrumentation of the tractor for collecting data and monitoring the health of the machine. The instrumentation scheme and the details of the arrangement are illustrated below.

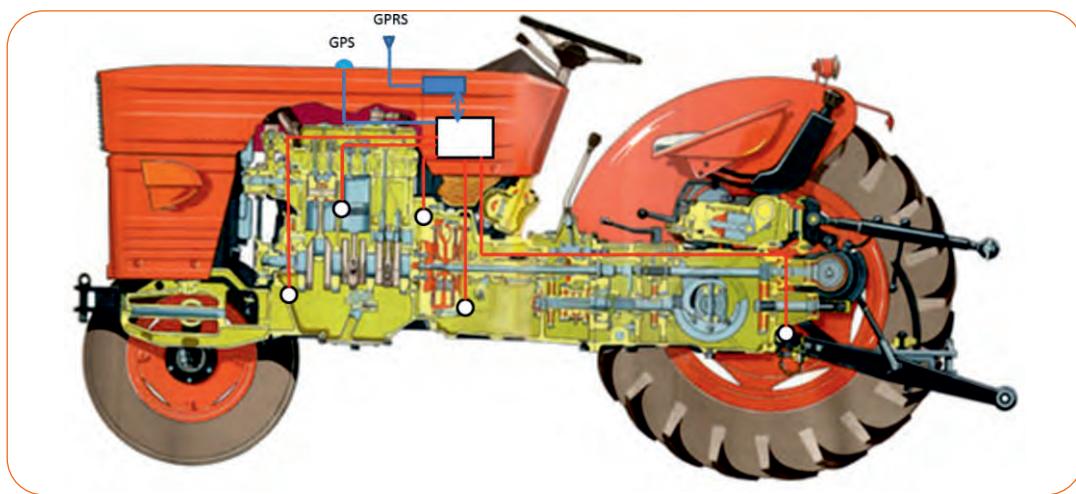


Fig.3.8 – Instrumentation scheme for tractors

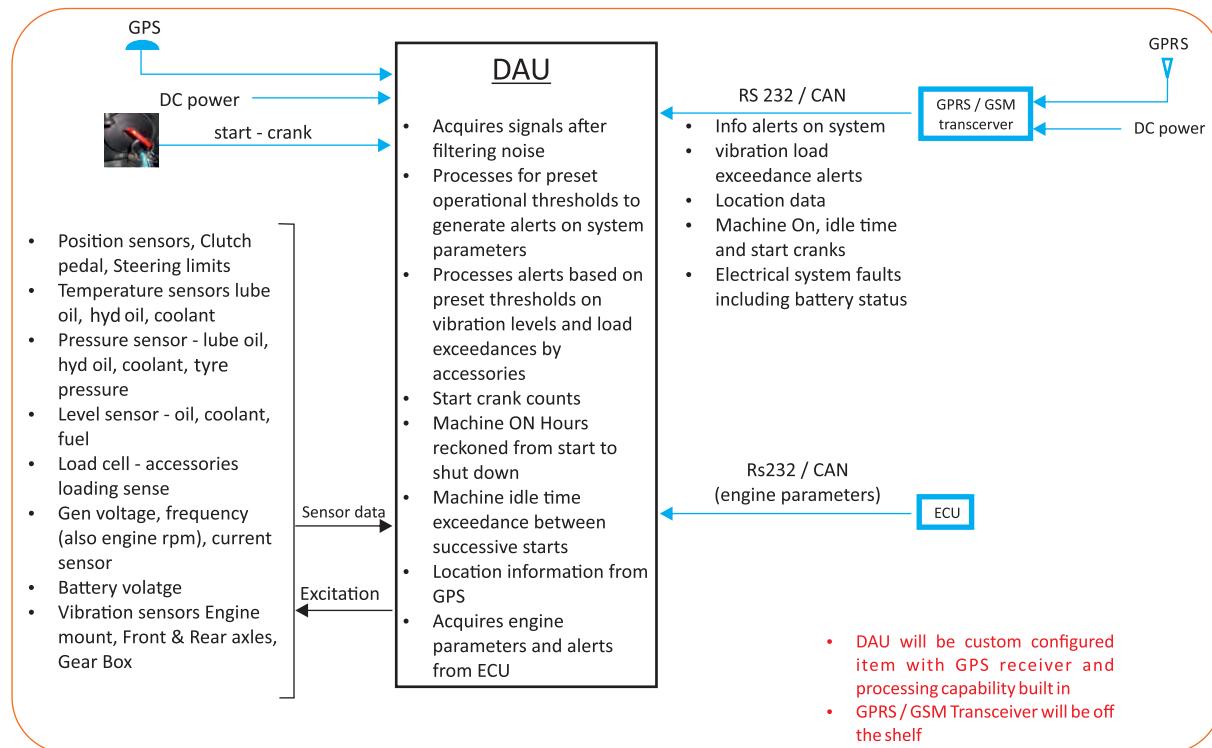
3.2.2 Design

This IoT application is for monitoring the tractor performance from various objectives. Let's have a look at the design used to achieve this.

- The connected devices here are the Tractors.
- DAU electronic unit, an embedded system monitors the tractor systems.
- DAU is interfaced to GPRS or Wi-Fi connectivity.
- Wi-Fi communication model and enabling technology is used because of long data range.
- Cloud based computing is also essential to access data from different servers and support the proposed GUI with the required data.

This system requires sensors to monitor various parameters. The following sensors are used in this application:

- Vibration sensor for engine mount and power train
- Temperature sensor - lube oil, hydraulic oil and coolant
- Pressure sensor – lube oil , hydraulic oil and coolant
- Level sensor - oil , coolant, fuel
- Load cell - accessories loading sense
- Sensors for general voltage, frequency (rpm), current, battery voltage



Sensors → Data Acquisition → Telemetry

Fig.3.9 – Schematic block diagram

3.2.3 Data Gathering

User interface, monitoring and control:

At the user end (remote location) following information is to be made available on real time in 2 formats.

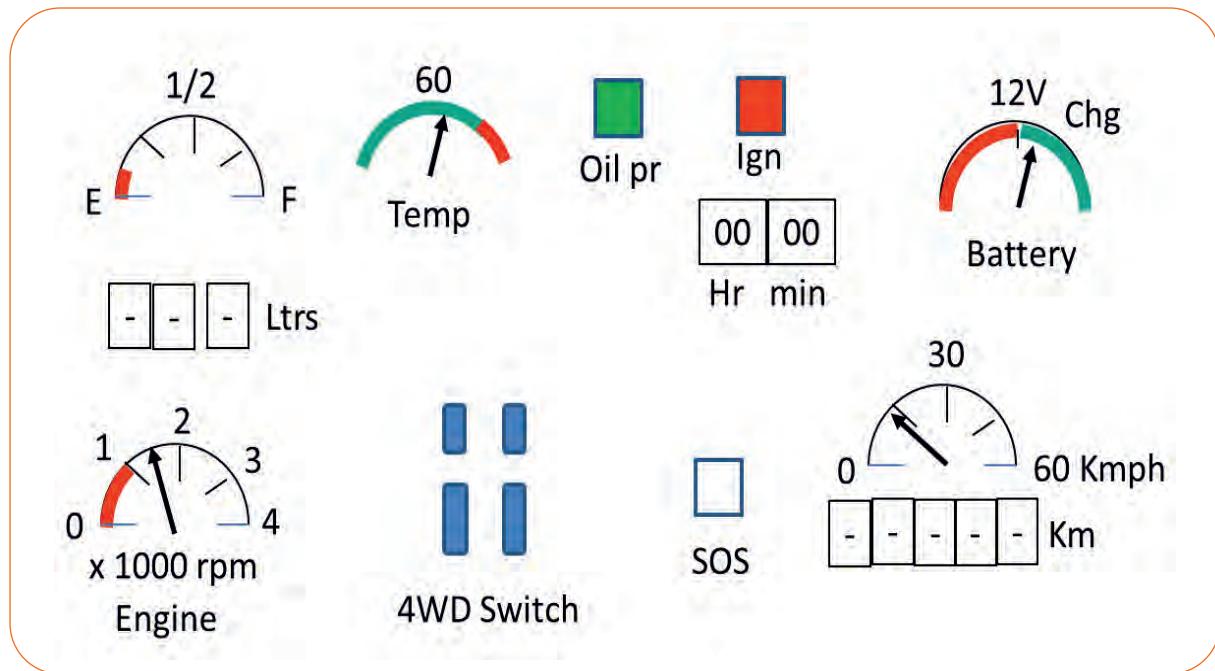


Fig.3.10 – GUI- Real time display

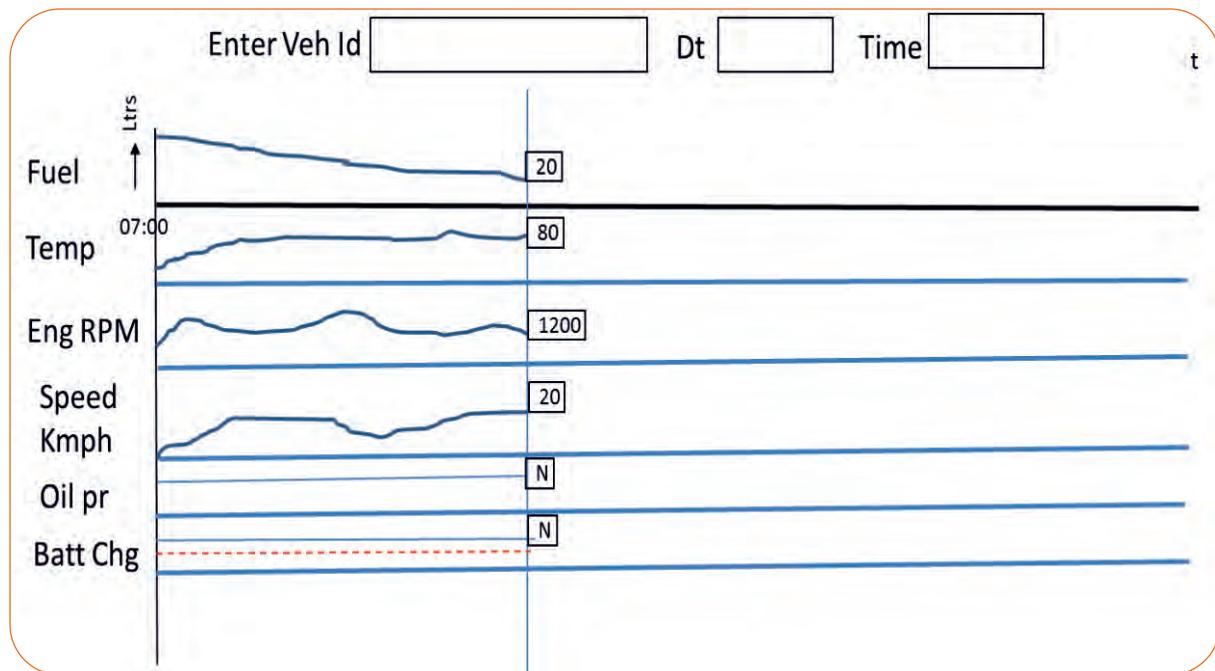


Fig.3.11 – GUI-Histogram format

To support the information at various user centres, GPRS (General Packet Radio Services) will be essential for multipoint access to transport the individual vehicle data to the customer site and share the data through internet connectivity. The arrangement can be as below for a fleet of tractors.

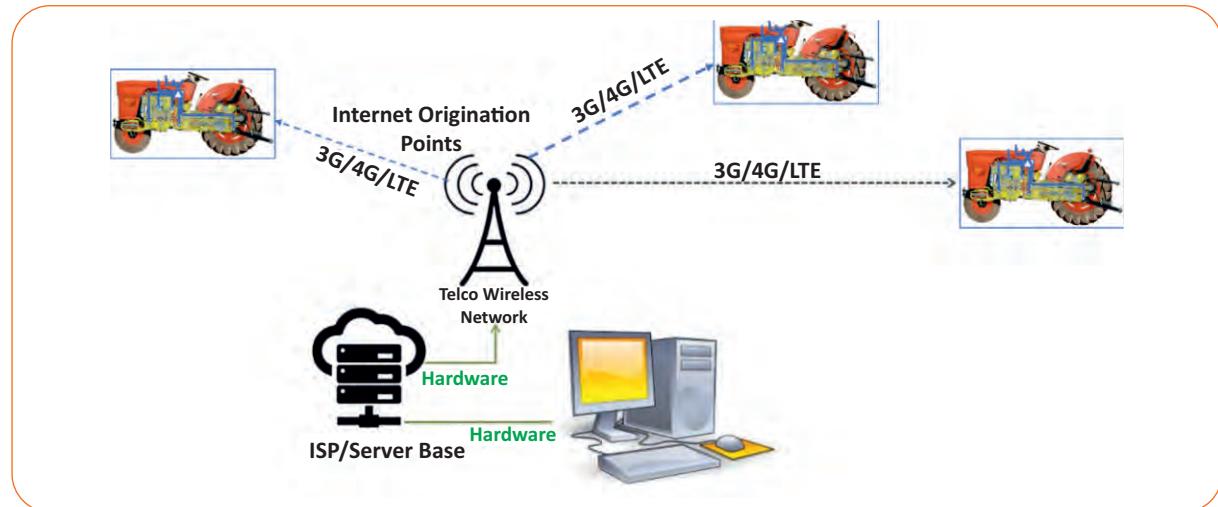


Fig.3.12 – Telematics of tractor using IoT

The data acquisition unit, used in the tractor, is required to have GPRS interface to have the Internet connectivity. GPRS / Wi-Fi will be used for communication gateway to access the Internet.

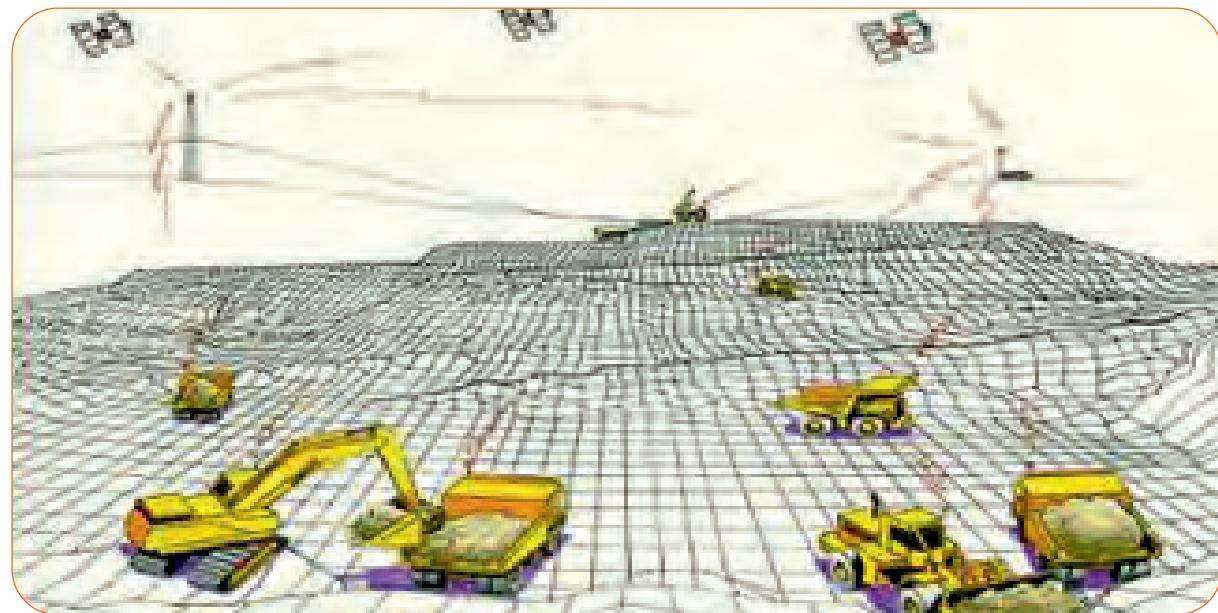


Fig.3.13 – Connected workplace for off road operations through the Internet

3.2.4 Security

The current and future connected vehicles will have system modules and infotainment modules connected to the Internet. This will pose many security problems which were not present before when these vehicles were considered as standalone devices. Now with IoT applications growing, the vehicle is one more node in the network of other personal and public devices.

The security of a connected vehicle closely resembles a combination of the following:

- Mobile security
- IoT security
- Application security

Out of the three, 'IoT security' is relatively new and has similar challenges as connected vehicles. So, the approach towards securing a connected vehicle will require a framework which will adapt the processes, techniques, technologies and best practices from the three fields mentioned above.

Potential Risks:

- Driver distractions (e.g. sudden unexpected volume, wipers' activation), engine shutoff or degradation, steering changes (autonomous vehicles)
- Risk of wrong information fed to safety critical systems like steering, braking and vehicle malfunction alert modules
- Reduced or nil response rates to safety set thresholds or deployment of devices like airbags and ABS brakes
- Manipulation of response to environment vectors like traffic and road inputs and vehicle RFID devices
- Some Less Safety-Critical Vehicle specific risks such as
 - Theft of the vehicle or contents
 - Enabling physical crime against occupants
 - Insurance or lease fraud
 - Eavesdropping on occupants
 - Theft of information (e.g. personal profile, phone list, bank details)
 - Vector for attacking mobile devices in the car
 - Theft of PII
 - Unauthorized tracking of the vehicles and their location

Recommendations:

Hardware Security: Use of secure boot and software attestation function, trusted platform module, tamper protection, cryptographic accelerator, active memory protection, device identity directly on device. (e.g. Intel EPID, physically un-cloneable function)

Software Security: Secure boot, partitioned OS, module level authentication, enforcement of approved and appropriate behavior, secure product development lifecycle.

Network Security: Message and device authentication, identify and enforce predictably holistic behavior, access control.

Cloud Security: Secure authenticated channel to cloud, remote monitoring of vehicle, threat intelligence exchange, OTA updates, credential management.

Supply-chain Security: Authorized distribution channel, track and trace components, continuity of supply, ability to identify uncertified component.

Battery backup and SD card is provided to save limited data if there is a loss of power or connectivity.

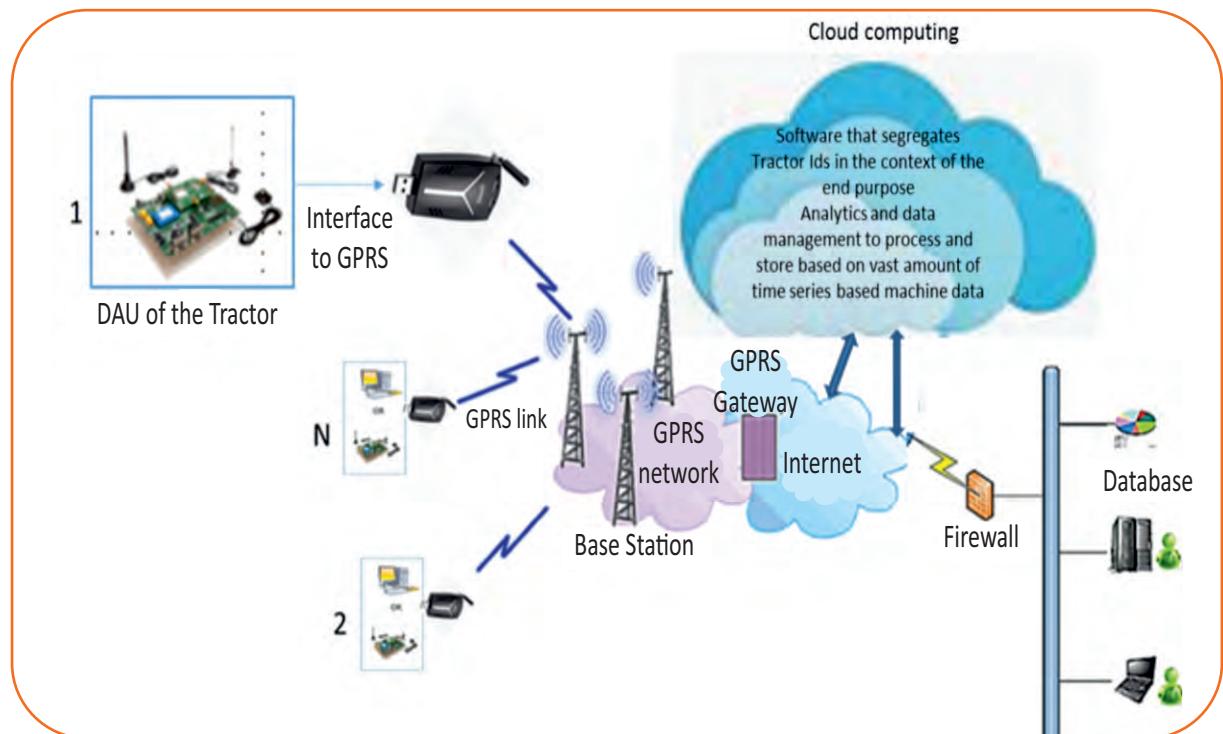


Fig.3.14 – Telematics based IoT for monitoring tractors

3.2.5 Basic Equipment Required for Model

- Various types of sensors
 - o Temperature sensor
 - o Pressure sensor
 - o Level sensor
 - o Load cells
- DAU (Data Acquisition Unit)
- ECU (Engine Control Unit)
- GPRS/GSM Trans receiver

Acronyms used in this unit:

ABS	Antilock Braking System
BAC	Breath Alcohol Concentration
BAIID	Breath Alcohol Ignition Interlock Device
DAU	Data Acquisition Unit
GUI	Graphical User Interface
NHTSA	National Highway Traffic Safety Administration
RPM	Revolutions Per Minute

Summary



1. Drinking and driving is one the main cause of road accidents. It is also important to know that more than 70% of road accidents are due drunk driving.
2. Breath Alcohol Ignition Interlock Device (BAIID) employs sensors to test the breath sample and the vehicle will start only if the alcohol concentration (Breath Alcohol Concentration) is below the set point.
3. This system uses a **handheld unit, a base unit and a cloud based data collection and an analysis unit.**
4. A recent application of IoT in the automotive domain is the monitoring of the health of off-road vehicles like tractors and earth moving equipment.
5. These vehicles are very expensive pieces of equipment and are put to use at far-off locations that are not very easy to access.
6. The cost of loss of business due to off-time of the vehicles is very high.
7. IoT facilitates remote monitoring of the vehicle for various stake holders and enables proactive support to keep the machines in operational condition and also provide data for design improvements to achieve better performance.
8. The application requires use of sensors and instrumentation of the tractor for collecting data and monitoring the health of the machine.
9. DAU electronic unit, an embedded system, monitors the tractor systems.
10. DAU is interfaced to GPRS or Wi-Fi connectivity.
11. This system requires sensors to monitor various parameters.



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4. Use Cases – Medical/ Healthcare

Unit 4.1 – Automated BP Monitor

Unit 4.2 – Remote Patient Monitoring



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Automated BP Monitor' IoT application
2. Describe various features of 'Automated BP Monitor'
3. Describe how the 'Automated BP Monitor' works
4. State the importance and benefits of 'Remote Patient Monitoring' IoT application
5. Describe various features of 'Remote Patient Monitoring'
6. Describe how the 'Remote Patient Monitoring' works

UNIT 4.1: Use Case 1 – Automated BP Monitor

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Automated BP Monitor' IoT application
2. Describe various features of 'Automated BP Monitor'
3. Describe how the 'Automated BP Monitor' works

4.1.1 Scenario

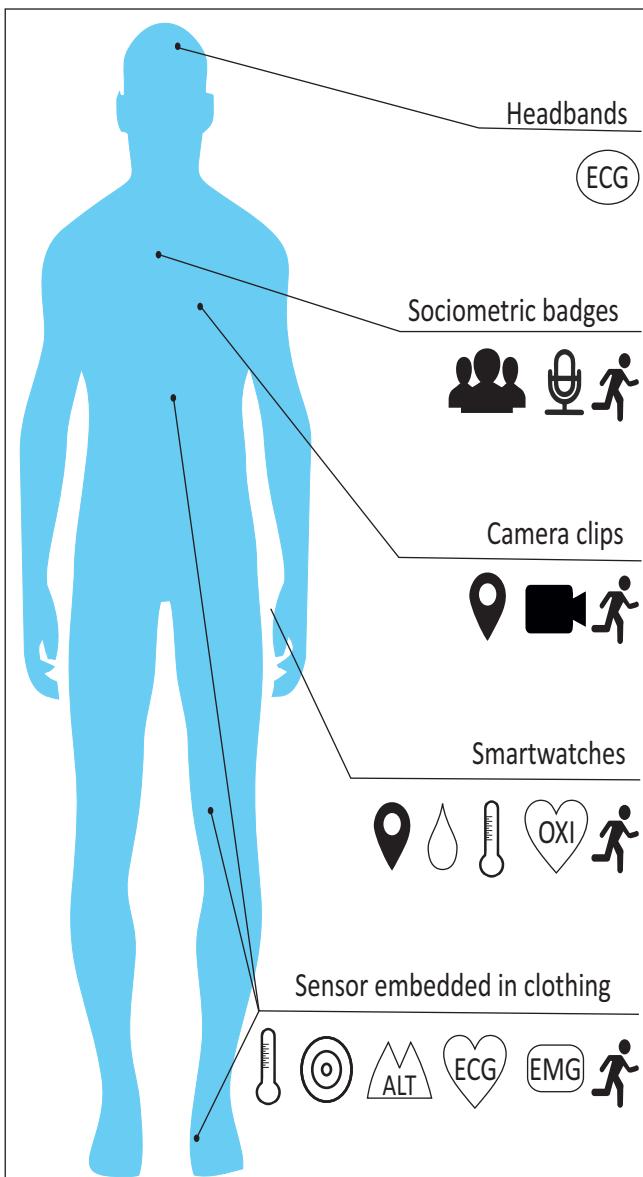
IoT application in medical electronics has been overwhelming and likely to grow in leaps and bounds in the coming years. This can provide innumerable advantages for providing timely attention by the doctor and paramedical staff. The Internet of Medical Things (IoMT) is the collection of data from medical devices and applications that connect to healthcare IT systems through online computer networks. Medical devices equipped with Wi-Fi allow machine-to-machine communication.

IoT devices link to cloud platforms on which captured data can be stored and analysed.

Following can be the future developments:

- Remote patient monitoring of people with chronic or long-term conditions
- The location of patients admitted to hospitals
- Patients' wearable mHealth devices, which can send information to caregivers

Information gathered can connect to analytics dashboards typically as devised for the telematics. There are now more possible applications of IoT than before because many consumer mobile devices are built with Near Field Communication (NFC) Radio Frequency Identification (RFID) tags that allow the devices to share information with IT systems.



	Accelerometer
	Altimeter
	Digital camera
	Electrocardiogram
	Electromyogram
	Electroencephalogram
	Electrodermograph
	Location GPS
	Microphone
	Oximeter
	Bluetooth proximity
	Pressure
	Thermometer

INTERNET Of MEDICAL THINGS

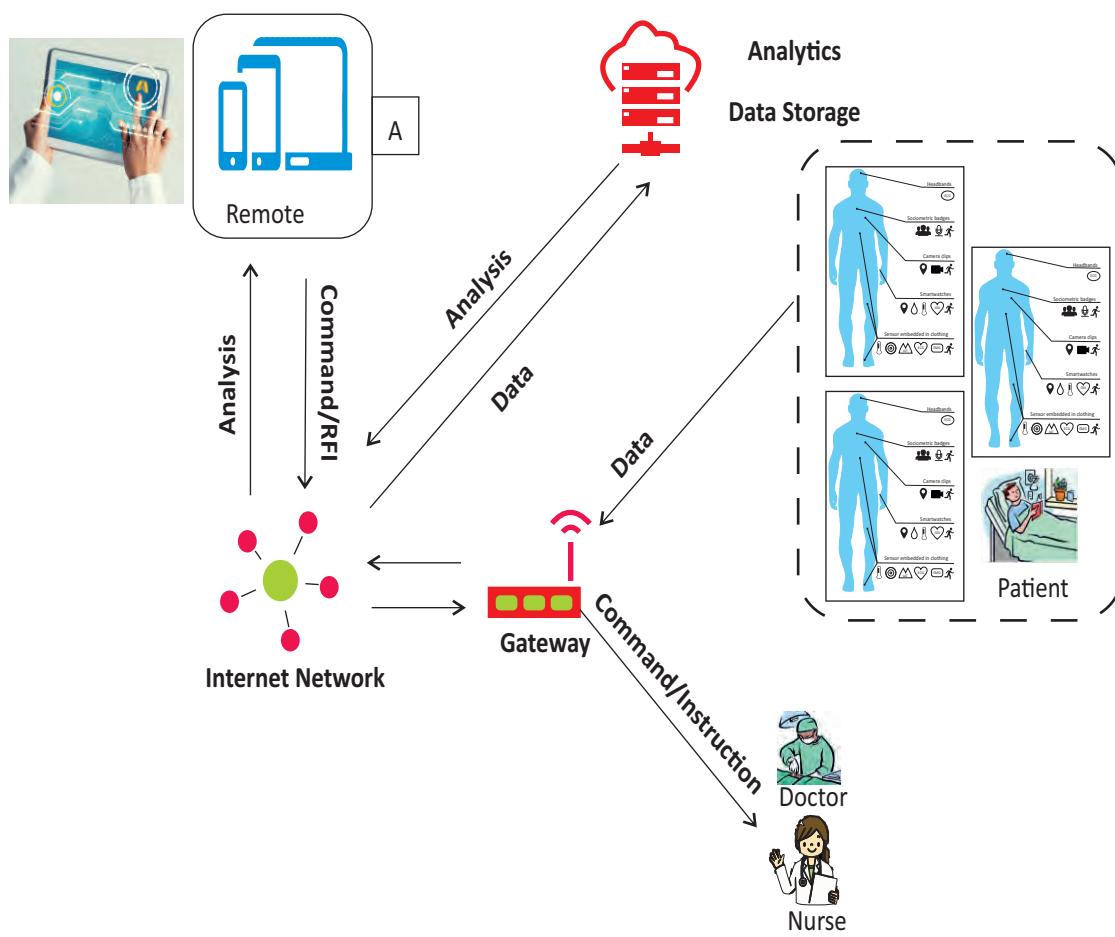


Fig.4.1 – Internet of Things applied to medical application and Healthcare

As an example, we will study Automated BP Monitoring, also known as automated non-invasive sphygmomanometers.

4.1.2 Design

The process cycle gets initiated with one press of the start button. The process cycle involves pressurising the cuff, establishing the systolic pressure and diastolic pressure levels along with heart beat. At the end of the cycle this data is presented on the display panel and also gets stored in the memory. Last 10 measurements are stored. The stored data is recallable through memory recall button. The process is managed by a microcontroller to turn ON / OFF the motor – pump for pressurising the cuff; read the pressure transducer and deduce the systolic and diastolic pressure.

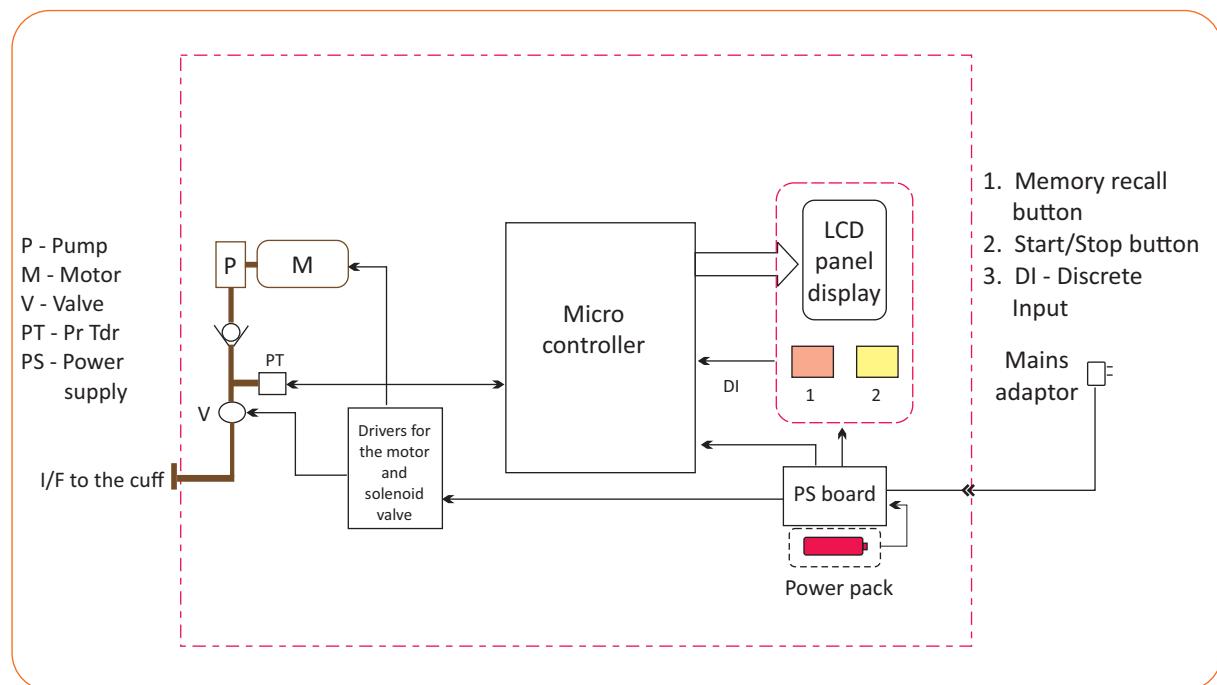


Fig.4.2 – BP monitor block diagram

- This device can be connected through IoT application using an RFID to Ethernet and then to a local hub as it is not a mobile platform.
- This is proposed using RFID tag on the BP monitor to connect to a hub as a number of BP monitors are expected to be in use in a health care centre.

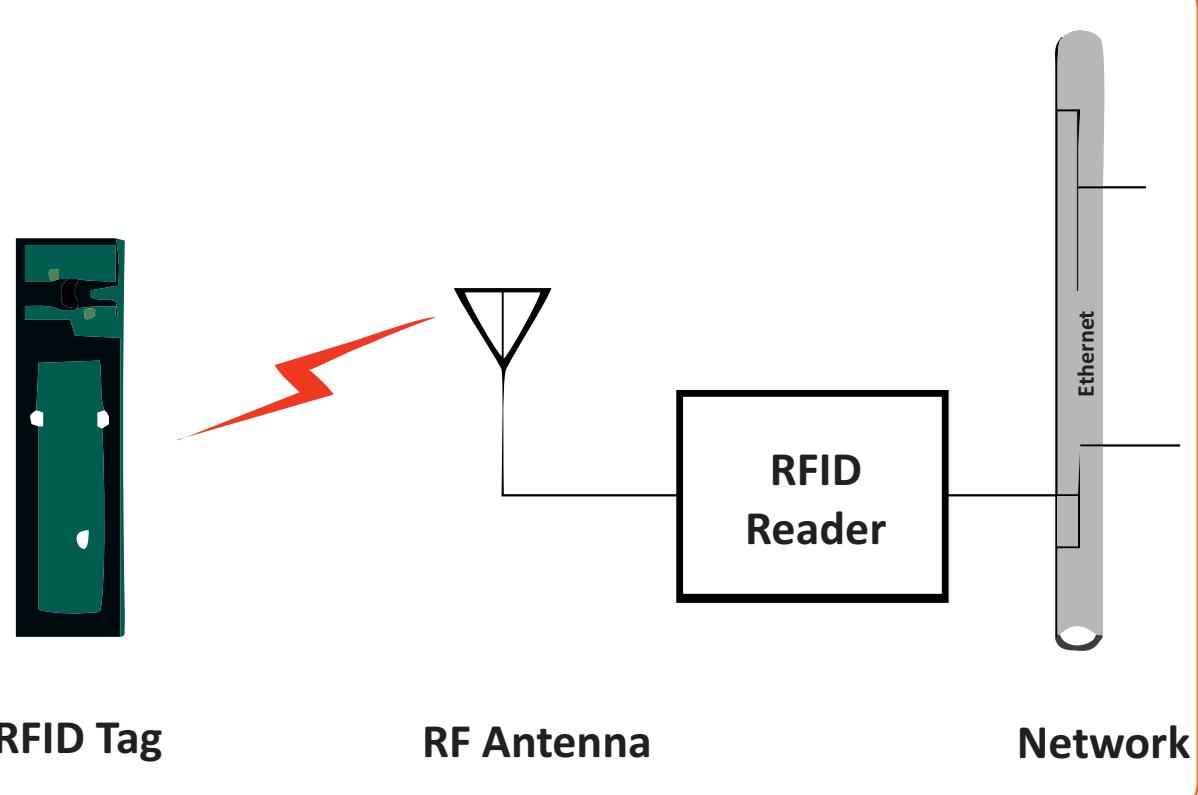


Fig.4.3 – RFID integration to internet

- Wired LAN may be used and the internet access is through the Ethernet
- Tags are to be attached to the BP monitor. Two types of tags are available i.e., Passive and active tags.

Passive Tags

- Do not require power – draw power from the Interrogator field
- Lower storage capacities (few bits to 1 KB)
- Shorter read ranges (4 inches to 15 feet)
- Usually 'Write Once Read Many'

Active Tags

- Battery powered
- Higher storage capacities (512 KB)
- Longer read range (300 feet)
- Typically can be rewritten by RF Interrogators

- It is preferred to use active tags.
- Integration of RFID is illustrated below:

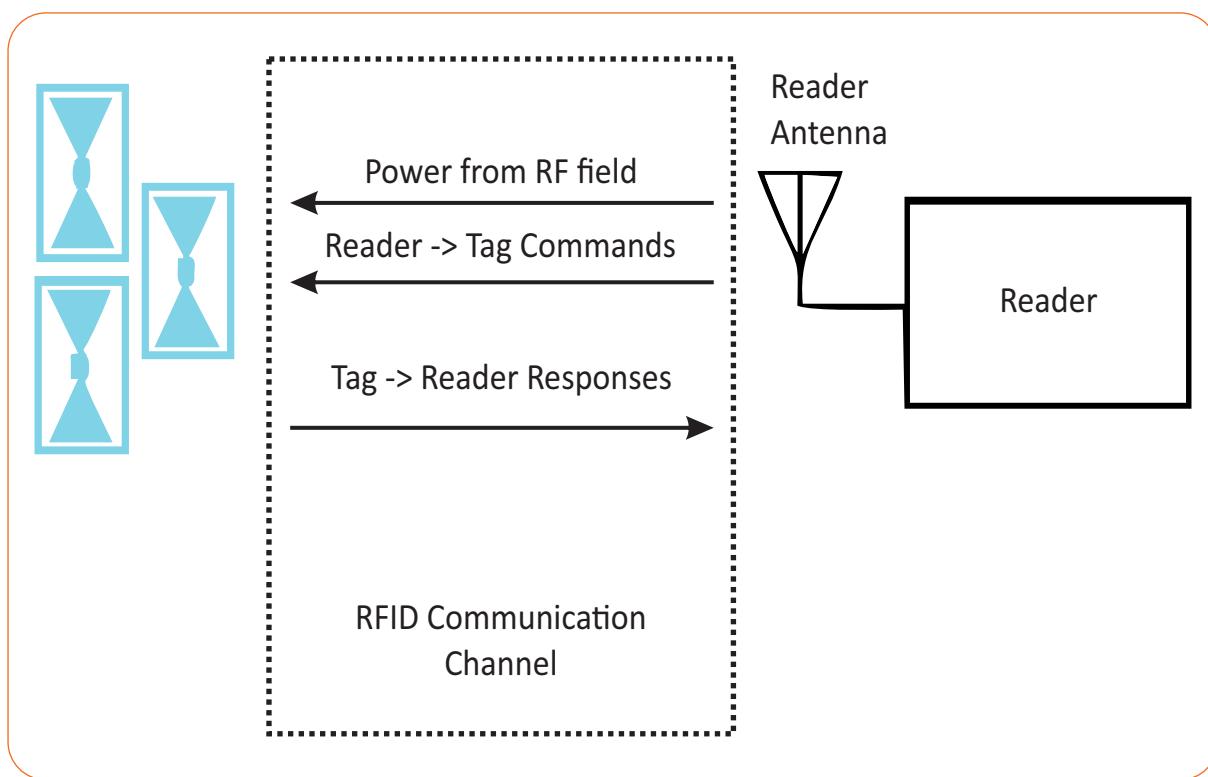


Fig.4.4 – RFID integration to reader

- The IoT Protocol used is RFID linking to Ethernet
- BP monitor is the connected device with RFID

4.1.3 Data Gathering

In a Hospital or outpatient environment a number of BP monitor devices may be connected to the Internet through a RFID reader and data collected by the machine is uploaded via an Internet gateway to a cloud based storage server. This data is shared and processed by an application layer and made available to authorised users like medical and hospital staff. Output is used for medical diagnosis and resulting treatment advice and alerts are transmitted to patients and patient responders via the cloud and internet gateways to mobile devices.

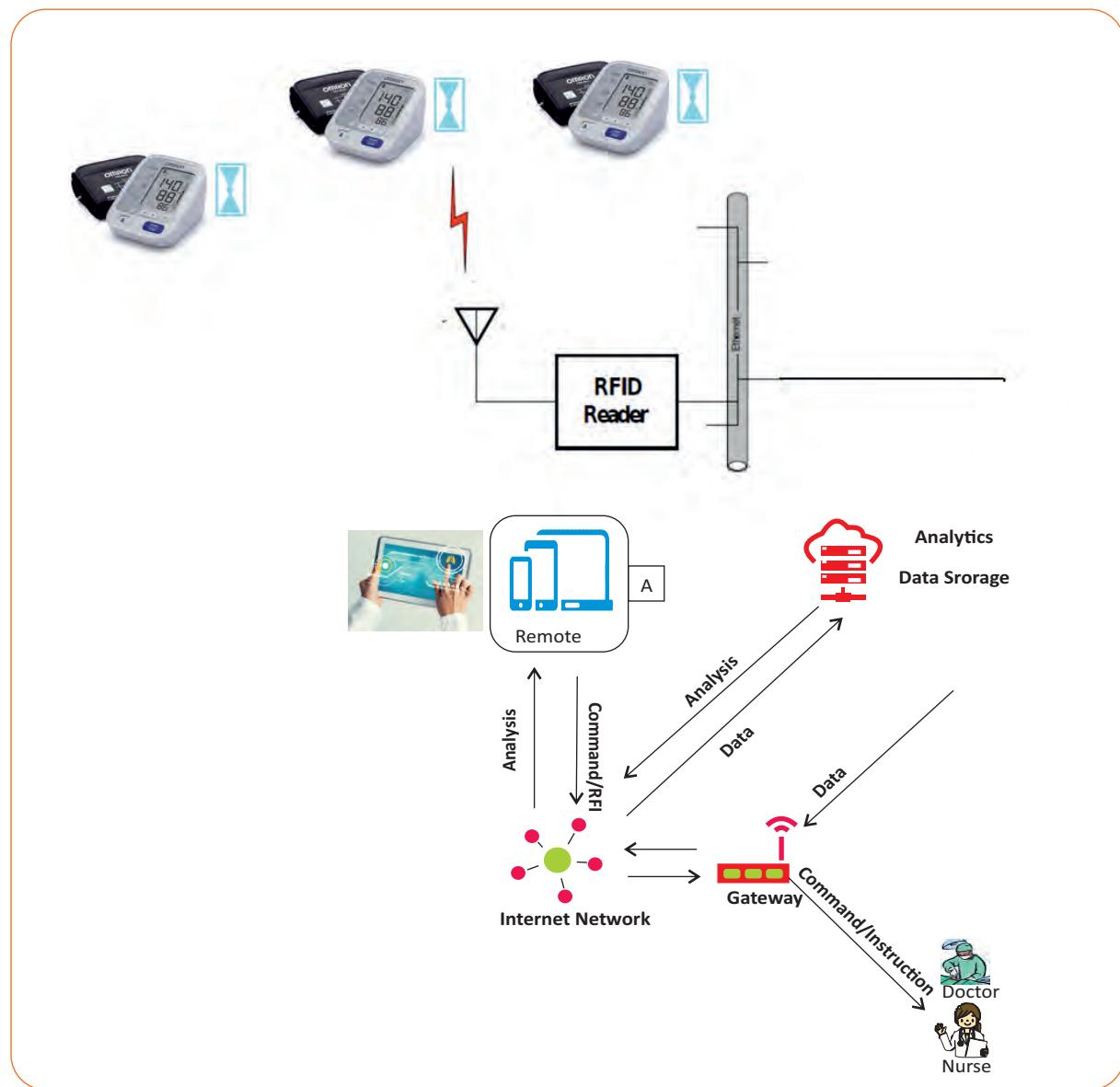


Fig.4.5—BP monitoring integrating to healthcare system of IoT

4.1.4 Security

The cyber security posture of medical devices has increasingly become a concern to healthcare providers, device manufacturers, regulators and patients. Due to their long useful life, unique care-critical use case and strict regulatory oversight, these devices tend to have a low security maturity, significant vulnerabilities and an overall high susceptibility to security threats.

Potential risks:

Typical risks of security breaches and compromise of data can be broadly categorized as:

- **Theft of Patient records** including Patient Health Information (PHI) , social security numbers, passwords, billing details, insurance records, etc. which can be used to cause damage to privacy and financial loss to stakeholders.
- **Ransomware and malware attacks** on the critical life and health support systems through connected devices like wearables, in-plants, portable and mobile devices.
- **Malfunction and infection of critical devices** in a patient health support system causing malfunction or disablement due to malware which can put patients at risk.

Some Proposed Measures:

- **For mobile and wearable devices:**
 - Enabling remote lock and wipe, to easily remove unauthorized users from the enterprise system or to erase content of the device in case of theft
 - Ensure secure authentication, secure boot and access management of the device
 - Enforcement of data encryption
 - Enforcement of device-level passwords
 - Monitoring the operating system's integrity to avoid jailbreak and rooting procedures
 - Secure email and attachments to prevent malware being spread from personal accounts
 - Prevent installation of untrusted apps
 - Log devices and actions for audit and manage allowed access of mobile assets
- **For device manufacturers:**
 - Take steps to limit unauthorized device access to trusted users only, particularly for those devices that are life-sustaining or could be directly connected to hospital networks. Appropriate security controls may include: user authentication, for e.g. user ID and password, smartcard or biometric; strengthening password protection by avoiding hard-coded passwords and limiting public access to passwords used for technical device access; physical locks; card readers and guards.
 - Protect individual components from exploitation and develop strategies for active security protection appropriate for the device's use environment. Such strategies should include timely deployment of routine, validated security patches and methods to restrict software or firmware updates to the authenticated code.

- Use design approaches that maintain a device's critical functionality, even when security has been compromised, known as "fail-safe modes".
- Provide methods for retention and recovery after an incident, where security has been compromised. Cyber security incidents are increasingly likely and manufacturers should consider incident response plans that address the possibility of degraded operation and efficient restoration and recovery.
- **For healthcare facilities:**
 - The FDA is recommending that steps should be taken to evaluate network security and protect hospital system.
 - In evaluating network security, hospitals and healthcare facilities should consider:
 - Restricting unauthorized access to the network and networked medical devices
 - Making certain that appropriate antivirus software and firewalls are up-to-date
 - Monitoring the network activity for unauthorized use
 - Protecting individual network components through routine and periodic evaluation, including updating security patches and disabling all unnecessary ports and services
 - Contacting the specific device manufacturer if there is a cyber security problem related to a medical device. If you are unable to determine the manufacturer or cannot contact the manufacturer, the FDA and DHS ICS-CERT may be able to assist in vulnerability reporting and resolution
 - Developing and evaluating strategies to maintain critical functionality during adverse conditions

4.1.5 Basic Equipment Required for Model

The basic requirements for this application are:

- Microcontroller
- LCD panel display
- PS board
- Sphygmomanometer
- RFID Tag
- RFID Antenna
- RFID Reader

UNIT 4.2: Use Case 2 – Remote Patient Monitoring

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Remote Patient Monitoring' IoT application
2. Describe various features of 'Remote Patient Monitoring'
3. Describe how the 'Remote Patient Monitoring' works

4.2.1 Scenario

The healthcare sector is growing at a rapid pace and the need for reliable health services is also in demand. In India national spending for Healthcare has reached up 4.7% of GDP. Healthcare costs are on the rise globally. The two major pointers of healthcare sector are quality of the products offered and the access to good healthcare centers. The growing burden of chronic diseases is driving healthcare players to look for alternative ways to help patients with chronic illness in managing their condition.

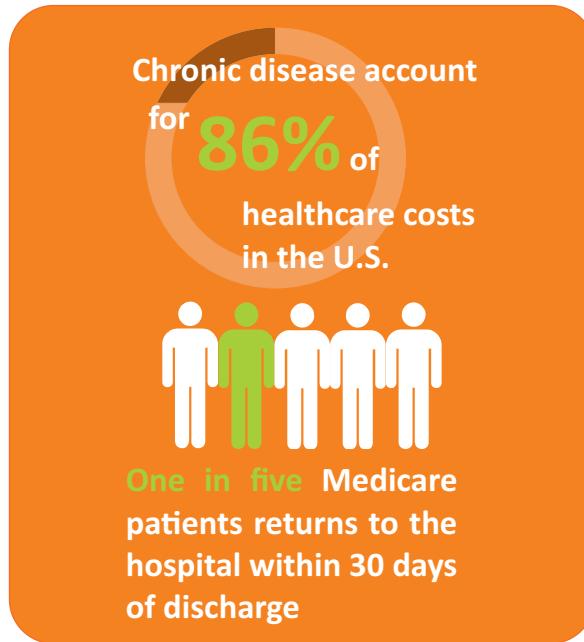


Fig.4.6 – Data on chronic diseases

Home monitoring mechanism wherein physicians and patients are closely connected is being adopted in developed countries. This system promotes adherence to treatment and ensures that an early action can be initiated. This system also reduces the cost of hospitalization.

Tele-health applications remotely connect providers and patients. This system utilizes remote monitoring devices and electronic recorders.

Benefits of remote healthcare solutions:

- Reduced hospital re-admissions and lengths of stay
- Fewer emergency room visits
- Lower cost of chronic disease care
- Improved self-management of health conditions
- Timely, affordable and convenient access to care, wherever and whenever it's needed
- Proactive support when it is medically necessary
- Enhanced patient quality of life

4.2.2 Design

Remote Health Solutions involve integration of 3 functions	
Collect	The Sensors
Transmit and Aggregate	The Gateway
Transmit and Analyse	Big Data
Notify	Visualization

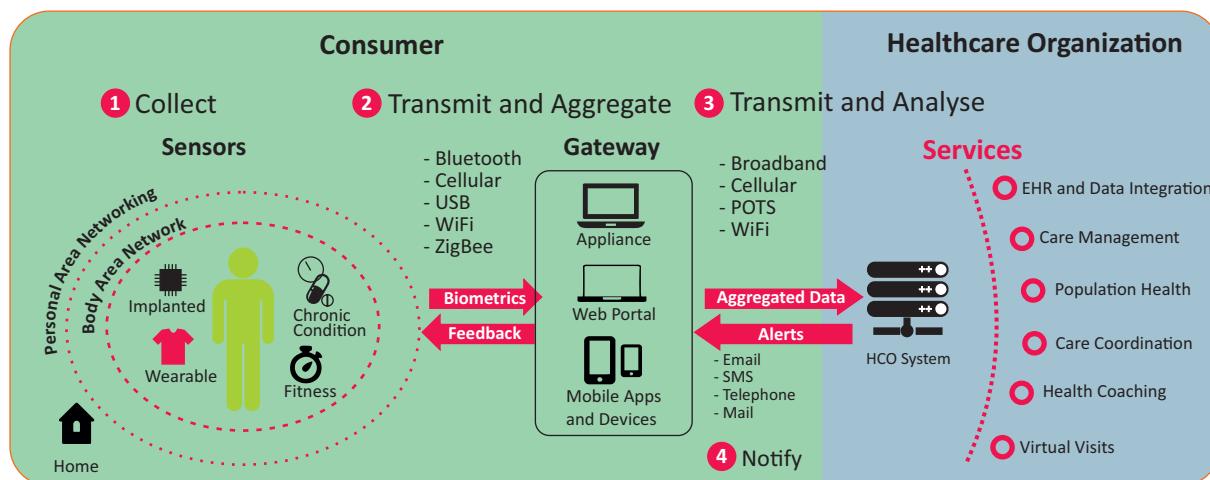


Fig.4.7 –Remote health solution depiction

4.2.3 Data Gathering

Collect - The Sensors:

Wearable sensors, such as activity monitors and clinical wearable devices, are used in this solution. Such sensors provide biometric and fitness data. This data is communicated directly to a gateway for integration with the patient record or to a big data platform running in the cloud for use in advanced analytics.



Fig.4.8 – Wearable technology

Transmit and Aggregate - The Gateway

The gateways enable multiple medical devices to communicate back to the healthcare organisation.

Application software runs in the edge gateway and edge gateways transmit the data to the healthcare organization. The gateways also help in encryption of data from peripherals, update controls, secure device pairing, etc.

Transmit and Analyse - Big Data

The complex data is transmitted to cloud service for advanced analytics. This advanced analytics leads to meaningful interaction with the patient and the customer care provider.

Notify - Visualisation

Some graphics tools such as dashboards, portals and mobile applications are built into the system.

4.2.4 Basic Equipment Required for Model

The basic requirements for this application are:

- Wearable sensors like activity monitors, wearable devices
- Gateways, etc.

Acronyms used in this unit:

BP	Blood Pressure
IoMT	Internet of Medical Things
LAN	Local Area Network
NFC	Near Field Communication





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5. Use Case - Aerospace

Unit 5.1 – Control, Data Linking and Monitoring



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Control, data linking and Monitoring for UAV' IoT application
2. Describe various features of 'Control, data linking and Monitoring for UAV'
3. Describe how the 'Control, data linking and Monitoring for UAV' works

UNIT 5.1: Use Case 1 – Aerospace – Control, Data Linking and Monitoring of Unmanned Aerial Vehicle and Drone

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Control, data linking and Monitoring for UAV' IoT application
2. Describe various features of 'Control, data linking and Monitoring for UAV'
3. Describe how the 'Control, data linking and Monitoring for UAV' works

5.1.1 Scenario

Unmanned Aerial Vehicles (UAVs) are at the forefront of an evolution. These unmanned systems are no longer primarily associated with war and combat situations. With a deadline of Sept. 15, 2015 for full integration into U.S. airspace, it is highly likely that UAVs will play an increasing role in their critical infrastructure operations.

Industries such as public safety, land/ crop surveying and oil /gas are being eyed as key markets that can benefit from the use of unmanned systems for monitoring and surveillance. For several applications such as wildfire monitoring and border protection, UAVs can even be used to protect people and save lives.

The related system for the IoT application for UAVs is targeted towards the Avionics for flight control and data link and mission monitoring systems. The onboard Flight controller receives and transmits flight data to the ground base station to enable the control of the flight parameters and achieve mission objectives. The data link acquires data from video and camera sensors which is fed to the base station for analysis and record. Video data may also be used for manual mission control of the aircraft or with the auto pilot mode. The IoT systems may enable 'aircraft to aircraft' and 'aircraft to base' communication.



Fig.5.1 – Unmanned Aerial Vehicle

5.1.2 Design

Avionics and data system architecture with sensors:

The architecture of the system is illustrated in the block diagram shown below.

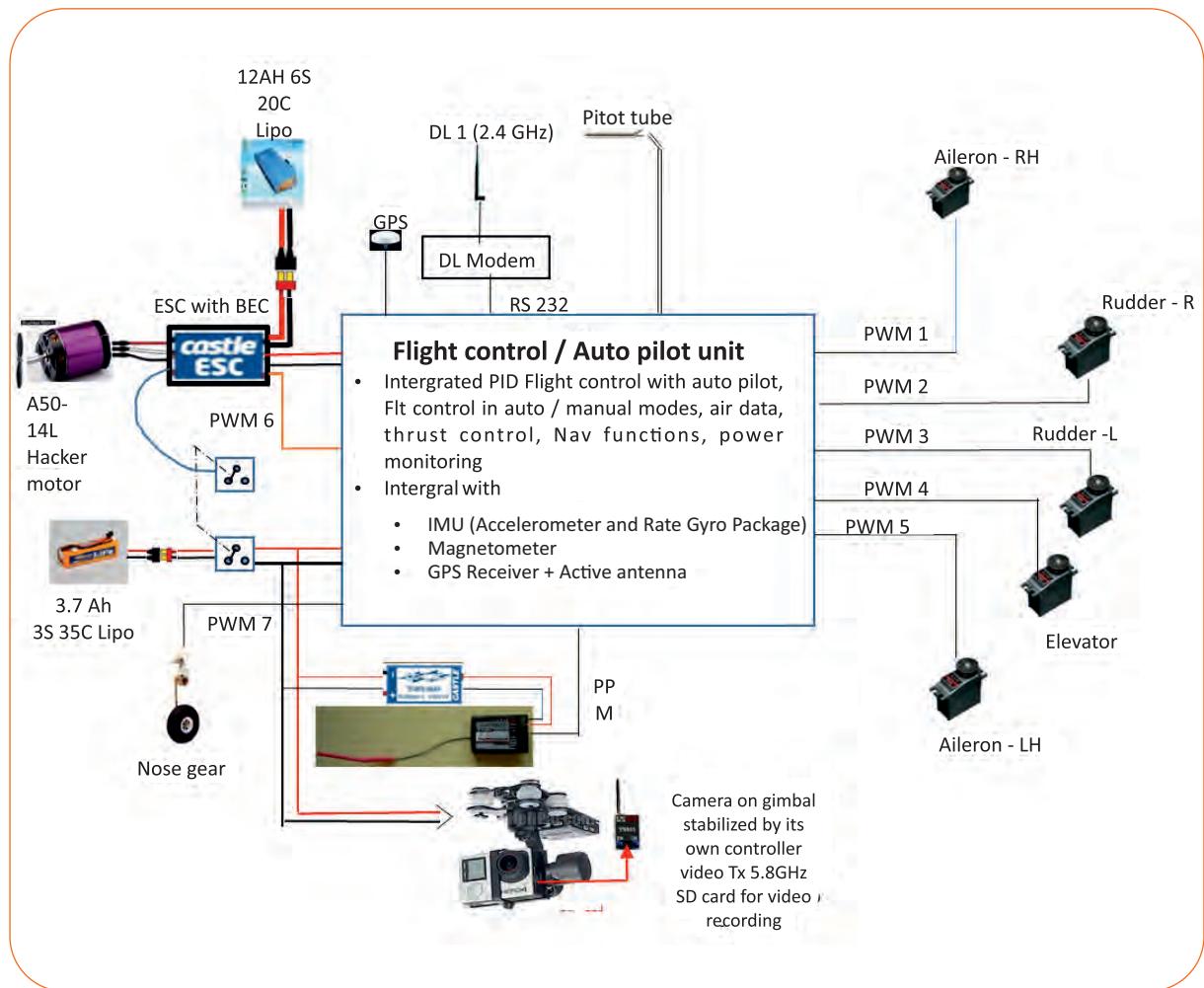


Fig.5.2 – Flight control and data links with sensors and actuators

The electrical power for the UAV systems is managed by two Lithium Ion Batteries for powering the propulsion motor through Electronic Speed controller (ESC) and other avionics. The other battery is used to provide power to avionics and also acts as a backup power during critical situations.

Typical mission profile is illustrated below.

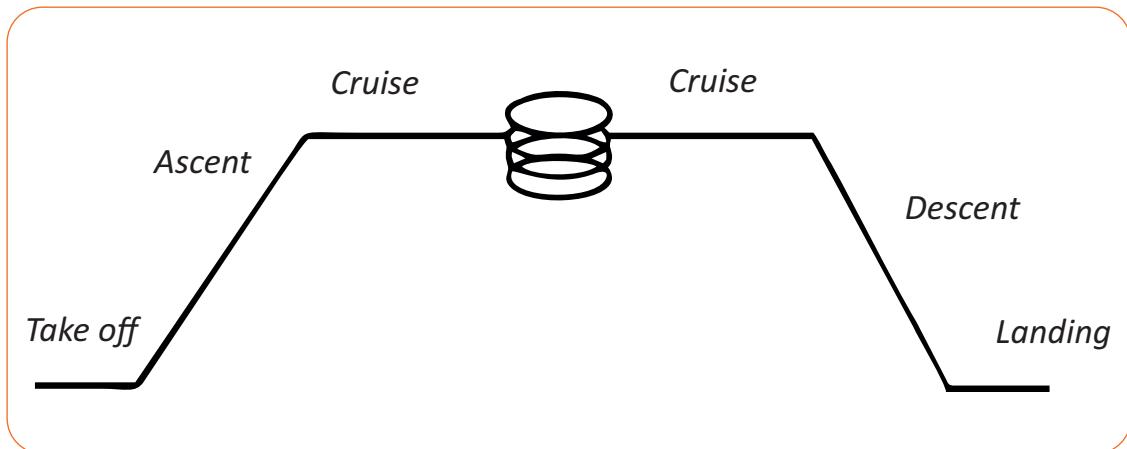


Fig.5.3 – UAV operation profile -2 Hrs 10 km radius

Propulsion system:

The Propulsion system is driven by an electric motor. An electronic speed controller (ESC) with current control capability is used for speed control of the motor. The ESC with a BEC (Battery Eliminator Circuit) is chosen to provide a redundant power supply to the Auto pilot. This takes care of a single point failure due to the power supply in completing the mission by the UAV.

5.1.3 Data Gathering

Monitoring and Flight Control / Auto Pilot (FC/AP) Unit:

The Flight Control /Auto Pilot unit is the heart of the UAV system. It is a micro controller based intelligent unit capable of ensuring stable flight profile of UAV in line with the inputs received from the data link. This implements a PID (Proportional Integral and Differential) control law to evolve the control commands for the control surfaces i.e., ailerons, elevator rudder and propulsion motor. The PID controller reads sensor inputs and then computes the desired actuator output by summing up the calculated proportional, integral and derivative components from the responses. The controller is tuned for the optimum performance either through simulation or through test results or both. All the control commands are in the form of PWM signal with varied ON - OFF duty cycle for different rates.

The following sensor inputs support to the control law for flight control and auto piloting:

- Rate inputs from the 3 axis accelerometers and gyro package
- Air data from pitot static pressure sensor
- Heading from 3 axis magnetometer and GPS
- Navigation inputs from GPS

The FC/AP unit houses the rate gyro and accelerometer pack (Inertial Measuring Unit – IMU), the magnetometer, the GPS receiver with an active antenna. Additional external GPS antenna will improve the GPS reception. Hence an external GPS antenna is also added. A pitot tube mounted at the leading edge of the wing is integrated to FC/AP to support the navigation function and air data measurement and calculation. The FC/AP have to be located at the Centre of Gravity (CG) of UAV for correct sensing of the rate inputs.

Apart from flight control and auto piloting the FC/AP performs the following functions:

- Monitor the Electrical power supply voltage and current for the propulsion motor and its rpm
- Release signal (PWM) for the parachute
- Storage of the flight plan
- Data logging
- Nose wheel steering

10 servo drives are used by the AP for the following controls:

- Rudder LH
- Rudder RH
- Aileron LH
- Aileron RH
- Elevator
- Nose wheel steering
- Propulsion motor rpm control

Video Transmitter Unit:

A camera sub system is interfaced with a video transmitter unit and operates at 5.8GHz.

5.1.4 Data Communication and Analysis

This will enable the sharing of information and collection of data from UAVs at different locations for monitoring. Each UAV will be a device with internet connectivity. Actions can be pre-programmed for operation in autonomous mode as is the case for defence or disaster response systems.

The UAVs are flown with pre-programmed flight plan so that they are self-contained in their flight path and land automatically at the end of the plan. The data covering the onboard system status alerts and the images they capture are shared through GPRS, Wi-Fi and internet connectivity.

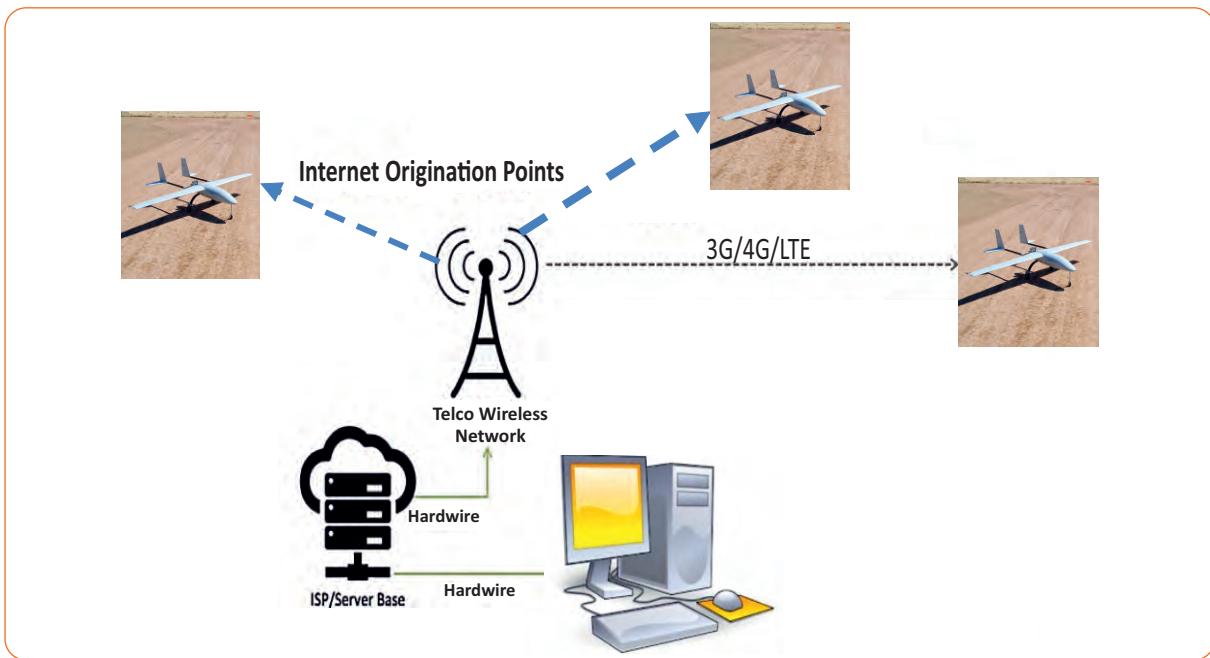


Fig.5.4 – Group of UAV control system

The IoT application Outline, Analysis and Outputs

- The connected devices are UAVs with their onboard sensors and ground controllers.
- For the design of IoT, the electronic controller in the UAV has to be interfaced to GPRS for Wi-Fi connectivity.
- Wi-Fi is chosen for the communication model as enabling technology for the IoT because of the data rate.
- For video streaming and data refresh, high data rate will be required.
- Though it has a smaller range compared to Sigfox or OnRamp, the data rate is the deciding factor. The range however can be met because of the availability of the mobile towers.
- The data from UAVs with IDs will be available on the internet for user view at a remote center.
- The following data of the UAV will be monitored at the remote location and enabled through IoT.

- **UAV:** Id, Attitude of UAV – Pitch, Roll, Yaw, Heading, Location (GPS), Video (as captured by UAV), Ground speed.

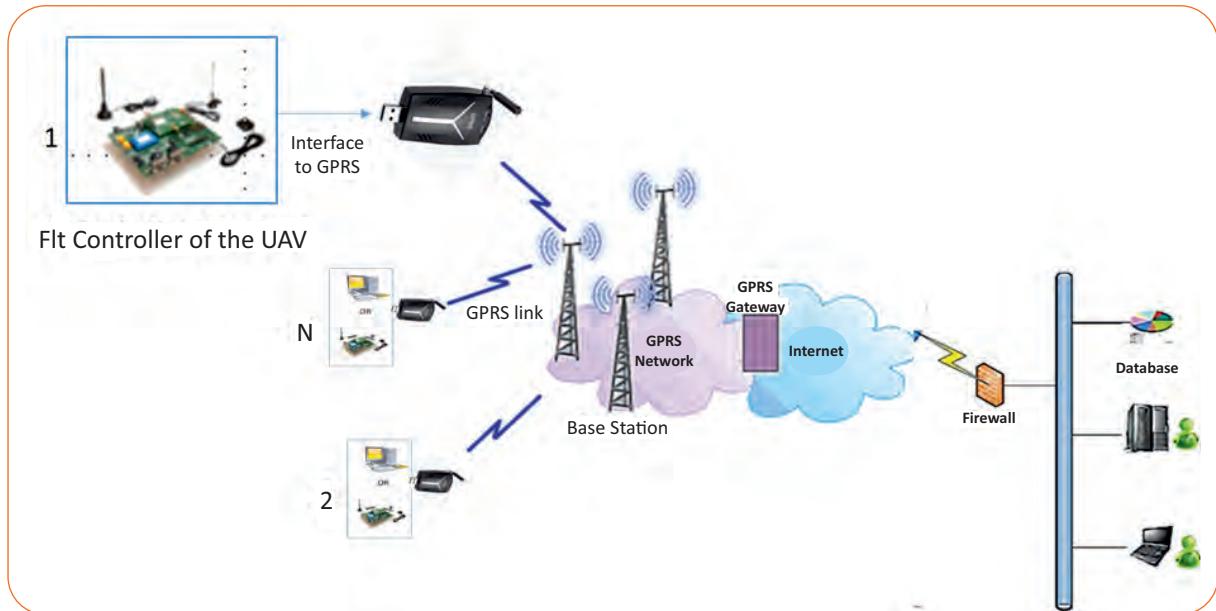


Fig.5.5– IoT Scheme for UAV

5.1.5 Security

The access is protected and secured for the authorised stake holders with passwords and encrypted data links. Safety is the top priority for agencies like the FAA for the operation of UAVs and Aircraft particularly as it relates to secure and reliable Command and Control (C2) links and sense and avoid tactics. Aircraft without reliable (C2) links are vulnerable to mission failure, hazardous flight and hacking.

There are a number of (C2) link solutions which have been used. Machine to Machine (M2M) wireless solutions are also available using multiple frequency options.

Some of the Key considerations for secure (C2) links that need to be incorporated are:

- Access control measures by Authentication, Authorization and Accounting offered with secure access control prevents unauthorized intrusion and hacking.
- Advanced Data Encryption and the Federal Information Processing Standards (FIPS) which specify publication 197 for Advanced Encryption Standard (AES) for cryptographic algorithms to protect electronic data. FIPS 140 specifies 4 levels of security for cryptographic modules from 1 to 4 each building on the previous level and adding stricter measures.

- Advanced wireless technologies like frequency hopping spectrums that can hop to avoid detection and multiple user defined cryptographic keys which allow user to change key positions on demand.
- Use of established wireless service providers who can provide secure networks with the above enablers.

5.1.6 Basic Equipment Required for Model

The basic requirements for this application are:

- Video and Camera sensor
- Flight Control/ Auto pilot unit
- PWM
- DL modem
- Pilot tube
- ESC with BEC
- A50-14L hacker motion
- 3.7 Ah 3S35C Lipo

Acronyms used in this unit:

AES	Advanced Encryption Standards
AP	Auto pilot
BEC	Battery Eliminator Circuit
C2	Command and Control
CG	Center of Gravity
ESC	Electronic Speed Controller
FAA	Federal Aviation Administration
FC	Flight Control
FIPS	Federal Information Processing Standards

GPRS	General Packet Radio Service
GPS	Geographical Positioning System
IMU	Inertial Measuring Unit
M2M	Machine to Machine
PID	Proportional Intelligent Differential
UAV	Unmanned Aerial Vehicle



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6. Use Cases - Transportation

Unit 6.1 - Smart Transportation



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Smart Transportation' IoT application
2. Describe various features of 'Smart Transportation'
3. Describe how the 'Smart Transportation' works

UNIT 6.1: Use Case 1 – Smart Transportation

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Smart Transportation' IoT application
2. Describe various features of 'Smart Transportation'
3. Describe how the 'Smart Transportation' works

6.1.1 Scenario

Smart transportation is the result of technological advancements in mobile terminals and automotive electronics. This intelligent system is generating huge data in urban areas and posing a challenge for data storage and data analytics.

The real time intelligent system is designed to analyze the following:

- **Vehicle recognition** – plate number, plate colour, car body color, car logo etc.
- **Clothing feature recognition** – clothing colour of upper and lower body
- **Face detection** – face detection in the image
- **Behavior detection** – running, hitting the line, intruding the region, going against the traffic rules



Fig.6.1 – Vehicular traffic

A special system needs to be designed to handle the challenge of data storage and data analytics

Let us take the scenario of Beijing:

- 10 million travelers everyday
- 50 million urban transportation cards/day
- Over 9 million vehicles per day
- Over 1,00,000 operating vehicles GPS monitoring data
- Nearly 10,000 fixed detectors
- 100 million pieces of communication data/day

How to manage such huge data?

This is possible with 'smart transport' solution.

Urban traffic is producing data at every moment.

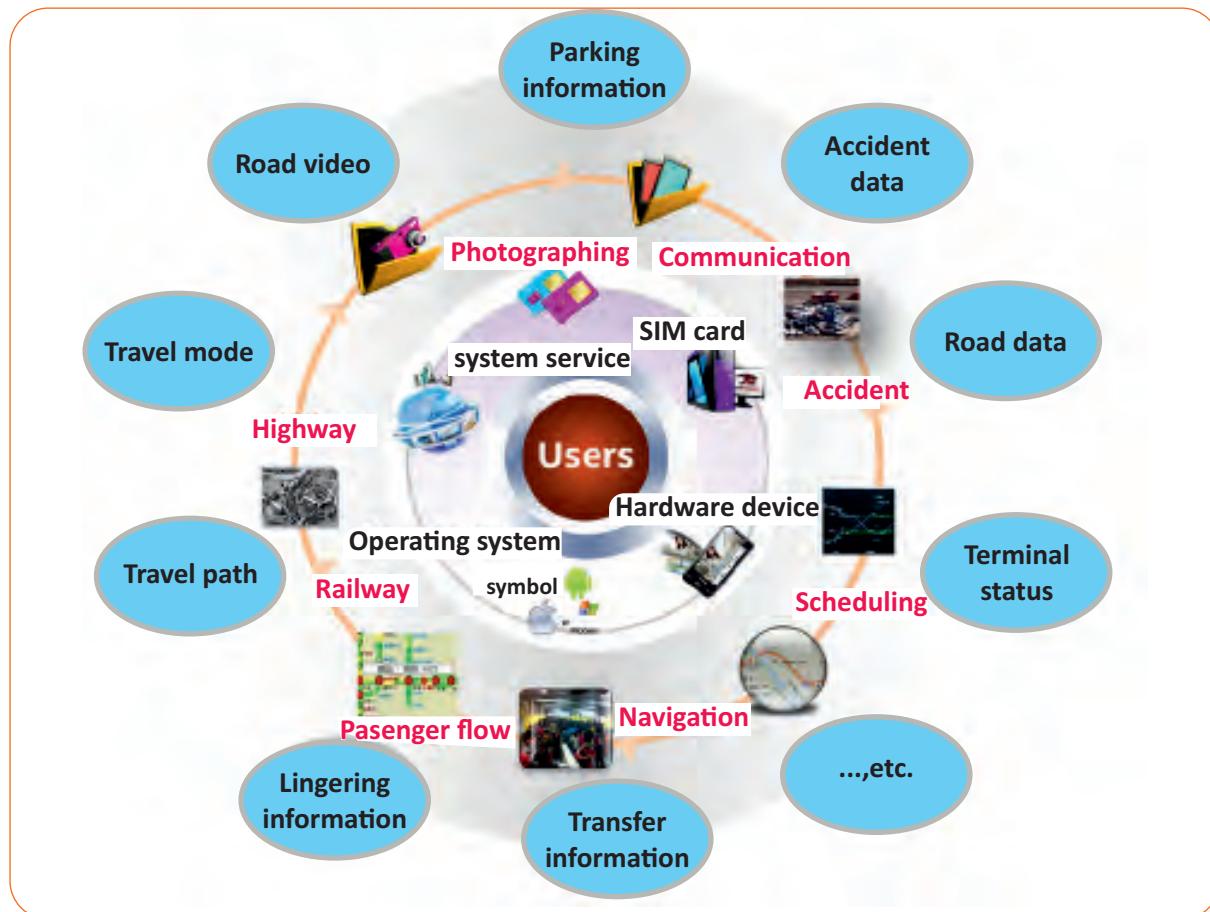


Fig.6.2 – Smart transportation architecture

This transport solution provides a good platform for data storage and analysis.

6.1.2 Design

This transport solution uses frontend devices like web camera and NVR (Network Video Recorder) and backend devices like data centers. Data acquisition and data storage are considered as frontend tasks and data analysis as a backend task.

Frontend technology:

Intel Atom and Intel Core processor platforms are used considering high performance, high reliability and high scalability. The intelligent network video recorder which is compatible to Intel processor is used.

The intelligent network video recorder will have a unique IP address. Some specifications of such recorders are provided below:

- 128-way HD access
- 348 Mbps access
- 256 Mbps storage
- 384 Mbps forwarding
- To support advanced video coding format (H.265/H.264/MPEG4/2-way HDMI and 1-way VGA)

Backend technology:

Big data processing technologies such as Spark and Hadoop architecture is used for real-time data acquisition and summary. Real-time data analysis and offline mining of large data can also be processed using the same architecture.

Big data processing system includes:

- Batch Layer
- Speed Layer
- Servicing Layer

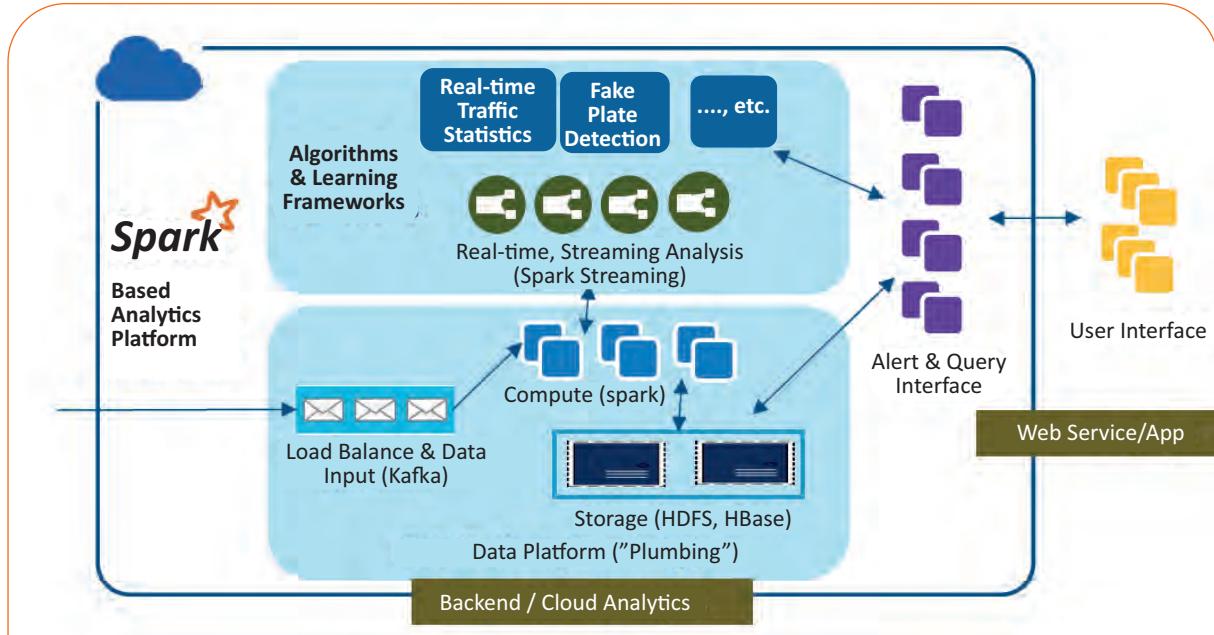


Fig.6.3 – Backend/Cloud analytics

6.1.3 Data Gathering

We have seen that big data processing system includes 'Speed Layer', 'Batch Layer' and 'Servicing Layer'.

Now we will see tasks performed by various layers of big data processing system.

Speed Layer

The following tasks are performed by the Speed Layer:

- Real-time streaming analysis
- Process streaming data received from devices
- Advanced analytical application

The real-time data will be saved as Hbase and is called as 'History data'.

Batch Layer

Spark computing engine is utilized for batch pre-computation of data. The results of pre-computation are stored in Hbase. This data can be used by Servicing layer.

Servicing Layer

The Servicing layer can check the history data and batch processing view through Hbase interface. Servicing layer can also use Spark or Spark SQL computing engine to realize statistical query function.

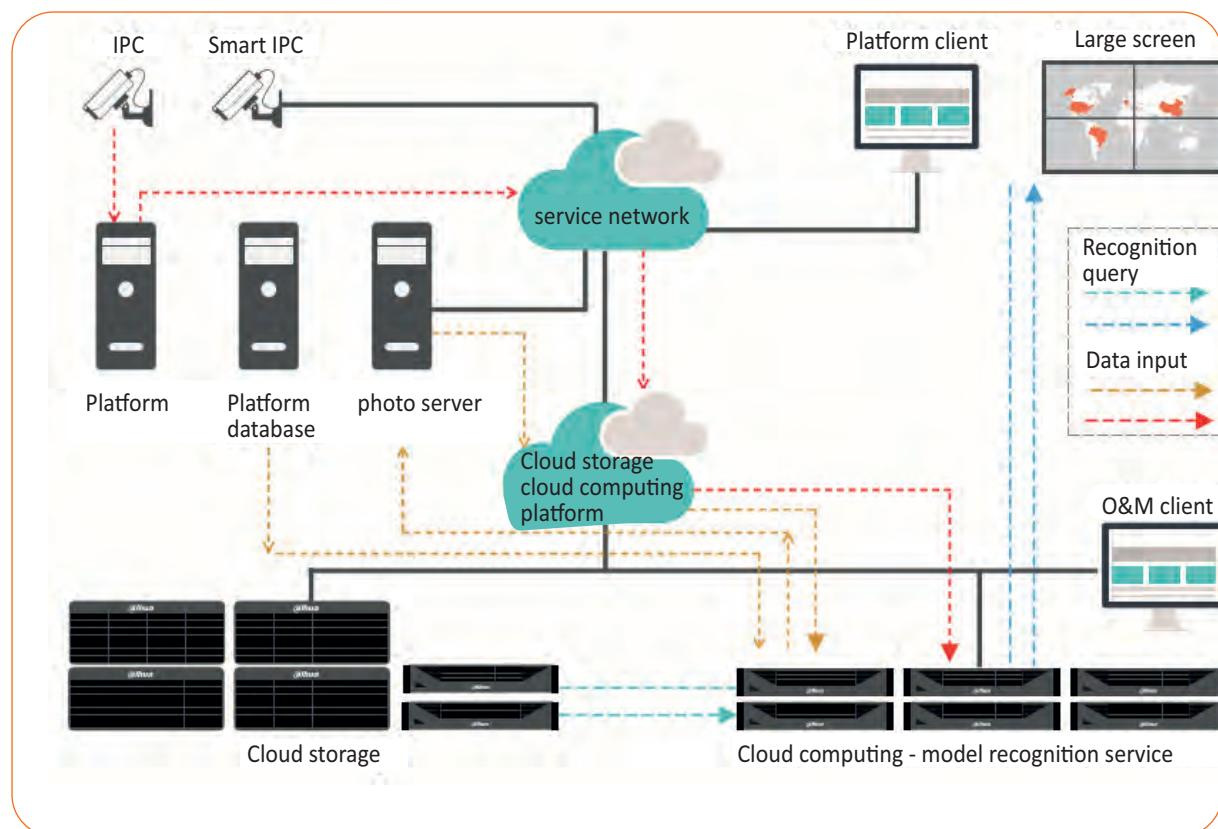


Fig.6.4 – Servicing layer

The Spark system architecture can perform activities like processing, streaming computing and real-time analysis. Interactive computing can support more complex machine learning and image processing algorithm.

Results :This system is successfully implemented in one big city and has the capacity to process 1.5 million pieces of data each day

6.1.4 Basic Equipment Required for Model

The basic requirements for this application are:

- Spark based Analytics platform
- Intel Atom and Intel core processor
- NVR- Network video recorder
- Web camera
- Cloud storage and computing
- Service network



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7. Use Cases - Energy

Unit 7.1 - Smart Mesh

Unit 7.2 - Condition Based Maintenance of Distribution Power Transformers



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Smart Mesh' IoT application
2. Describe various features of 'Smart Mesh'
3. Describe how the 'Smart Mesh' works
4. State the importance and benefits of 'Condition Based Maintenance of Distribution Power Transformers' IoT application
5. Describe various features of 'Condition Based Maintenance of Distribution Power Transformers'
6. Describe how the 'Condition Based Maintenance of Distribution Power Transformers' works

UNIT 7.1: Use Case 1 – Smart Mesh

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Smart Mesh' IoT application
2. Describe various features of 'Smart Mesh'
3. Describe how the 'Smart Mesh' works

7.1.1 Scenario

Electrical grid is a network of devices functioning together to transmit the electricity from one location to another. Lots of challenges have been discovered over the years that bring out the need for automation, digitization and analytics in most functions of the grid. To make a grid smart, it is required to make each and every unit smart (communication enabled and connected most of the time).

One can imagine the amount of data being generated from each electricity meter and being transmitted to a centralized location as well as the time required to process this huge amount of data. An important aspect of smart grid is a strong communication backbone that should enable collection of data from each meter with minimum latency.

This is an end to end implemented solution to digitally monitor overall operations of a smart grid. It ensures that all devices in a smart grid are connected all the time on a wide area communication network.

7.1.2 Design

Below are important component of our solution:

A. Hardware

1. Wi-Fi communication module for meters

- This is used to make electricity meters smart by enabling communication.
- These Smart Meters act as **internet hubs**, providing connectivity to households.
- They are also an additional source of revenue for utility providers.

2. Edge Gateway to be mounted on transformer

- It is used to collect data from each meter and authenticate meters for entering into Wi-Fi mesh.
- It monitors health parameters of transformer such as top oil temperature, bottom oil temperature etc.
- It uses a magnet mounting arrangement to install gateway without any mechanical work.

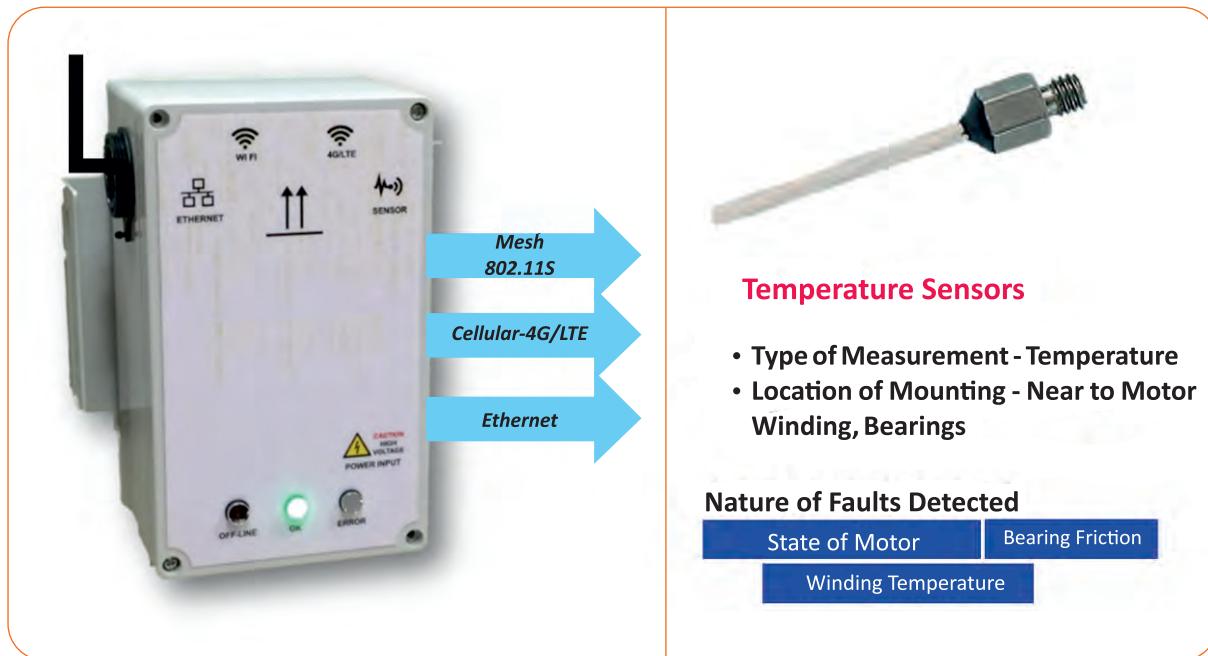


Fig.7.1 – Smart mesh

Fig.7.2 – Temperature sensor

B. Software

1. Firmware for edge gateway

- It is the embedded analytics algorithms for data cleansing, preparation and preprocessing.
- It forwards data to centralized database hosted in cloud environment.

2. Reporting Application

- It enables utilities to region wise monitor overall operations including outages, energy theft, billing, communication status, load profiling etc.
- It provides user managements – role based dashboards.

3. Data collection and asset tracking application

- This is an application to configure and manage electricity distribution network.
- It defines hierarchy of device connectivity (electrical as well as communication network).



Tri-axial Accelerometers

- Type of Measurement - Tri-axial caps Vibration
- Location of Mounting - Bearing, Foundation/Overall

Nature of Faults Detected

Misalignment & Looseness	Bearing Friction
Lubrication	Gear Damage



Current Sensors

- Type of Measurement - Current
- Location of Mounting - Input Line
- To Capture the current patterns during Start, stop and continuous operation of equipment

Nature of Faults Detected

Insulation Failure	Winding Failure
Current Leakage	Overloading

Fig.7.3 – Tri-axial accelerometer

Fig.7.4 – Current sensor

C. Communications

1. Implemented 802.11s protocol for communication over Wi-Fi mesh network.
2. Cellular – 3G/LTE connectivity.
3. Ethernet connectivity.
4. Proprietary protocols implemented to form a Wi-Fi mesh network of meters and edge gateway mounted on transformer.
5. Communication modules to transmit data from edge gateway to central location database in cloud environment.

D. Analytics

1. Energy consumption trends at each level i.e. circuit, transformer and meter.
2. Energy theft detection and revenue loss calculations.
3. Outage detection and trends.
4. Communication network response rate monitoring.
5. Critical assets reporting on priority.
6. Load profiling and energy usage.

Digital technology that allows for two-way communication between the utility and its customers. The sensing along the transmission lines is what makes grids smart. The purpose of infusing controls and automation is to respond digitally to our quickly changing electric demand such as:

- More efficient transmission of electricity.
- Quicker restoration of electricity after power disturbances.
- Reduced operations and management costs for utilities and ultimately lower power costs for consumers.
- Reduced peak demand, which will also help lower electricity rates.
- Increased integration of large-scale renewable energy systems.
- Better integration of customer-owned power generation systems, including renewable energy systems.
- Improved security.
- Giving customers control – the right information and tools to make intelligent energy choices and track consumption usage in real-time.

7.1.3 Data Gathering

Software Architecture:

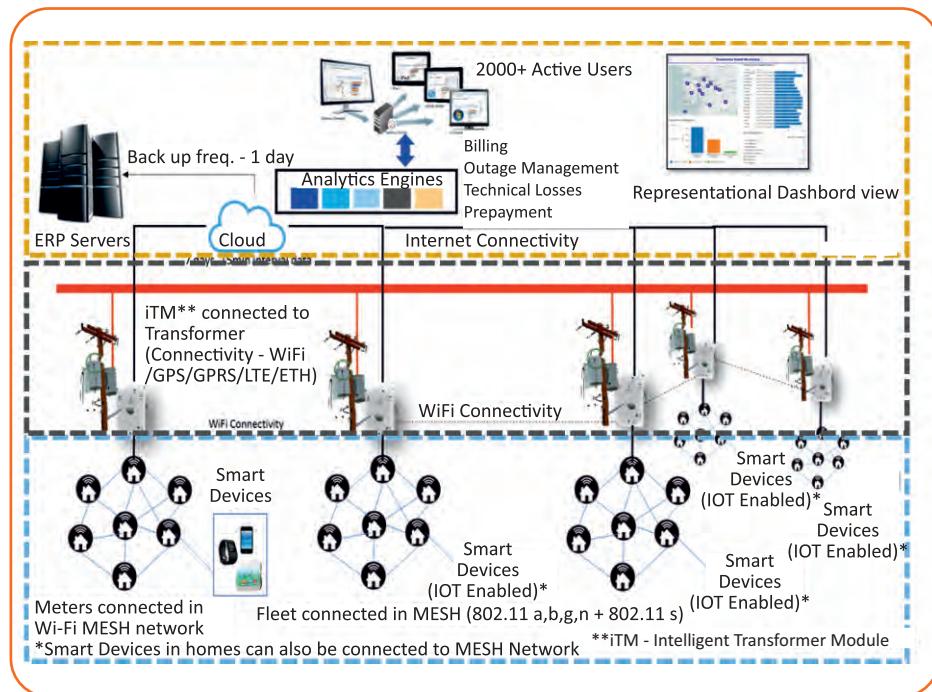


Fig.7.5 – Smart Architecture

There are 3 levels at which data gets generated in an electrical grid:

1. Substation or circuit level (highlighted using red color line)
2. Transformer level (shown using an image of pole mounted transformer)
3. Meter level (connected in a Wi-Fi mesh network)

Special features of this solution:

- **Wireless mesh network:** The solution helps to connect each home to a massive wireless mesh network. Data from individual meters is seamlessly transmitted to the distribution transformers via the shortest and most efficient path. These paths are dynamic and adjust in real-time on account of any malfunctioning in the mesh.

Further reading:

What is a mesh network?

https://en.wikipedia.org/wiki/Wireless_mesh_network

- Smart Meters act as **internet hubs**, providing connectivity to households. It is also an additional source of revenue for utility providers.
- **Connectivity to the entire smart city ecosystem:** Street light control using daylight sensors, clean energy programs, automated tracking and billing at automobile charging points.
- **Single unified interface for energy monitoring:** The entire city's networks of transformers are wirelessly connected and their data is pushed to the cloud in real-time. Operators have access to a single, unified interface to view an entire city's consumption patterns.
- **Analytics for continuous energy supply:** Load profiling and real-time analytics help determine the energy needs to provision for adequate power supply, maintain continuous uptime during peak demand and also control power losses in transmission lines.
- **Remote monitoring of critical power machinery:** At every stage of the power generation and transmission process, critical machinery is remotely monitored in a central control station. Any anomalies are picked up at a nascent stage and rectified during a planned and scheduled maintenance.

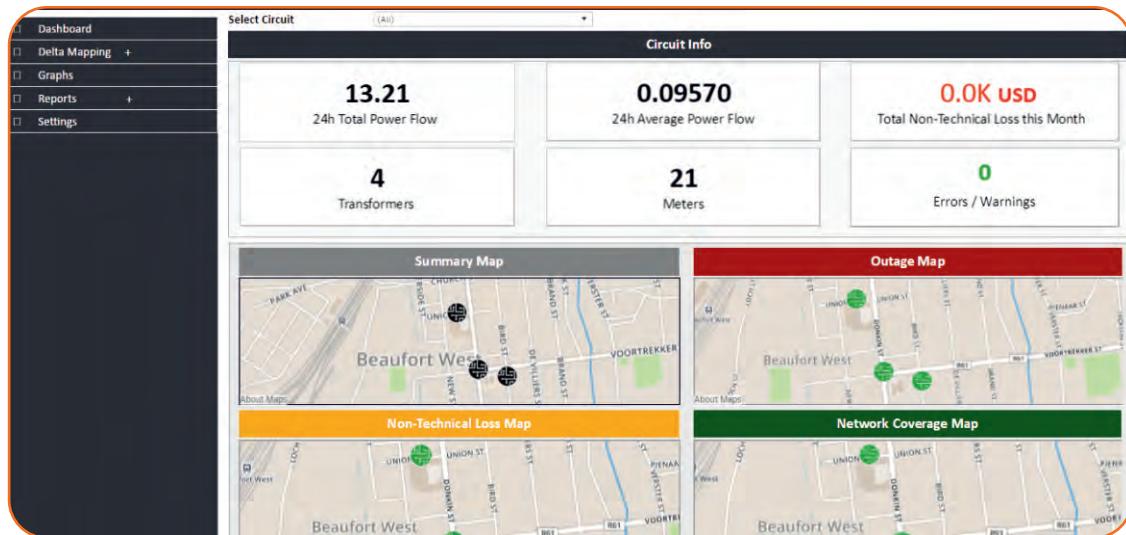
7.1.4 Security

Three Layered Security:

Coupled with advanced data encryption, user authentication into the smart grid system is controlled using a three layer security algorithm.

1. There is a separate network access for consumers and utility providers.
2. Major dashboards are provided for utilities to monitor the operations in below mentioned areas:
 - Overall summary
 - Outages or power failures
 - Non-Technical loss or energy theft
 - Communication network coverage
3. Role based authentications are provided for individual dashboards.

For the demo purpose, current user will have all the read-only accesses of all sections.





7.1.5 Basic Equipment Required for Model

The basic requirements for this application are:

- Wi-Fi communication module for mesh
- Edge gateways
- Temperature sensor
- Customized software
- Tri-axial accelerometer
- Current sensor
- ERP servers
- Smart meters

Unit 7.2: Use Case 2 – Condition based Maintenance of Distribution Power Transformers

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Condition Based Maintenance of Distribution Power Transformers' IoT application
2. Describe various features of 'Condition Based Maintenance of Distribution Power Transformers'
3. Describe how the 'Condition Based Maintenance of Distribution Power Transformers' works

7.2.1 Scenario

Power transformers are an integral part of any power distribution network. Owing to humongous capital and maintenance cost involved for this equipment, there exists a huge scope to optimize expenses thereby improving the revenue.

Where do distribution companies struggle ?

- Unavailability of dashboards or tools to visualize the status of multiple parameters associated with power transformers.
- Unforeseen failures in transformers leading to downtime and penalty.
- Loss of asset life due to continuous faults/failures.
- Poor maintenance planning.
- Unavailability of advanced solutions to monitor the health of transformers.

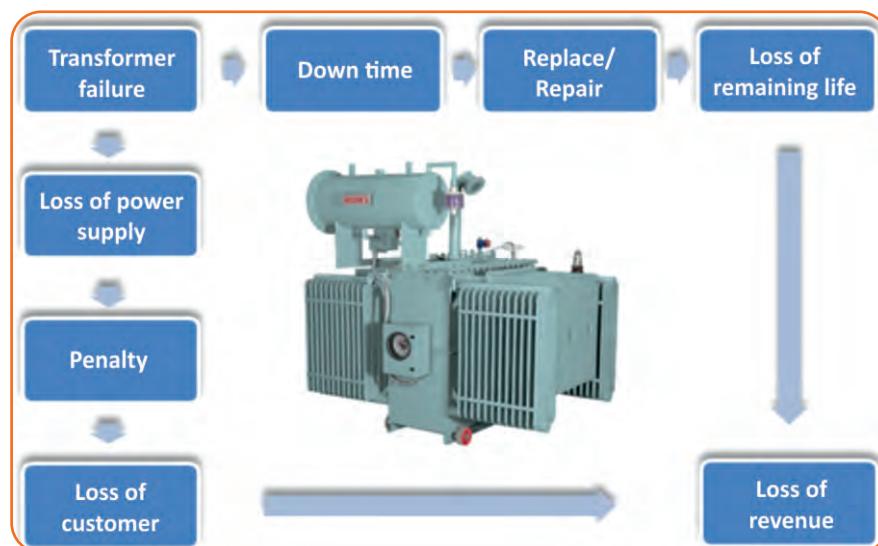


Fig.7.7 – Consequence of Transformer failure

7.2.2 Design

The proposed model dwarfs the limitations with respect to the operator's capability, limited input data, absence of intelligent monitoring devices and inability to correlate multiple test results.

The model is based on developing an adaptive testing/maintenance plan based on the transformer's history and domain expertise instead of adhering to a static testing plan. In this way, the distribution company can optimize maintenance cost and avoid potential failures.

Multiple tests are conducted as per the adaptive testing plan and the results are updated to a central database from which the model fetches data for analysis. The reports are analyzed simultaneously and various calculated parameters are evaluated for determining health index of the transformers. In case of potential faults or failures, the type of fault is identified before evaluating the calculated parameters.

Dashboards are the most important part of this model which visualize the trending of various test parameters and calculated parameters. They customize the quantity of data to be displayed as per the requirement. Based on the analysis, the model updates the adaptive testing plan and the next test date is determined.

Following parameters/tests are considered for this model building:

- Dissolved Gas Analysis (DGA)
- Oil Sample Test (OST)
- Loading history
- Winding Hot spot and Top Oil Temperature
- Degree of polymerization or Furanic compound analysis

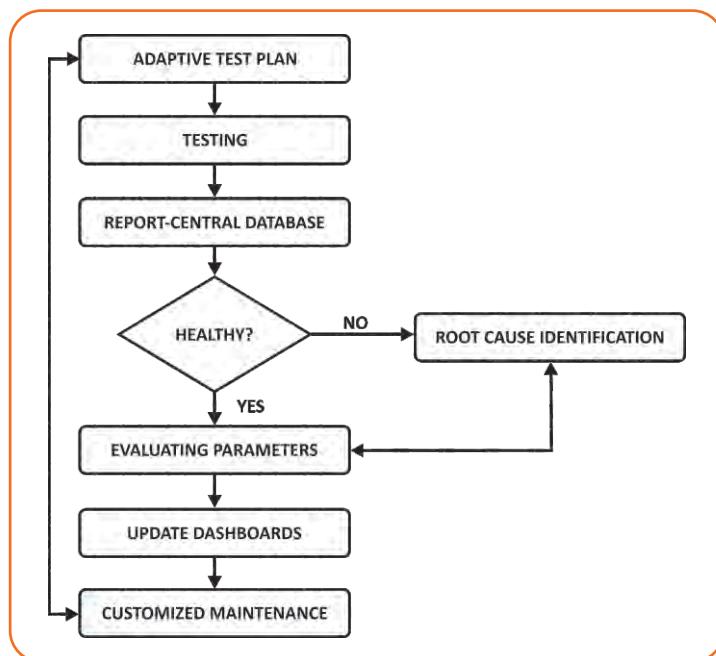


Fig.7.8 – Flow chart of the design

7.2.3 Data Gathering

Bringing Analytics to Analysis:

The key to this approach is to maximize the amount of information that can be utilized from the existing data set. The history of transformers form the base on which the model is developed. Accuracy of the model is improved with increased availability of data, which has enough data points (failure points) for tuning the model. Various faults are also identified based on the developed relationships and reference standards (IEC/IS)

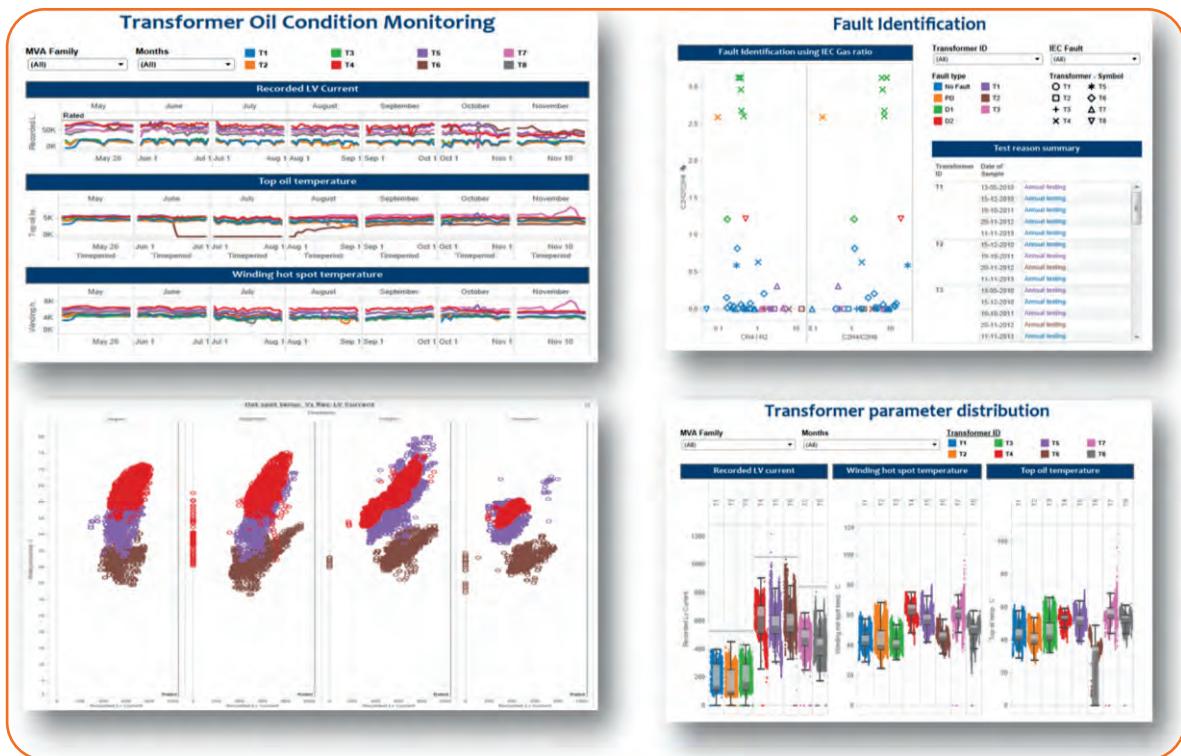


Fig.7.9 – Sample Dashboard

How does a solution dashboard look like?

Dashboards created for transformer health monitoring and assessment are shown below. Box plot enables us to understand and analyze the overall distribution of recorded values. Trending of multiple parameters helps the operator to monitor the variation of each parameter with reference to its limits over a period of time and thus plan necessary corrective actions or maintenance activity in case of abnormal variations. Fault identification using IEC gas ratio is another critical feature of this model. To assess the overall condition, a numerical value is computed to represent the health of a transformer and the same is compared along with its age. A unique solution for monitoring various parameters individually and to assess overall health of the transformer is thus achieved with this model.

7.2.4 Security

1. **Device Level Security:** Devices are connected into the network with unique and dedicated device IDs.
2. **Firmware level security:** Data encryption from source (hardware) using SSL.
3. **Application Level security :** Hierarchy level access to data for relevant stakeholders using login and password credentials.

7.2.5 Basic Equipment Required for Model

The basic requirements for this application are:

- Dissolved gas analyzer
- Oil sample tester
- Oil temperature sensor
- Polymer compound analyzer





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8. Use Cases - Retail

Unit 8.1 – Retail Sensor Platform
Unit 8.2 – Smart Black Box



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Retail Sensor Platform' IoT application
2. Describe various features of 'Retail Sensor Platform'
3. Describe how the 'Retail Sensor Platform' works
4. State the importance and benefits of 'Smart Black Box' IoT application
5. Describe various features of 'Smart Black Box'
6. Describe how the 'Smart Black Box' works

UNIT 8.1: Use Case 1 – Retail Sensor Platform

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Retail Sensor Platform' IoT application
2. Describe various features of 'Retail Sensor Platform'
3. Describe how the 'Retail Sensor Platform' works

8.1.1 Scenario

According to reports, inventory distortion in the form of overstock, stock out and shrinkage represent over \$ 1 trillion worth of losses for retailers worldwide. It is also estimated that, potential impact of IoT on retail will range from \$140 billion to over \$1 trillion by 2025.

In 2015, Intel began working with the clothing manufacturer Levi's in a proof of concept to deliver near real-time inventory monitoring in the Levi San Francisco store. Intel is marketing this solution as 'Retail Sensor Platform'.

8.1.2 Design

RFID tags are placed on all items in the store. Data readings are forwarded to the Intel gateways and then pushed back to back-office systems for cloud based analytics.

The system consists of the following:

- The Intel Retail Sensor Platform.
- An Intel based gateway located at the back end of the store for forwarding the data to the cloud.
- The Trusted Analytics Platform (TAP) is the part of the cloud based solution. It provides tools, algorithms, and engines to work with data scientists to conduct advanced analytics.
- External APIs which enables software developers and solution providers to integrate new and adjunct applications such as inventory location tracking.

8.1.3 Data Gathering

RFID antennas are always on, gathering and disseminating the Stock Keeping Unit (SKU) level data on constant basis. Since the system is continuously scanning for products, it is able to locate and account for every item on the sales floor at any given time.

The system provides alerts to allow stock to be replenished when running low. Once the plug and play device is connected to an Intel gateway, via one wire, it begins collecting and forwarding the inventory information.

Intel is also developing sensor capabilities with video analytics to analyse the way customers move in the store, to help the retailer optimize the layout and placement of merchandise.

Results and Benefits:

1. Visibility of inventory in real-time to improve efficiency.
2. Reducing inventory costs.
3. Improved understanding of customer behavior.
4. Identifying new usage models and retail applications.
5. Better customer experience.

8.1.4 Basic Equipment Required for Model

The basic requirements for this application are:

- The Intel Retail Sensor Platform.
- An Intel based gateway located at the back end of the store for forwarding the data to the cloud.
- The Trusted Analytics Platform (TAP) is the part of the cloud based solution. It provides tools, algorithms and engines to work with data scientists to conduct advanced analytics.
- External APIs which enables software developers and solution providers to integrate new and adjunct applications such as inventory location tracking.

UNIT 8.2: Use Case 2 – Smart Black Box

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Smart Black Box' IoT application
2. Describe various features of 'Smart Black Box'
3. Describe how the 'Smart Black Box' works

8.2.1 Scenario

There is a growing concern about the decline of the vending industry. Sales are lost because of customers preferring new ways of buying such as touch screen kiosks.

'Smart Black Box' solution accommodates the new features that the customer wants such as cashless payments, touch screens, etc. This solution also enables vendors to respond to consumer tastes rapidly.

8.2.2 Design

This solution incorporates multiple hardware-based components onto a single software based platform.

Smart Black Box solution has new features to help customers and vendors.

Customers:

- Cashless payment options.
- Touch screen option to make selections.
- Interactive digital signage.

Vendors:

- Remote management with online monitoring and diagnostics.
- Reliable remote monitoring of temperatures for hot or cold beverages.
- Reliable data to base product and campaign data analytics.
- New technologies for customer loyalty, including using a smart phone app that allows machines to communicate with customers through beacon technology.

The box is based on the Intel Vending Reference Platform, a secure architecture that streamlines systems and protocols and powered by Intel vPro processor.

The network connectivity part of the solution is provided by Jersey telecom. A SIM management platform provides real-time connectivity status and control.

8.2.3 Data Gathering

The hardware is based on Intel's low power dual-core i7-3571UE processor, integrating graphics and supporting several display interfaces. The system uses the solid state Drive 520 series. It consolidates several functions onto a single Intel processor board, thereby lowering the total cost of the system.

The vending machines have a range of built-in capabilities including Bluetooth connectivity and social media links. Touch screens replace buttons to allow users to navigate through product information and make selections. The machines also accept credit and debit cards.

The system comprises of AVA (Anonymous Viewer Analytics), AIM counter (a viewer capable of recording and analysing a video stream of the customer) and a web based reporting system allowing data analysis. All this comes with a cloud based licence and sensor management system.

The AVA feature uses an optical sensor to view the customer and detect purchase choices and dwell times. The brand markets can use this information to ascertain the effectiveness of their ads.

Results and Benefits:

- Supplier
 - Real-time data on the machines, such as when to restock or when to collect cash.
 - This solution also provides faults alerts.
- Brand Marketing
 - The brand owner can tighten the supply chain, enabling just in time delivery Losses due to overstocking significantly reduced.

8.2.4 Basic Equipment Required for Model

The basic requirement for this application is Intel- dual core i7-357UE processor

Acronyms used in this unit:

AVA	Anonymous Viewer Analytics
SKU	Stock Keeping Unit
TAP	Trusted Analytics Platform





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9. Use Cases – Manufacturing

Unit 9.1 - Condition Based Maintenance of Rotating Equipment



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Condition based Maintenance of Rotating Equipment' IoT application
2. Describe various features of 'Condition based Maintenance of Rotating Equipment'
3. Describe how the 'Condition based Maintenance of Rotating Equipment' works

UNIT 9.1: Use Case 1 – Condition based Maintenance of Rotating Equipment

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Condition based Maintenance of Rotating Equipment' IoT application
2. Describe various features of 'Condition based Maintenance of Rotating Equipment'
3. Describe how the 'Condition based Maintenance of Rotating Equipment' works

9.1.1 Scenario

Typical challenge in any industry is related to maintenance of critical assets e.g. 'Homogenizer' in food processing industry, 'Transformers' in electrical grid, 'Compressors and Conveyors' in manufacturing industry. Most industries follow a periodic and preventive maintenance strategy to maintain these critical assets. This approach leads to unnecessary maintenance activities without assessing the current condition of the asset.

This use case details IoT application in maintenance of equipment.

9.1.2 Design

The solution is a complete end to end solution that enables plant managers to optimally design the maintenance strategy based on the actual condition of the asset thereby reducing overall maintenance cost.

The solution consists of various components such as smarthead gateway having inbuilt fast data acquisition modules, integrated analytics algorithms, advance data compression and storage methods etc. Data acquisition is done at the sampling speed of 20 KHz.

Going beyond the preventive maintenance strategy, a condition based predictive maintenance solution has been developed that gives additional time for plant managers to plan the maintenance activities for the critical assets adequately. Validated machine learning based algorithms for various types of machine e.g. motor, pumps, compressors, etc. have been developed.

These algorithms quantify the current condition of assets on which cost effective decisions can be taken.

Potential Areas of Machine Failure:

- Noise
- Loose parts
- Low oil
- Misalignment
- Tight parts
- Defective parts
- Wear and tear of matching parts
- Bent crankshaft
- Overloading

Benefits of predictive maintenance strategy:

- Optimal maintenance schedule
- Reduced unplanned production downtime
- Extended operating life of machines
- Reduced quality issues such as rejection and rework
- Better planning and inventory maintenance of optimal level, which helps in budgeting and ensuring availability of spare parts

Condition Monitoring Applications:

- Heavy industrial equipment with high KW rating
- Oil pumps
- Hydraulic systems
- Automotive engines
- Truck and Off Highway Vehicles

9.1.3 Data Gathering

Functional Architecture:

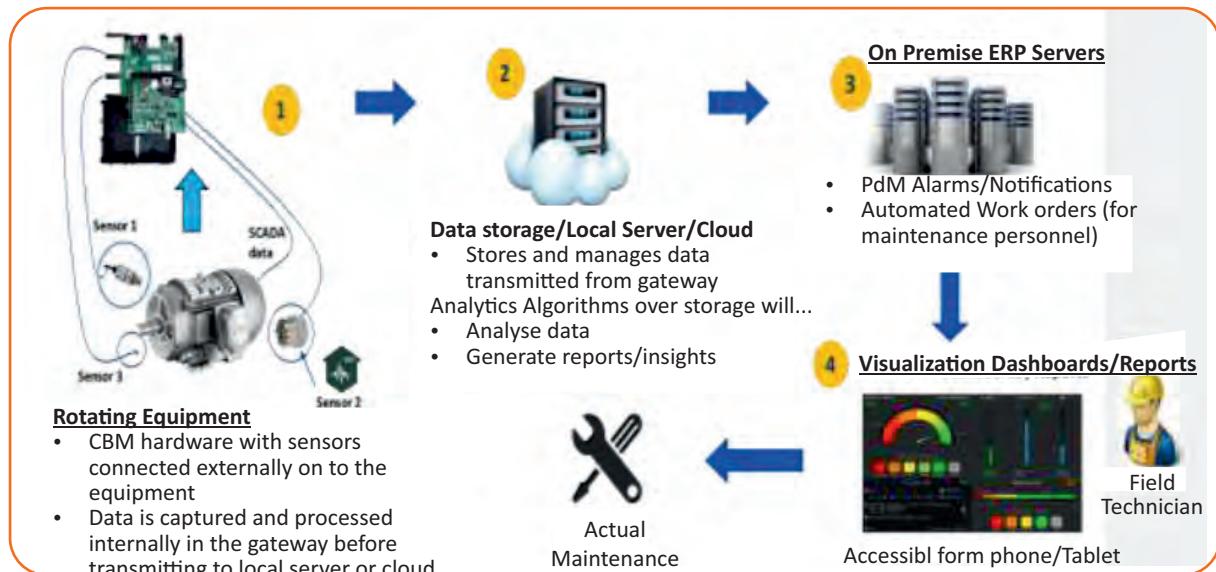
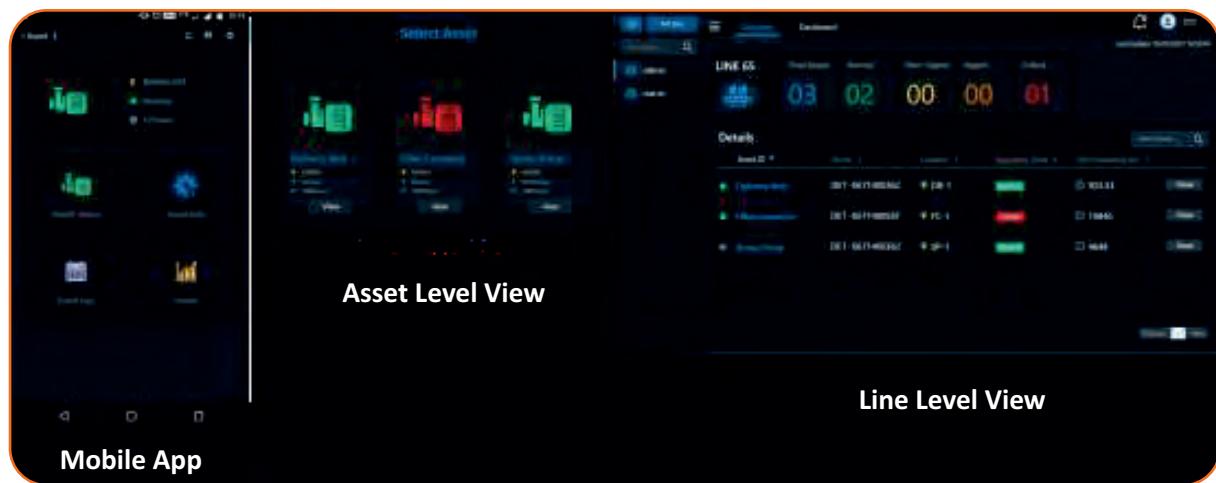


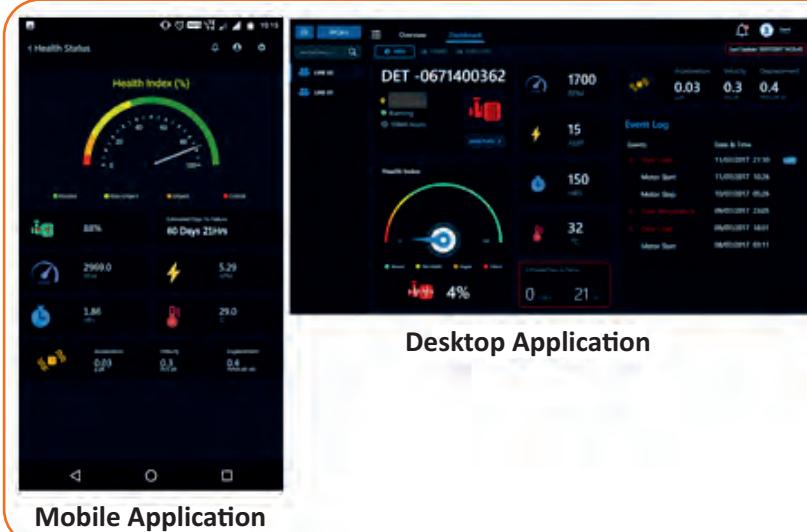
Fig.9.1 – Functional architecture

Reporting:



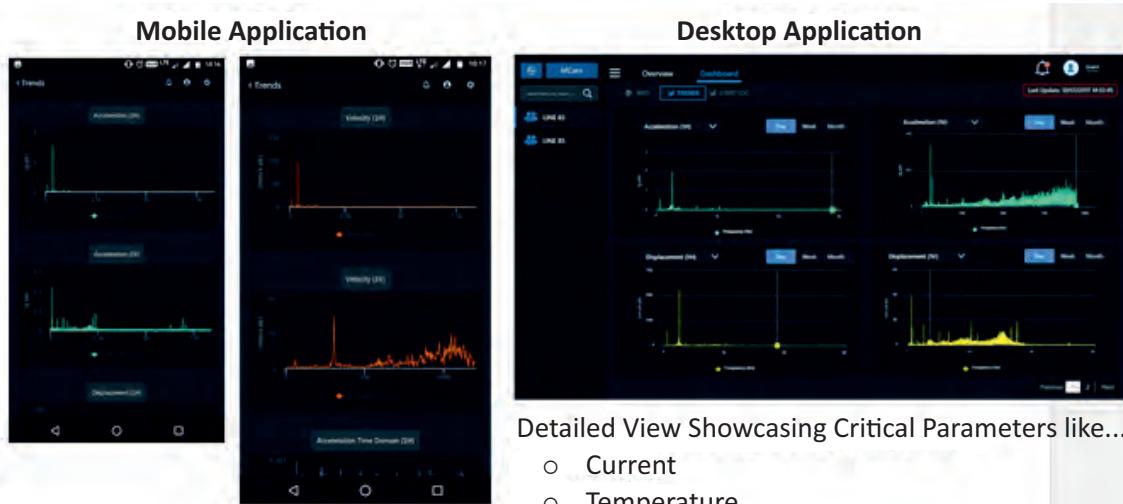
Get detailed insights at the Plant, Line and Asset Level

Details of Faults, Locations, Status, Operations etc.



Detailed Asset View Showcasing

- Alarms and Events
- Asset Current Status
- Health Index
- Critical Parameters like
 - Current
 - Temperature
 - Vibration
 - Pressure
- No. and Type of Faults
- Mean Time to Failure
- Total Running Hours
- Time to Next Maintenance



- Current
- Temperature
- Vibration

Fig.9.2 – Dashboards

9.1.4 Security

1. Device Level Security:

Devices are added into the network with unique and dedicated device IDs.

2. Firmware Level Security:

Data is encrypted from source (Hardware) using SSL.

3. Application Level Security:

Hierarchy level access to data for relevant stakeholders is provided using login and password credentials.

9.1.5 Basic Equipment Required for Model

The basic requirements for this application are:

- Data acquisition system
- Sensors
- Data storage/ Local server
- ERP servers





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10. Use Case - Logistics

Unit 10.1 - Warehousing Operations

Unit 10.2 - Freight Transportation



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Warehousing Operations' IoT application
2. Describe various features of 'Warehousing Operations'
3. Describe how the 'Freight Transportation' works
4. State the importance and benefits of 'Freight Transportation' IoT application
5. Describe various features of 'Freight Transportation'
6. Describe how the 'Freight Transportation' works

UNIT 10.1: Use Case 1 – Warehouse Operations

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Warehousing Operations' IoT application
2. Describe various features of 'Warehousing Operations'
3. Describe how the 'Freight Transportation' works

10.1.1 Scenario

The objective of any logistics company is to deliver goods to the customer within the promised time and in good condition. The goods are collected from various locations and stored at warehouses. The goods are dispatched to the consignee from warehouses located at strategic location. Warehousing plays a very critical role in the entire supply chain, however, in today's economic scenario, warehousing serves as a key source of competitive advantage for logistics provider who can deliver fast, cost-efficient and increasingly flexible warehousing operations for their customers.

Warehousing operation is not an easy task as it involves multiple types and forms of goods. Every inch of a warehouse should be optimally utilized to store, process, retrieve and deliver goods as fast as possible. This is not possible without technological intervention. This requires a strong platform to perform all these operations. Modern warehouses contain many 'dark assets' that can be connected and optimized through IoT.



Fig.10.1 – IoT application in warehousing

10.1.2 Design

Pallet or item level tagging is carried out using low-cost, minuscule identification devices such as RFID. This will pave the way for IoT driven smart inventory management.

Wireless readers capture data transmitted from each pallet as it arrives through the inbound gateways. The data will include information on the product such as volume and dimensions. This data is aggregated and sent to Warehouse Management System (WMS) for processing.

This system reduces the effort of manual accounting and volume scanning of pallets. Cameras are attached to the gateways to detect damages by scanning pallets for imperfections.



Fig.10.2 – Overview of Warehouse Management System

10.1.3 Data Gathering

Once the pallets are moved to the right location, tags transmit signals to the WMS to provide real-time visibility into inventory levels thus avoiding out of stock situation. In case of any misplacement of items, sensors send alert to the warehouse manager to track the item's exact location for corrective actions.

Sensors monitor the condition of an item and alert the warehouse manager when the temperature or humidity thresholds are to be compounded. This would allow warehouse staff to take corrective action, ensuring service quality and greater customer confidence.



Fig.10.3 – Warehouse Management System

For the outbound delivery, pallets are scanned through an outbound gateway, to ensure that right items, in the right order for delivery are being sent. Stock levels are updated automatically in the WMS for accurate inventory control.

IoT can also be used for optimal asset utilization. Machineries and vehicles are connected to the central system thus enabling managers to track all the assets in real-time environment. Managers will get alerts if an asset is being over utilized or underutilized so that, they can take corrective actions.

Connected assets in a warehouse also enable predictive maintenance for warehouse transport system.

Higher levels of worker health and safety can be achieved by using IoT. Sensors and actuators combined with radar or cameras attached to the forklift can allow them to communicate with other forklifts and scan the environment for hidden objects that could cause collision.

IoT can also be used to achieve other benefits in smart warehousing.

10.1.4 Basic Equipment Required for Model

The basic requirements for this application are:

- RFID tags
- Wireless readers
- Gateways
- WMS (Warehouse Management System)
- Camera
- Sensor

Unit 10.2: Use Case 2 – Freight Transportation

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Freight Transportation' IoT application
2. Describe various features of 'Freight Transportation'
3. Describe how the 'Freight Transportation' works

10.2.1 Scenario

The major challenge for any Logistics company is to track and monitor the freight or shipment cargo as goods are dispatched through various modes of transport including road, sea and air. The logistics operator is also responsible to deliver the goods in good condition. The logistics company may get lot of queries from the consignee regarding the delivery of their goods and current status.

With hundreds of thousands of oceans, air and road assets, freight transportation presents a great potential for IoT network. Today it is already possible to track and monitor a container in freight and shipment in a cargo.



Fig.10.4 – Modes of Transport

An IoT application platform should have better features for tracing and tracking which should be faster, accurate, predictive and secure.

The challenge faced by the logistics industry is that the solutions provided so far are proprietary and the solutions cannot communicate with each other. There is a need to create a new platform using existing hardware and software capabilities. The solution should provide end-to-end integrity of supply chains.

10.2.2 Design

Agheera, a real-time tracking solution provider, has developed an open platform for connecting various telematics and sensor hardware devices to consolidate data across different applications and modes. The platform merges multiple assets such as a connected swap body or truck into one easy-to-use portal with worldwide accessibility, allowing logistics providers and customers to track all assets and their various devices at once.



Fig.10.5 – Tracking and tracing of goods

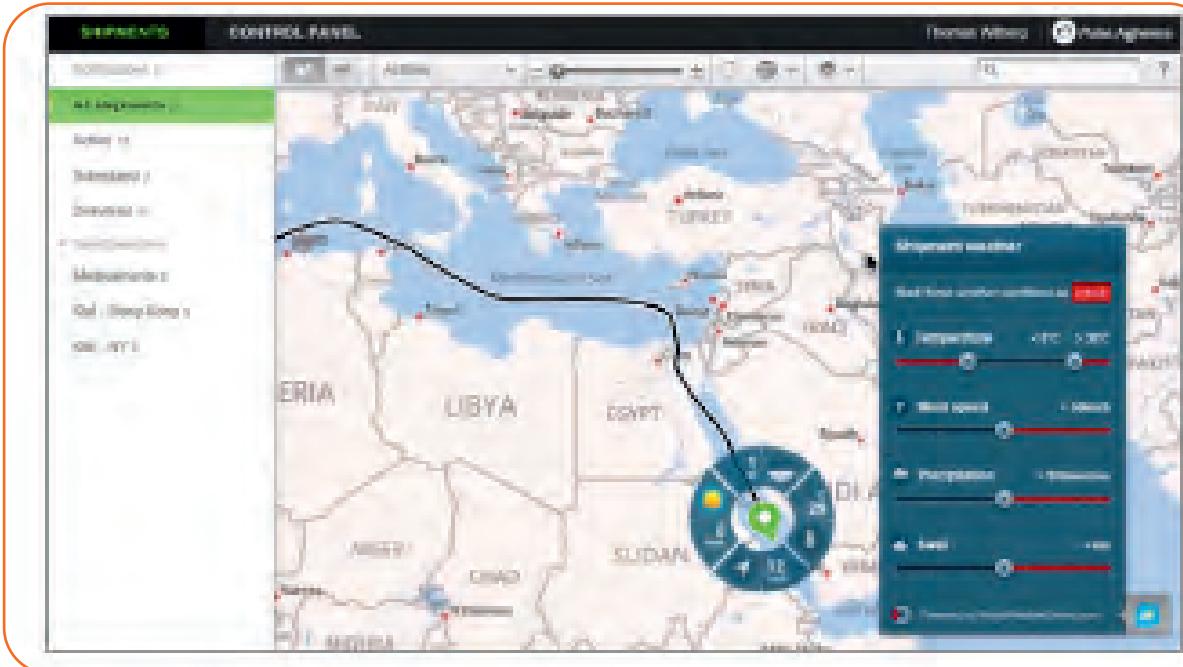


Fig.10.6 – Agheera real-time tracking solution

Through IoT, logistics providers will gain clear visibility on the movement of goods — meter by meter and second by second — as well as item-level condition monitoring to ensure that goods arrive in time, at the right place and intact.

10.2.3 Data Gathering

As we have seen, location and condition monitoring through IoT will provide a new level of transport visibility and security. Telematics sensors in trucks and multi-sensor tags on items transmit data on the location, condition (whether any thresholds have been crossed) and if a package has been opened (to detect possible theft).



One Solution from DHL is the **Smart Sensensor**,³⁸ which offers full-condition monitoring. This intelligent sensor can monitor temperature and humidity, while also indicating shock and light events, to ensure complete intergrity during transportation.

Fig.10.7 – Smart sensor

Through IoT, logistics providers will gain clear visibility on the movement of goods — meter by meter and second by second — as well as item-level condition monitoring to ensure that goods arrive in time, at the right place and intact.

RFID	Radio Frequency Identification
WMS	Warehouse Management System



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11. Use Cases - Agriculture

Unit 11.1 – Calving

Unit 11.2 – Increasing Yield



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Calving' IoT application
2. Describe various features of 'Calving'
3. Describe how the 'Calving' works
4. State the importance and benefits of 'Increasing Yield' IoT application
5. Describe various features of 'Increasing Yield'
6. Describe how the 'Increasing Yield' works

UNIT 11.1: Use Case 1 – Calving

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Calving' IoT application
2. Describe various features of 'Calving'
3. Describe how the 'Calving' works

11.1.1 Scenario

Calving is a stressful time for farmers. Almost one in 14 calves die during the birth. Until now, the only way to improve these odds was to keep watch over the expectant cow around the clock.

Animal welfare company Moocall has developed a remote monitoring solution for pregnant cows. This simple solution is based on the principle that cows move their tails more often the closer they get to delivery.



Fig.11.1 – Expecting cow

11.1.2 Design and Data Gathering

The Moocall service senses tail motion via a battery-powered monitor that is clipped to the cow's tail. The device sends SMS alerts, when it detects enough motion to show a cow is about to go into labour. As a result, farmers can carry on with their daily work or get good nights sleep.

Moocall relies on Vodafone's managed connectivity to ensure coverage in even the most remote farming areas and to help the company expand internationally.

It is also planned to introduce similar devices for horses and have other ideas for new developments such as flock protection.



Fig.11.2 – Moocall device

11.1.3 Security

Device level security features are deployed in this solution. SMS alerts are sent to the registered mobile number.

11.1.4 Basic Equipment Required for Model

The basic requirements for this application are:

- Battery powered Moocall device

Unit 11.2: Use Case 2 – Increasing Yield

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Increasing Yield' IoT application
2. Describe various features of 'Increasing Yield'
3. Describe how the 'Increasing Yield' works

11.2.1 Scenario

Historically, crop farming has relied on farmers' expertise, built up over generations, to identify the best way to work the land and identify the opportune moments to plant and harvest. But even the best farmers can find their hard work undermined by poor weather. And the impact can be severe. For instance, the combination of weak farm gate prices and exceptional levels of rainfall resulted in some Irish crops running at losses of 30% in 2016.

Precision farming and the deployment of IoT technology promises to make crop management more predictable, introduce a new level of efficiency and drive up productivity.

11.2.2 Design and Data Gathering

Soil sensors

Narrow Band IoT (NB-IoT) is a low-cost technology that's enabling farmers to measure soil conditions such as moisture content, pH levels and temperatures, providing them with better insight into when to plant crops. Even deep in the soil, the wireless sensors provide excellent connectivity and coverage and the low power consumption means farmers don't need to change a battery for over 10 years.

The technology can also help when it comes to spraying. By monitoring conditions such as temperature, humidity and wind speed, farmers can get a better understanding of the conditions that allow pathogens to take hold. Using IoT, the farmer knows when to spray and where.

More precise use of pesticides and fertilizers can save money, deliver better results and lower the impact on the environment — which is a good news for everyone.



Fig.11.3 – IoT use in farming

11.2.3 Basic Equipment Required for Model

The basic requirements for this application is:

- Soil sensor





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12. Use Cases - Mining

Unit 12.1 - Safety in Mining

Unit 12.2 - Availability in Mining



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance and benefits of 'Safety in Mining' IoT application
2. Describe various features of 'Safety in Mining'
3. Describe how the 'Safety in Mining' works
4. State the importance and benefits of 'Availability in Mining' IoT application
5. Describe various features of 'Availability in Mining'
6. Describe how the 'Availability in Mining' works

UNIT 12.1: Use Case 1 – Safety in Mining

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Safety in Mining' IoT application
2. Describe various features of 'Safety in Mining'
3. Describe how the 'Safety in Mining' works

12.1.1 Scenario

Mining is a unique industry where the miners have to adjust to the changing environment under the ground. Miners have to work with materials and many factors that may not be controllable. Mining ventures are extremely capital intensive. The infrastructure for mines in remote locations alone may cost several hundred million dollars. High fixed costs represent a large component of a mining operation's total costs. Once the presence of an ore deposit has been established, several years of intensive effort is required before the property is brought in stream and ore is produced on a continuous basis.

Mining is broadly categorised as 'Underground Mining' and 'Surface Mining'. Each type will have its own challenges and advantages.

Mining is a very complex activity and many variables are to be controlled to make this venture profitable within the defined time frame. Mining operators are looking for technological interventions that aid in the operation's efficiency and at the same time, the solution should cover all aspects of mining.

As we are aware, mines are located at remote locations, hence some constraints are to be addressed to implement IoT solutions.

Some of the constraints are:

- Infrastructure setup
 - Site is located at remote locations
 - Most mine sites have no cellular access
 - Significant effort is required to establish WiFi setup
- Networking constraints
 - For the existing mines, IoT technology may add additional load on the bandwidth
 - Reinstallation or up-gradation of IT infrastructure is an expensive affair
- Cyber attacks
 - The application might be vulnerable to cyber attacks
 - Important data might be shared with competitor organisations

- Attackers may halt the operation of the machine by entering the network
- Illegitimate update of machine software can result in malfunction or can increase the warranty costs of the manufacturer

Mining is a complex activity involving too many variables and to be profitable in this highly capital intensive and complex industry requires some of the best technologies. At the same time, the mine operators look at solutions that support them in managing and also making money out of the mines. In order to deliver end to end solutions to support the mining value chain, one of the key requirement is the connectivity of individual devices/systems and integration of them to a single solution. Use of network infrastructure either local WiFi (with a tunnel to the Internet) or cellular or satellite can support this need. This sets the base for IoT in mining.

Safety in Mining:

The IoT technology can be used for the safety of personnel and equipment. This will have a cascading effect on the overall safety in the mining operations.

Safety in mining relates to one of the three major causes:

1. Environment
2. Equipment
3. Operator behavior

Let us try to understand how IoT helps in the above.

Safety in Mining – Environment:

The following are some of the frequent contributors that are important in mining safety.

- **Hazardous terrains**

Both in 'Surface' and 'Underground' mining, collapse of the working floor is a serious concern. There is a possibility of toppling of the machine when the floor collapses. This will pose a serious threat to the operator. In Underground mining, there is a possibility that the workers might get trapped inside the tunnel when the roof collapses. There are notable such incidents in the recorded history of operation of mine sites.

- **Dust**

Dust is one of the most common hazard in mining. Dust not only affects the operation of the machines due to poor visibility but also poses a serious threat to the operator when he inhales the dust.

- **Toxic gas leakage in underground tunnels**

When working underground, people are susceptible to accidental leakages of natural gas or other hazardous gases that were produced by decomposition of organic material buried underground.

- **Excessive noise**

Blasting of rocks produce excessive noise that might even cause the impairment of hearing.

Safety in Mining – Equipment:

When multiple mining trucks operate in the same area, space can fill up pretty quickly. With such large vehicles sharing a full road, they can damage or even topple other machines when accidentally collided with. As an example, a loader or a shovel machine can damage the cab of the operator of the truck if not properly positioned.

A low-speed collision between small vehicles may result in a dent or two, a few hundred dollars in damage and minor injuries to drivers or passengers. But a collision between large mining trucks—even at low speed—has the potential to seriously injure operators or others on site and can result in several thousands of dollars in damage and lost productivity due to downtime.

While training, alert operators are an important first step in preventing heavy-to-heavy collisions, object detection systems provide an additional measure of mine safety that can prevent mining collisions that result in injury and costly repairs. A suite of sensors and cameras helps improve operator visibility, allowing workers to confirm the safety of an area both visually and by the sensor before moving the truck.

Because large mining trucks have extended stopping distances, it's important for operators to get a good look at their surroundings before moving in any direction. By automatically activating at low speeds or stops, object detection systems provide operators with a quick look at the area surrounding the truck, which could be the difference between a productive cycle and a collision.

While object detection systems can improve mine safety and avert heavy-to-heavy vehicle collisions, they do not replace standard mining safety procedures.

Safety in Mining – Operator Behavior:

Fatigue and distraction are an inevitable force of nature. Their consequences can be costly, even fatal. IoT enables by intervening before it's too late with a fatigue monitoring system. A non-intrusive, in-cab fatigue detection technology that instantly alerts operators the moment fatigue or distraction is identified, is now available in the industry.

12.1.2 Design

Safety in Mining – Environment:

One potential solution to mitigate this safety risk using IoT is **Virtual Fencing** demarcating the restricted areas keeping people and equipment away from hazardous zones. Installing the physical fences would be both expensive and ineffective keeping in mind that the area of mining would expand and could be subject to harsh environments.

Avoidance zone systems are designed to use **global positioning, wireless radio technology and office software to map mines and create electronic fences that identify worksite boundaries**. Machine operators can view the avoidance zones on their displays and can be warned when they near the end of the safe zone. The mine controllers sitting in the remote office would also be able to view the movement of machines and ensure that the safety of the operator is not compromised.

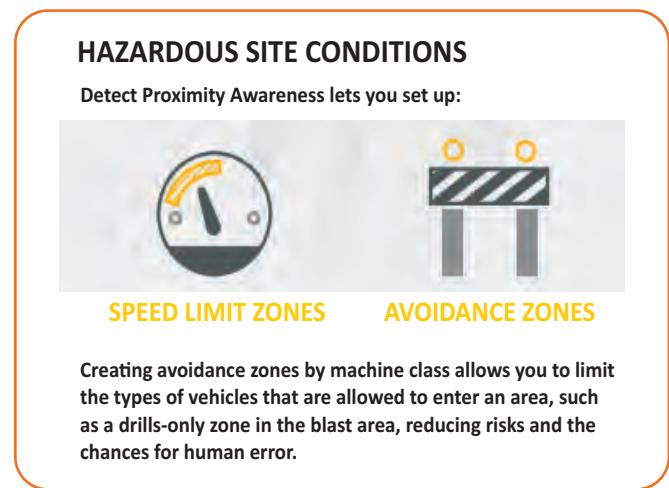


Fig.12.1 – Hazardous site conditions

How it Works?

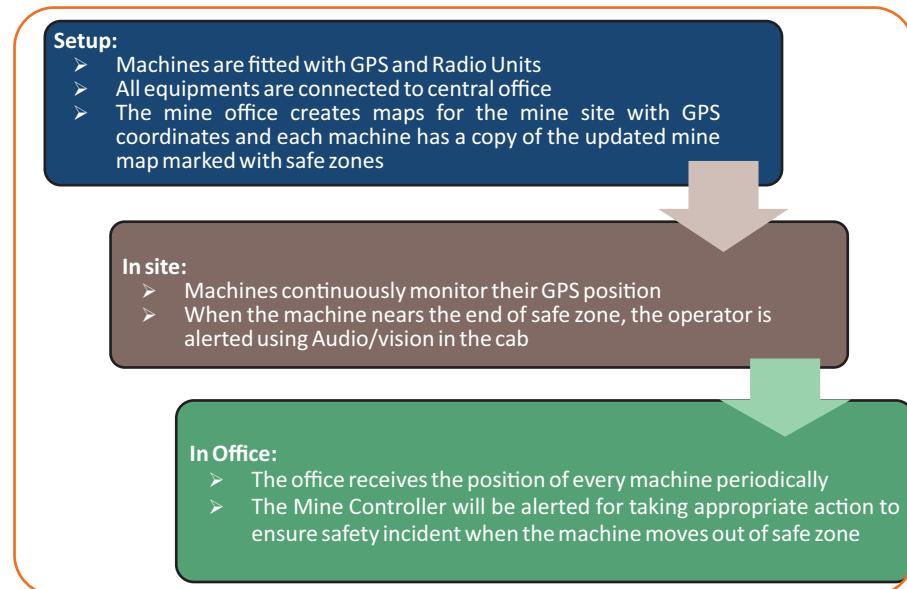


Fig.12.2 – Working mechanism for Safety - Environment

Safety in Mining – Operator Behavior:

Fatigue detection technology works by monitoring eye-closure duration and head pose. If the system detects a fatigue or distraction event the operator is immediately alerted through configurable in-vehicle seat vibration and/or audio alarm. Alerts can also be sent to the mine office with a call for action. Mine controller can arrange for shift change or schedule a break for that operator before an actual incident occurs.



Fig.12.3 – Fatigue detection technology

The fatigue or distraction event data from the system can also be sent to a 24-hour monitoring centre, which could be the mine office or a remote centre away from the mine site to classify and analyse the data. Capture & Playback can be used to record incidents for playback, analysis and training opportunities.

This data can be used to provide customised reporting with site-level recommendations. Cross-referencing fatigue and distraction events against available equipment data can provide suggestions to improve operational efficiency.

Fatigue management doesn't stop at the mine site. Behaviors of the site impact fatigue and distractions on the job, so any fatigue management program must include at-home cultural awareness and training elements that encourage healthy nutrition and good sleeping habits.

While the fatigue detection system is onboard, the machine can collect data for analysis of incidents on the site, to understand the sleeping habits and other activities. Industry now uses activity tracker bands, mobile devices and smart electric devices at home such as smart lighting system or smart TV. Analysis of this data helps plan work schedule for the team of personnel including proper shift breaks, selection of day vs night shift, alternating of shifts, counselling, etc.

12.1.3 Data Gathering

Data is the parent of any smart technology. Data gathering is the enabler of precise and predictive Technology by having its predictive capability based on the actual status of the machine.

The below mentioned sequence chart summarises the steps involved in Data Gathering and relaying.

On-Board - Data is collected by a Telematics Device from the sensor/Machine Microcontrollers using on-board systems.

Similarly any control command from the mine controller will be received by the Telematics Device which will be relayed to the necessary controller.

The protocol that is used on the machine is usually proprietary.

- CAN
- Bluetooth
- Fiber optic

Relying the information to Mine Server - The Telematics device will communicate the data between the machine and the central server using Wireless Technologies.

The Central server processes the information, relays to individual processing units in the mine control room, to be presented to the controller.

Fig.12.4 –Safety in Mining – Design

A wide range of Communication protocols can be used, some being proprietary to the mine site to assist in the relaying of data.

Message Queue Telemetry Transport (MQTT), Advanced Message Queuing Protocol (AMQP), Simple/Streaming Text Oriented Messaging Protocol (STOMP) are some of the popular protocols that are used in telematics.

All the protocols should be reliable, light-weight (on bandwidth) and should support security.

12.1.4 Security

Connectivity opens the door for hacking. Even the most protected system is vulnerable to attack and hence multiple levels of security must be provided to make the network safe.

The simplest form of attack is theft of the data. The data of the mine site is sensitive and private to the mine owner. Access to the mine information can be exploited by the competitors and social elements.

Any manipulation of Safety Technology must not result in a safety incident. Hence, it is mandated that as long as human is inside the machine, the technology must only be able to alert the person and must be capable of being overridden.

In mine sites, where complete or semi-autonomy is implemented, the network has to be given intense protection. Any hacking in the network can make the entire mine site vulnerable to remote control by an unidentified person.

Some common protection methods are given below,

- Most of the mine networks operate behind the Firewall. The Firewall needs to be updated frequently and be monitored for any hacking attempts
- Provide provision for private networks, disconnected to the Internet, when sensitive data or control information is handled
- Use Proprietary protocol with secure handshakes to relay information in the mine site

12.1.5 Basic Equipment Required for Model

The basic requirements for this application are:

- Infrastructure for connectivity – Wifi Towers which cover mine site
- Intelligent Central Control Unit
- Machines equipped with Telemetry and required sensors
- Special devices (or smartphones) for the Machine Users with IoT ability to predict fatigue

Unit 12.2: Use Case 2 – Availability in Mining

Unit Objectives



At the end of this unit, you will be able to:

1. State the importance and benefits of 'Availability in Mining' IoT application
2. Describe various features of 'Availability in Mining'
3. Describe how the 'Availability in Mining' works

12.2.1 Scenario

Reducing the downtime:

With larger machines, comes more moving parts, hence, more wear and tear of mechanical parts, requiring well planned maintenance of the machines. Availability in mining refers to the percentage of time the machine was available for actual production operations. It plays an important role since downtime can cost heavily in the capital intensive mining industry. Achieving high levels of physical availability of the machine requires planned maintenance, capturing of failures even before it occurs during production.

When such a failure occurs, the time required to bring back the machine to operation also plays a critical factor in availability of the machines. Remote locations of mines, safety of technicians, availability and time taken for spare parts to reach, all play a role in bringing back the machine to production.

When you know what's going on inside your equipment, you're one step ahead in the cost-control battle. You can monitor critical machine parameters, analyse trends and get real-time alerts when issues arise, so you can take action to fix problems before they turn into major repairs. You can also track what equipment is due for service, make sure maintenance gets done on time and even monitor how a machine performs when it's back on the job. This helps to run machines as efficiently as possible for as long as possible, while keeping unplanned downtime to a minimum.

As surface miners begin to put new machine guidance and production monitoring technologies to work on their job sites, they're discovering a number of additional benefits related to equipment health and maintenance—improvements that are increasing machine and component life and reducing costly unscheduled downtime.

New technologies also promote repair-before-failure strategies and give operators—who know their equipment best—more tools to identify and diagnose possible problems proactively. That's because in-cab displays not only provide real-time production and guidance data, but also deliver up-to-the-minute machine health information.

Consumables tracking are another feature that comes as a standard with many machine guidance and production monitoring tools. It lets mine managers monitor the use and condition of commonly used components to ensure they're replaced exactly when needed—before failure, but not before the end of their useful life.

Increasing the component life cycle through haul road maintenance:

Haul road conditions dictate **speed, fuel burn, tire life, safety and annual tonnage moved**. Clean, smooth surfaces extend tire life for mine haul trucks and reduce the chance of machine damage or accidents due to road hazards. Smooth, constant grades minimise transmission shifts, enable drivers to maintain higher average speeds, allow more constant braking effort on returns and reduce spillage and fuel consumption.

On the other hand, poorly designed or maintained mining haul roads can lead to dramatically increased costs caused by lost production time, shortened tire life, greater fuel usage, excessive component wear, major equipment repair and replacement and safety issues. Even exceptionally designed haul roads require time and effort to keep in top shape. Regular maintenance helps eliminate the small decreases in speed—and increases in cycle times—that negatively affect hourly and annual production.

Fortunately, several new tools and technologies are available to help mine operation managers enhance haul road construction and maintenance practices, with the ultimate goal of increasing tire and mining truck life, improving fuel economy and reducing cost per ton.

12.2.2 Design

Reducing the Downtime:

On mining drills, for example, sensors and logic systems monitor the bit, stabilizer and steels—recording revolutions, time in use and distance travelled over the life of the product. Knowing exactly how long and in what conditions these components have been operating allows maintenance managers to make informed decisions about replacement, which helps keep downtime and costs to a minimum.

All this data is transferred to central data analytics storage from different mine sites around the world. Running advanced analytic logics, combined with insights from service inspection and oil sample inspections—Condition Monitoring Experts can arrive at actionable recommendations that could save a component, system or even a machine from failure well ahead.

For example, the coolant in any engine performs the job of removing the heat of the engine block, a failure in this component or system can result in engine failure. In order to predict this, we could monitor the coolant temperature before it enters the engine block and after it exits the engine block. The difference should be positive high (Outlet minus inlet). However, any impurities in the coolant can reduce the cooling function resulting in lower outlet temperature. This can be identified well ahead by monitoring the trend of outlet minus inlet coolant temperature and setting alerts for the threshold.

Setup

- Temperature sensors for the coolant connected to embedded control unit, that can transfer data back to site office



Sensing

- On-Board system periodically reads the values of the sensors and relays the information to the Off-Board Intelligent Analyser System
- The Analyser system detects and ascertains any abnormality in the measured values
- The system also predicts the tentative failure time and notifies the mine controller



- The mine controller modifies the schedule to move the faulty machine to service zone
- Mine controller consults with mine equipment technicians and solves the issue

Fig.12.5 – Design steps

Increasing the component life cycle through haul road maintenance:

Onboard machine systems, for example, can assess road conditions and quantify the severity of the haul, with sensors measuring factors such as component loading, impact shock, strut pressure data, transmission shift frequency, gear on grade, brake/retarder use and more. Many of these systems can then transmit real-time data to operators and maintenance personnel about problem areas to avoid and correct. On-Board Machine Systems can now directly talk over the internet to the data centres sending this information for analytics.

In addition, software packages can simulate mining truck productivity and estimated cost per ton on various haul road profiles. Mines can use these tools to determine if mining trucks are achieving predicted speed on grades, as well as cycling and waiting at the loader in predicted time ranges. With this data, operation managers can investigate possible causes behind delays—Are rough or slippery roads or tight corners forcing operators to slow down? Is rolling resistance higher than planned? Is visibility poor due to dust or obscured views?—and make the necessary adjustments. This software can run on the cloud on heaps of data from multiple mine sites.

The tracking capabilities now built into many mining machines also can assist with haul road maintenance for mines. These systems generate reports showing where health and operational alerts occur, which can help drivers and operation managers spot site problems—including suboptimal haul road conditions—that affect mining equipment availability, health and asset life.

It is important to note that certain mining equipment such as Trucks requires paved roads. If the truck with tons of payload is frequently made to pass over a bumpy terrain, the stress on the suspension systems is higher than it is designed for which may result in earlier failure. Skidding of a machine in the narrow road of the mine site will severely impair the mine site till the machine is removed. The below example illustrates how lane maintenance can be done.

Setup

- Machine with GPS and Suspension Stress sensor
- Connected via IoT to the mine control room

Sensing

- On-Board system periodically reads the values of the sensors and relays the information to the Off-Board Intelligent Analyser System
- The Analyser system detects the abnormality in the terrain such as bumps and ascertains the same by comparing the values from different machines that move over the terrain
- The system notifies the mine controller

Action

- The mine controller modifies the schedule to cordon the area requiring pavement of road
- Mine controller instructs pavement machines such as Motor grader to reach the area and pave the roads

Fig.12.6 – Design steps

Such preventive maintenance saves a lot of repair cost for the Mine Owner and improves the productivity of the mine site.

12.2.3 Data Gathering

Data is the parent of any smart technology. Data gathering is the enabler of precise and predictive Technology by having its predictive capability based on the actual status of the machine.

The below sequence chart summarises the steps involved in Data Gathering and relaying from the mines to the mine site.

On-Board - Data is collected by a Telematics Device from the sensor/machine microcontrollers using on-board systems.

Similarly any control command from the mine controller will be received by the Telematics Device which will be relayed to the necessary controller.

The protocol that is used on the machine is usually proprietary.

- CAN
- Bluetooth
- Fiber optic

Relaying the information to Mine Server - The Telematics device will communicate the data between the machine and the central server using Wireless Technologies.

The Central server processes the information, relays to individual processing units in the mine control room to be presented to the controller.

Fig.12.7 – Data gathering architecture

A wide range of Communication protocols can be used, some being proprietary to the mine site to assist in the relaying of data.

Message Queue Telemetry Transport (MQTT), Advanced Message Queuing Protocol (AMQP), Simple/Streaming Text Oriented Messaging Protocol (STOMP) are some of the popular protocols that are used in telematics.

All the protocols should be reliable, light-weight (on bandwidth) and should support security.

12.2.4 Security

Connectivity opens the door for hacking. Even the most protected system is vulnerable to attack and hence multiple levels of security must be provided to make the network safe.

The simplest form of attack is theft of the data. The data of the mine site is sensitive and private to the mine owner. Access to the mine information can be exploited by the competitors and anti-social elements.

In mine sites, where complete or semi-autonomy is implemented, the network has to be given intense protection. Any hacking in the network can make the entire mine site vulnerable to safety issues intentionally induced by malicious elements.

Some common protection methods are given below,

- Most of the mine networks operate behind the Firewall. The Firewall needs to be updated frequently and be monitored for any hacking attempts
- Provide provision for private networks, disconnected to the Internet, when sensitive data or control information is handled
- Use Proprietary protocol with secure handshakes to relay information in the mine site

12.2.5 Basic Equipment Required For this Model

The following are the requirement for this solution.

- Temperature sensors for monitoring
- Any microcontroller unit
- Buzzer or Lamp to alert

Microcontroller unit can sense the temperature output and trend the data at 1 point per 1 hour sampling rate if the average trend plot of such temperature channel exceeds the threshold, record is created & alarm unit is triggered. This can be experimented on simple pump systems in the campus.



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13. Professional Skills

Unit 13.1 – Office, e-mail and telephone etiquette

Unit 13.2 – Goal setting and time management



Key Learning Outcomes



At the end of this module, you will be able to:

1. State the importance of following office etiquettes
2. Apply e-mail and office etiquettes in your day to day activities
3. Effectively follow telephone etiquettes
4. Explain the importance of goal setting in your life
5. Perform task analysis and use time effectively

Unit 13.1: Professional Skills – Part 1

Unit Objectives



At the end of this unit, you will be able to:

1. Dress up yourself in formal attire
2. Explain cubicle etiquette
3. Behave properly at common places
4. State e-mail etiquette
5. Explain telephone etiquette

13.1.1 Office Etiquette

Attire:

To achieve excellence in the career, professional skills also play a major role along with technical skills. In this session, we will learn few professional skills.

Let us see what attire suits for office

- Business formals are suitable for office.
- Men can wear plain/ striped full sleeve or half sleeved shirts, formal trouser and formal shoes (black/brown).
- Women can wear Saree/Salwar kameez, plain/stripped shirts/cotton tops, formal trouser/skirts shoe/slip-ons.



Fig. 8.1 - Formal attire

Avoid:

Men	Women
<ul style="list-style-type: none">• No flashy cuff links, rings or gold chains. Wedding ring is fine.• No visible body piercing.	<ul style="list-style-type: none">• One pair of conservative, non-dangling earring and one ring per hand.• No dangling or distracting bracelets. No visible body piercing beyond earrings.

Cubicle etiquette:

- Always use your 'library voice' when speaking in a cubicle environment.
- When someone adjacent to you asks someone a question for which you know the correct answer, resist the urge to volunteer this information. Doing so will confirm that you were eavesdropping.
- Do not use sign language or whisper to attract the attention of someone who is dialing, checking mail or involved in another activity.
- When you decorate your cubicle, remember that others view your cubicle throughout the day. Be careful not to offend others on moral, religious, cultural or sexual grounds.

Common place behavior:

Rest rooms:

- Flush the toilet.
- Throw your paper towels in the trash.
- Wash your hands every single time.

Cafeteria and Break out area:

- Please do not "break line" while in a queue to collect food.
- Respect the rights of others; do not be loud or noisy.
- Do not move from one table to another while/after eating.
- All litter is to be thrown in the trash. It should never be left on the tables or on the floor.
- If you spill something, get help from a custodian to clean it up.
- Use good table manners at all times.

Elevator:

- Do not attempt to board elevator before previous passengers have disembarked.
- Take the stairs if travelling between one or two floors, barring personal injury.
- Hold the door for others running to catch the carriage. However, do not hold the door indefinitely and delay travel for other passengers.
- Give others their personal space in an uncrowded elevator.
- Do not call out the floor to the person standing nearest the buttons as if that person is the lift operator.
- Do not carry on personal conversations, be it person-to-person or via cellular phone.

13.1.2 E-mail Etiquette

e-mail:

In the office, you may be required to communicate with others using e-mail. There are certain rules to be followed, when writing the e-mails.

To:	The addresses in the “To” are the people who have to act on the e-mail
Cc:	The addresses in the “Cc” are for people who need to be kept informed
Bcc:	The addresses in “Bcc” receive a copy of the information. Addresses in “To” and “Cc” do not know of inclusion of addresses in “Bcc”
Reply All	Do not automatically “Reply to all”. Take one last look at your distribution list—is this e-mail necessary for all recipients?
Subject:	All messages should have clear and specific “Subject Lines” that <ul style="list-style-type: none"> • describe the message content • specify if there are any actions required and due dates • mention clearly who the message is for
Salutation	Americans: Hi, Europeans: Hello, Asians: Dear

Body	In the first 1–3 lines of your email, specify what this e-mail is about. <ul style="list-style-type: none"> • Does it include action required? • Does it require a reply by a certain date? • What information is contained that the reader will find necessary for their job?
Signature	End the e-mail with either 'Thanks and Regards' or just 'Regards'
Capital letters	Do not use capital letters. It indicates shouting

Dos and Don'ts

Dos	Don'ts
<ul style="list-style-type: none"> • Be concise and precise. • Paragraph and line spacing should be legitimate and visually appealing. 	<ul style="list-style-type: none"> • Do not use too much of punctuation. • Do not use excessive formatting.

13.1.3 Telephone Etiquette

Telephone etiquette:

Answering incoming call:

- Answer incoming calls within 2nd or 3rd ring.
- Always identify yourself. (To avoid the embarrassment of interrupting and informing the caller that he is speaking to the wrong person).

Making the call:

- Keep a pen and paper handy.
- Introduce yourself and ask for the person you want to speak to.
- State the purpose of the call and ask if it's a good time to speak.
- Seek a good time to call back if the speaker is busy else continue.

Answering on your friend's behalf:

- Ask if the caller would want you to take a message for him.
- Ask for his name, the organisation he represents and his phone number if the caller wants a call back.
- Ask if you should ask your colleague to return the call.

Transferring the call:

- Inform the caller to whom his call is being transferred and the number.
- Stay on line till until someone answers.
- If there is no response from the other end, inform the caller about it and request him/her to call back directly to the given number.

Putting on hold:

- Inform the caller that he/she would be put on hold.
- Get back to the caller every 45 seconds to apologise for being put on hold.
- Once back to the call thank the caller for his patience.

Closing the call:

- Close with positive note.
- Summarise.
- Reiterate the action needed (Re-emphasise the responsibilities).

How to make a call transfer:

- First, explain the reason and then express **your request**. People are much more cooperative and patient when they know the reason why.

Taking messages:

- Get the full name, if you do not understand it clearly or it isn't a familiar name ask the caller to spell it out for you.
- Ask for the name of the organisation.
- Get the full telephone number including the area code if it is long.
- Ask if there is any information you would like to leave.
- Say "Thank you "and tell the caller that you will give the person the message.
- Being a courteous speaker.

- “May I help you please?”
- “I am sorry to keep you waiting”
- “Thank you for calling”
- “It was nice talking to you”
- “Is there anything else that I can do for you?” The caller's name (be sure to pronounce it correctly)

Use of Mobile phones in office:

- Attending personal calls in office: Do not stay at your desk while attending personal call.

Cell phones in meetings:

- Do not bring your cell phone to meetings. It is a clear signal that your mind is not 100 percent on your job.
- Remember there was a time before we had cell phones.

Unit 13.2: Professional Skills –Part 2

Unit Objectives



At the end of this unit, you will be able to:

1. Explain the rules for goal setting
2. State the importance of SWOT analysis
3. Carryout self swot analysis
4. Manage time effectively

13.2.1 Goal setting

Rules for goal setting:

- Set one goal at a time: Choose one major goal and stay focused.
- Intensify your desire to achieve your goal: The single most important reason why people do not achieve their goal is because they do not have a strong enough desire.
- Develop a strong belief that you can achieve your goal: If you do not believe that you can reach your goal, you would not.
- Set a dead line for your goal: Dead line will move you to action .
- Write your goal down—your goal is no longer just a thought.
- When you put pen to paper you turn your thoughts into something tangible. You can actually see it and touch it.
- Break your goal down to mini goals: It's the planning of the route to your goal.
- Define your tasks for every mini goal.

Self SWOT:

Strengths:

- What advantages do you have that others don't have (for example, skills, certifications, education or connections)?
- What do you do better than anyone else?
- What personal resources can you access?
- What do other people (and your boss, in particular) see as your strengths?
- Which of your achievements are you most proud of?
- What values do you believe in that others fail to exhibit?
- Are you part of a network that no one else is involved in? If so, what connections do you have with influential people?

Weakness:

- What tasks do you usually avoid because you don't feel confident doing them?
- What will the people around you see as your weaknesses?
- Are you completely confident in your education and skills training? If not, where are you weakest?
- What are your negative habits (for example, are you often late, are you disorganised, do you have a short temper or are you poor at handling stress?)
- Do you have personality traits that hold you back in your field? For instance, if you are apprehensive talking to outsiders, sharing thoughts in meetings etc.

Opportunities:

- What new technology can help you? Or can you get help from others or from people via the Internet?
- Do you have a network of strategic contacts to help you or offer good advice?
- What trends do you see in your chosen field and how can you take advantage of them?

Threats:

- What obstacles do you currently face in life?
- Are any of your colleagues competing with you?
- Does changing scenarios (business, economic) threaten your prospects?
- Could any of your weaknesses lead to threats?

13.2.2 Time management

Prioritisation technique:

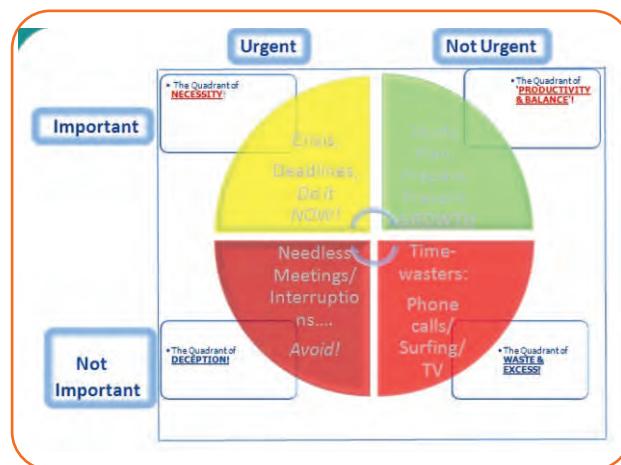


Fig. 8.2 - Time management

Quadrant 1 represents things which are both urgent and important. We've called this "firefighting". The activities need to be dealt with immediately, and they're important. Give examples like crisis in the family, accidents that require immediate attention.

Quadrant 2 represents things which are important, but not urgent. We've termed this one "Quality Time". Although the activities here are important and contribute to achieving the goals and priorities—they don't have to be done right now. As a result, they can be scheduled in when you can give quality thought to them. A good example would be the preparation of an important talk or preparing for an examination. Prayer time, family time and personal relaxation/recreation are also part of Quadrant 2. Activities that are planned in Quadrant 2 and not acted upon would move to Quadrant 1. This leads to stress and issues in prioritisation.

Quadrant 3 represents things which are distractions. They must be dealt with right now, but frankly, are not important. For example, when you answer an unwanted phone call—you've had to interrupt whatever you were doing to answer it.

The final quadrant, Quadrant 4, consists of things which are neither urgent nor important. Some meetings could fall into this category—they've been scheduled in advance, but if they achieve nothing, or you don't contribute to them, then they have simply wasted time. Other examples could include driving time and low quality relaxation or family time. Using the tool, consciously strive to maximise Quadrant 2 time. Allocate time in your diary to carry out these tasks when you are at your best. Doing so can reduce the amount of time taken up by firefighting quadrant 1 activities, since many quadrant 1 activities could have been quadrant 2 if they had been done earlier. You can also seek to reduce time spent in Quadrant 3 by improving your systems and processes for dealing with distractions and you can seek to eliminate as much as possible of quadrant 4 activities, by either not spending time on these things or changing the nature of them to make them more productive. For example, driving can be quadrant 4 if the time is unproductive, but there are a number of ways of making this time more productive by listening to a praise tape, praying, learning new skills with a tape course, planning and so on.

Tips for 'Time' management:

- Have a vision
- Plan ahead
- Prioritise your tasks
- Be organised
- Avoid overload
- Be able to be flexible





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14. Employability & Entrepreneurship Skills

Unit 14.1 – Personal Strengths & Value Systems

Unit 14.2 – Digital Literacy: A Recap

Unit 14.3 – Money Matters

Unit 14.4 – Preparing for Employment & Self Employment

Unit 14.5 – Understanding Entrepreneurship

Unit 14.6 – Preparing to be an Entrepreneur



Key Learning Outcomes



At the end of this unit, you will be able to:

1. Explain the meaning of health
2. List common health issues
3. Discuss tips to prevent common health issues
4. Explain the meaning of hygiene
5. Discuss the purpose of Swacch Bharat Abhiyan
6. Explain the meaning of habit
7. Discuss ways to set up a safe work environment
8. Discuss critical safety habits to be followed by employees
9. Explain the importance of self-analysis
10. Discuss motivation with the help of Maslow's Hierarchy of Needs
11. Discuss the meaning of achievement motivation
12. List the characteristics of entrepreneurs with achievement motivation
13. List the different factors that motivate you
14. Discuss the role of attitude in self-analysis
15. Discuss how to maintain a positive attitude
16. List your strengths and weaknesses
17. Discuss the qualities of honest people
18. Describe the importance of honesty in entrepreneurs
19. Discuss the elements of a strong work ethic
20. Discuss how to foster a good work ethic
21. List the characteristics of highly creative people
22. List the characteristics of highly innovative people
23. Discuss the benefits of time management
24. List the traits of effective time managers
25. Describe effective time management technique
26. Discuss the importance of anger management
27. Describe anger management strategies
28. Discuss tips for anger management
29. Discuss the causes of stress
30. Discuss the symptoms of stress
31. Discuss tips for stress management
32. Identify the basic parts of a computer
33. Identify the basic parts of a keyboard
34. Recall basic computer terminology
35. Recall the functions of basic computer keys

36. Discuss the main applications of MS Office
37. Discuss the benefits of Microsoft Outlook
38. Discuss the different types of e-commerce
39. List the benefits of e-commerce for retailers and customers
40. Discuss how the Digital India campaign will help boost e-commerce in India
41. Describe how you will sell a product or service on an e-commerce platform
42. Discuss the importance of saving money
43. Discuss the benefits of saving money
44. Discuss the main types of bank accounts
45. Describe the process of opening a bank account
46. Differentiate between fixed and variable costs
47. Describe the main types of investment options
48. Describe the different types of insurance products
49. Describe the different types of taxes
50. Discuss the uses of online banking
51. Discuss the main types of electronic funds transfers
52. Discuss the steps to prepare for an interview
53. Discuss the steps to create an effective Resume
54. Discuss the most frequently asked interview questions
55. Discuss how to answer the most frequently asked interview questions
56. Discuss basic workplace terminology
57. Discuss the concept of entrepreneurship
58. Discuss the importance of entrepreneurship
59. Describe the characteristics of an entrepreneur
60. Describe the different types of enterprises
61. List the qualities of an effective leader
62. Discuss the benefits of effective leadership
63. List the traits of an effective team
64. Discuss the importance of listening effectively
65. Discuss how to listen effectively
66. Discuss the importance of speaking effectively
67. Discuss how to speak effectively
68. Discuss how to solve problems
69. List important problem solving traits
70. Discuss ways to assess problem solving skills
71. Discuss the importance of negotiation

72. Discuss how to negotiate
73. Discuss how to identify new business opportunities
74. Discuss how to identify business opportunities within your business
75. Explain the meaning of entrepreneur
76. Describe the different types of entrepreneurs
77. List the characteristics of entrepreneurs
78. Recall entrepreneur success stories
79. Discuss the entrepreneurial process
80. Describe the entrepreneurship ecosystem
81. Discuss the purpose of the Make in India campaign
82. Discuss key schemes to promote entrepreneurs
83. Discuss the relationship between entrepreneurship and risk appetite
84. Discuss the relationship between entrepreneurship and resilience
85. Describe the characteristics of a resilient entrepreneur
86. Discuss how to deal with failure
87. Discuss how market research is carried out
88. Describe the 4 Ps of marketing
89. Discuss the importance of idea generation
90. Recall basic business terminology
91. Discuss the need for CRM
92. Discuss the benefits of CRM
93. Discuss the need for networking
94. Discuss the benefits of networking
95. Discuss the importance of setting goals
96. Differentiate between short-term, medium-term and long-term goals
97. Discuss how to write a business plan
98. Explain the financial planning process
99. Discuss ways to manage your risk
100. Describe the procedure and formalities for applying for bank finance
101. Discuss how to manage your own enterprise
102. List important questions that every entrepreneur should ask before starting an enterprise

UNIT 14.1: Personal Strengths & Value Systems

Unit Objectives



At the end of this unit, you will be able to:

1. Explain the meaning of health
2. List common health issues
3. Discuss tips to prevent common health issues
4. Explain the meaning of hygiene
5. Discuss the purpose of Swacch Bharat Abhiyan
6. Explain the meaning of habit
7. Discuss ways to set up a safe work environment
8. Discuss critical safety habits to be followed by employees
9. Explain the importance of self-analysis
10. Discuss motivation with the help of Maslow's Hierarchy of Needs
11. Discuss the meaning of achievement motivation
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27. Describe anger management strategies
28. Discuss tips for anger management
29. Discuss the causes of stress
30. Discuss the symptoms of stress
31. Discuss tips for stress management

14.1.1 Health, Habits, Hygiene: What is Health?

As per the World Health Organization (WHO), health is a “State of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity.” This means being healthy does not simply mean not being unhealthy – it also means you need to be at peace emotionally, and feel fit physically. For example, you cannot say you are healthy simply because you do not have any physical ailments like a cold or cough. You also need to think about whether you are feeling calm, relaxed and happy.

Common Health Issues

Some common health issues are:

- Allergies
- Asthma
- Skin Disorders
- Depression and Anxiety
- Diabetes
- Cough, Cold, Sore Throat
- Difficulty Sleeping
- Obesity

Tips to Prevent Health Issues

Taking measures to prevent ill health is always better than curing a disease or sickness. You can stay healthy by:

- Eating healthy foods like fruits, vegetables and nuts
- Cutting back on unhealthy and sugary foods
- Drinking enough water everyday
- Not smoking or drinking alcohol
- Exercising for at least 30 minutes a day, 4-5 times a week
- Taking vaccinations when required
- Practicing yoga exercises and meditation

How many of these health standards do you follow? Tick the ones that apply to you.

1. Get minimum 7-8 hours of sleep every night.
2. Avoid checking email first thing in the morning and right before you go to bed at night.
3. Don't skip meals – eat regular meals at correct meal times.
4. Read a little bit every single day.
5. Eat more home cooked food than junk food.
6. Stand more than you sit.
7. Drink a glass of water first thing in the morning and have at least 8 glasses of water through the day.
8. Go to the doctor and dentist for regular checkups.
9. Exercise for 30 minutes at least 5 days a week.
10. Avoid consuming lots of aerated beverages.

What is Hygiene ?

As per the World Health Organization (WHO), “Hygiene refers to conditions and practices that help to maintain health and prevent the spread of diseases.” In other words, hygiene means ensuring that you do whatever is required to keep your surroundings clean, so that you reduce the chances of spreading germs and diseases.

For instance, think about the kitchen in your home. Good hygiene means ensuring that the kitchen is always spick and span, the food is put away, dishes are washed and dustbins are not overflowing with garbage. Doing all this will reduce the chances of attracting pests like rats or cockroaches, and prevent the growth of fungus and other bacteria, which could spread disease.

How many of these health standards do you follow? Tick the ones that apply to you.

1. Have a bath or shower every day with soap – and wash your hair with shampoo 2-3 times a week.
2. Wear a fresh pair of clean undergarments every day.
3. Brush your teeth in the morning and before going to bed.
4. Cut your fingernails and toenails regularly.
5. Wash your hands with soap after going to the toilet.
6. Use an anti-perspirant deodorant on your underarms if you sweat a lot.
7. Wash your hands with soap before cooking or eating.
8. Stay home when you are sick, so other people don’t catch what you have.
9. Wash dirty clothes with laundry soap before wearing them again.
10. Cover your nose with a tissue/your hand when coughing or sneezing.

See how healthy and hygienic you are, by giving yourself 1 point for every ticked statement!

Then take a look at what your score means.

Your Score

0-7/20: You need to work a lot harder to stay fit and fine! Make it a point to practice good habits daily and see how much better you feel!

7-14/20: Not bad, but there is scope for improvement! Try and add a few more good habits to your daily routine.

14-20/20: Great job! Keep up the good work! Your body and mind thank you!

Swachh Bharat Abhiyan

We have already discussed the importance of following good hygiene and health practices for ourselves. But, it is not enough for us to be healthy and hygienic. We must also extend this standard to our homes, our immediate surroundings and to our country as a whole.

The ‘Swachh Bharat Abhiyan’ (Clean India Mission) launched by Prime Minister Shri Narendra Modi on 2nd October 2014, believes in doing exactly this. The aim of this mission is to clean the streets and roads of India and raise the overall level of cleanliness. Currently this mission covers 4,041 cities and towns across the country. Millions of our people have taken the pledge for a clean India. You should take the pledge too, and do everything possible to keep our country clean !

What are Habits ?

A habit is a behaviour that is repeated frequently. All of us have good habits and bad habits. Keep in mind the phrase by John Dryden: “We first make our habits, and then our habits make

us.” This is why it is so important that you make good habits a way of life, and consciously avoid practicing bad habits.

Some good habits that you should make part of your daily routine are:

- Always having a positive attitude
- Making exercise a part of your daily routine
- Reading motivational and inspirational stories
- Smiling! Make it a habit to smile as often as possible
- Making time for family and friends
- Going to bed early and waking up early

Some bad habits that you should quit immediately are:

- Skipping breakfast
- Snacking frequently even when you are not hungry
- Eating too much fattening and sugary food
- Smoking, drinking alcohol and doing drugs
- Spending more money than you can afford
- Worrying about unimportant issues
- Staying up late and waking up late

Tips



- Following healthy and hygienic practices every day will make you feel good mentally and physically.
- Hygiene is two-thirds of health – so good hygiene will help you stay strong and healthy!

14.1.2: Safety: Tips to Design a Safe Workplace

Every employer is obligated to ensure that his workplace follows the highest possible safety protocol. When setting up a business, owners must make it a point to:

- Use ergonomically designed furniture and equipment to avoid stooping and twisting
- Provide mechanical aids to avoid lifting or carrying heavy objects
- Have protective equipment on hand for hazardous jobs
- Designate emergency exits and ensure they are easily accessible
- Set down health codes and ensure they are implemented
- Follow the practice of regular safety inspections in and around the workplace
- Ensure regular building inspections are conducted
- Get expert advice on workplace safety and follow it

Non-Negotiable Employee Safety Habits

Every employer is obligated to ensure that his workplace follows the highest possible safety protocol. When setting up a business, owners must make it a point to:

- Immediately report unsafe conditions to a supervisor
- Recognize and report safety hazards that could lead to slips, trips and falls
- Report all injuries and accidents to a supervisor
- Wear the correct protective equipment when required
- Learn how to correctly use equipment provided for safety purposes
- Be aware of and avoid actions that could endanger other people
- Take rest breaks during the day and some time off from work during the week

Tips

- Be aware of what emergency number to call at the time of a workplace emergency
- Practice evacuation drills regularly to avoid chaotic evacuations

14.1.3 Self Analysis – Attitude, Achievement Motivation: What is Self-Analysis?

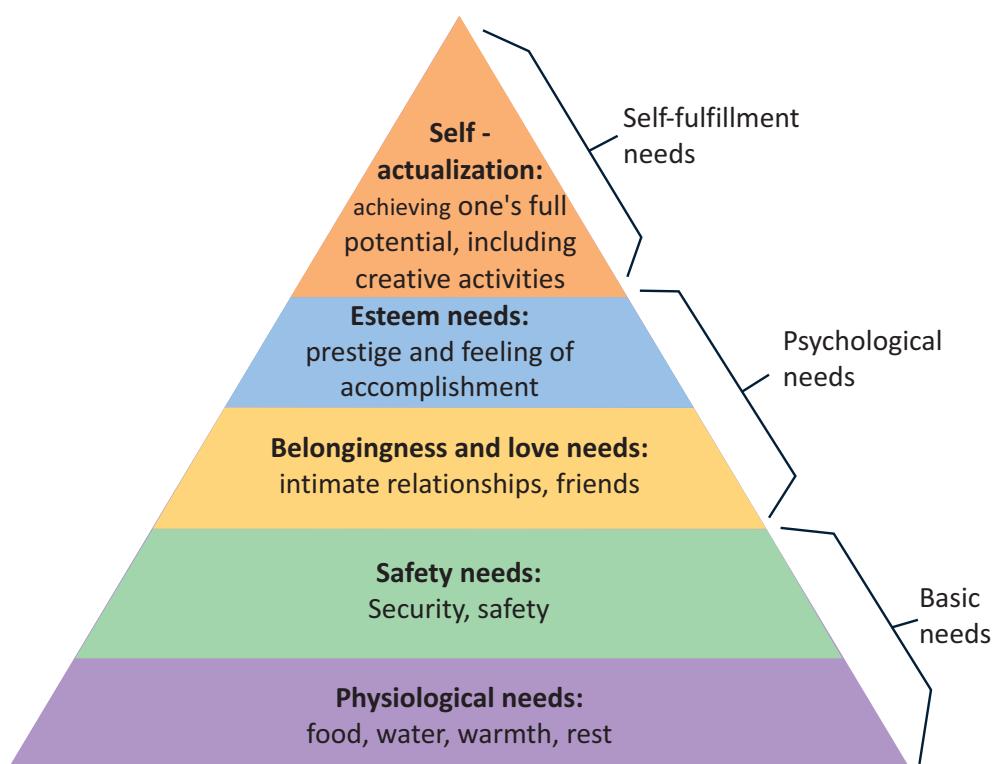
To truly achieve your full potential, you need to take a deep look inside yourself and find out what kind of person you really are. This attempt to understand your personality is known as self-analysis. Assessing yourself in this manner will help you grow, and will also help you to identify areas within yourself that need to be further developed, changed or eliminated. You can better understand yourself by taking a deep look at what motivates you, what your attitude is like, and what your strengths and weaknesses are.

What is Motivation ?

Very simply put, motivation is your reason for acting or behaving in a certain manner. It is important to understand that not everyone is motivated by the same desires – people are motivated by many, many different things. We can understand this better by looking at Maslow's Hierarchy of Needs.

Maslow's Hierarchy of Needs

Famous American psychologist Abraham Maslow wanted to understand what motivates people. He believed that people have five types of needs, ranging from very basic needs (called physiological needs) to more important needs that are required for self-growth (called self-actualization needs). Between the physiological and self-actualization needs are three other needs – safety needs, belongingness and love needs, and esteem needs. These needs are usually shown as a pyramid with five levels and are known as Maslow's Hierarchy of Needs.



As you can see from the pyramid, the lowest level depicts the most basic needs. Maslow believed that our behaviour is motivated by our basic needs, until those needs are met. Once they are fulfilled, we move to the next level and are motivated by the next level of needs. Let's understand this better with an example.

Rupa comes from a very poor family. She never has enough food, water, warmth or rest. According to Maslow, until Rupa is sure that she will get these basic needs, she will not even think about the next level of needs – her safety needs. But, once Rupa is confident that her basic needs will be met, she will move to the next level, and her behaviour will then be motivated by her need for security and safety. Once these new needs are met, Rupa will once again move to the next level, and be motivated by her need for relationships and friends. Once this need is satisfied, Rupa will then focus on the fourth level of needs – her esteem needs, after which she will move up to the fifth and last level of needs – the desire to achieve her full potential.

Understanding Achievement Motivation

We now know that people are motivated by basic, psychological and self-fulfillment needs. However, certain people are also motivated by the achievement of highly challenging accomplishments. This is known as Achievement Motivation, or 'need for achievement'.

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The level of motivation achievement in a person differs from individual to individual. It is important that entrepreneurs have a high level of achievement motivation – a deep desire to accomplish something important and unique. It is equally important that they hire people who are also highly motivated by challenges and success.

What Motivates You ?

What are the things that really motivate you? List down five things that really motivate you.

Remember to answer honestly!

I am motivated by:

Characteristics of Entrepreneurs with Achievement Motivation

Entrepreneurs with achievement motivation can be described as follows:

- Unafraid to take risks for personal accomplishment
- Love being challenged
- Future-oriented
- Flexible and adaptive
- Value negative feedback more than positive feedback
- Very persistent when it comes to achieving goals
- Extremely courageous
- Highly creative and innovative
- Restless - constantly looking to achieve more
- Feel personally responsible for solving problems

Think about it:

- How many of these traits do you have?

What is Attitude ?

Now that we understand why motivation is so important for self-analysis, let's look at the role our attitude plays in better understanding ourselves. Attitude can be described as your tendency (positive or negative), to think and feel about someone or something. Attitude is the foundation for success in every aspect of life. Our attitude can be our best friend or our worst enemy. In other words:

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"The only disability in life is a bad attitude."

When you start a business, you are sure to encounter a wide variety of emotions, from difficult times and failures to good times and successes. Your attitude is what will see you through the tough times and guide you towards success. Attitude is also infectious. It affects everyone around you, from your customers to your employees to your investors. A positive attitude helps build confidence in the workplace while a negative attitude is likely to result in the demotivation of your people.

How to Cultivate a Positive Attitude?

The good news is attitude is a choice. So it is possible to improve, control and change our attitude, if we decide we want to! The following tips help foster a positive mindset:

- Remember that you control your attitude, not the other way around
- Devote at least 15 minutes a day towards reading, watching or listening to something positive
- Avoid negative people who only complain and stop complaining yourself
- Expand your vocabulary with positive words and delete negative phrases from your mind
- Be appreciative and focus on what's good in yourself, in your life, and in others
- Stop thinking of yourself as a victim and start being proactive
- Imagine yourself succeeding and achieving your goals

What Are Your Strengths and Weaknesses ?

Another way to analyze yourself is by honestly identifying your strengths and weaknesses. This will help you use your strengths to your best advantage and reduce your weaknesses.

Note down all your strengths and weaknesses in the two columns below. Remember to be honest with yourself!

Strengths	Weaknesses

Tips

- Achievement motivation can be learned.
- Train yourself to finish what you start.
- Don't be afraid to make mistakes.
- Dream big.

14.1.4 Honesty & Work Ethics: What is Honesty?

Honesty is the quality of being fair and truthful. It means speaking and acting in a manner that inspires trust. A person who is described as honest is seen as truthful and sincere, and as someone who isn't deceitful or devious and doesn't steal or cheat. There are two dimensions of honesty—one is honesty in communication and the other is honesty in conduct.

Honesty is an extremely important trait because it results in peace of mind and builds relationships that are based on trust. Being dishonest, on the other hand, results in anxiety and leads to relationships full of distrust and conflict.

Qualities of Honest People

Honest individuals have certain distinct characteristics. Some common qualities among honest people are:

1. They don't worry about what others think of them. They believe in being themselves – they don't bother about whether they are liked or disliked for their personalities.
2. They stand up for their beliefs. They won't think twice about giving their honest opinion, even if they are aware that their point of view lies with the minority.
3. They are think skinned. This means they are not affected by others judging them harshly for their honest opinions.
4. They forge trusting, meaningful and healthy friendships. Honest people usually surround themselves with honest friends. They have faith that their friends will be truthful and upfront with them at all times.
5. They are trusted by their peers. They are seen as people who can be counted on for truthful and objective feedback and advice.

Importance of Honesty in Entrepreneurs

One of the most important characteristics of entrepreneurs is honesty. When entrepreneurs are honest with their customers, employees and investors, it shows that they respect those that they work with. It is also important that entrepreneurs remain honest with themselves. Let's look at how being honest would lead to great benefits for entrepreneurs.

- Honesty and customers: When entrepreneurs are honest with their customers it leads to stronger relationships, which in turn results in business growth and a stronger customer network.
- Honesty and employees: When entrepreneurs build honest relationships with their employees, it leads to more transparency in the workplace, which results in higher work performance and better results.
- Honesty and investors: For entrepreneurs, being honest with investors means not only sharing strengths but also candidly disclosing current and potential weaknesses, problem areas and solution strategies. Keep in mind that investors have a lot of experience with startups and are aware that all new companies have problems. Claiming that everything is perfectly fine and running smoothly is a red flag for most investors.
- Honesty with oneself: The consequences of being dishonest with oneself can lead to dire results, especially in the case of entrepreneurs. For entrepreneurs to succeed, it is critical that they remain realistic about their situation at all times, and accurately judge every aspect of their enterprise for what it truly is.

What are Work Ethics ?

Being ethical in the workplace means displaying values like honesty, integrity and respect in all your decisions and communications. It means not displaying negative qualities like lying, cheating and stealing.

Workplace ethics play a big role in the profitability of a company. It is as crucial to an enterprise as high morale and teamwork. This is why most companies lay down specific workplace ethic guidelines that must compulsorily be followed by their employees. These guidelines are typically outlined in a company's employee handbook.

Elements of a Strong Work Ethic

An entrepreneur must display strong work ethics, as well as hire only those individuals who believe in and display the same level of ethical behavior in the workplace. Some elements of a strong work ethic are:

- **Professionalism:** This involves everything from how you present yourself in a corporate setting to the manner in which you treat others in the workplace.
- **Respectfulness:** This means remaining poised and diplomatic regardless of how stressful or volatile a situation is.
- **Dependability:** This means always keeping your word, whether it's arriving on time for a meeting or delivering work on time.
- **Dedication:** This means refusing to quit until the designated work is done, and completing the work at the highest possible level of excellence.
- **Determination:** This means embracing obstacles as challenges rather than letting them stop you, and pushing ahead with purpose and resilience to get the desired results.
- **Accountability:** This means taking responsibility for your actions and the consequences of your actions, and not making excuses for your mistakes.
- **Humility:** This means acknowledging everyone's efforts and hard work, and sharing the credit for accomplishments.

How to Foster a Good Work Ethic?

As an entrepreneur, it is important that you clearly define the kind of behaviour that you expect from each and every team member in the workplace. You should make it clear that you expect employees to display positive work ethics like:

- **Honesty:** All work assigned to a person should be done with complete honesty, without any deceit or lies.
- **Good attitude:** All team members should be optimistic, energetic, and positive.
- **Reliability:** Employees should show up where they are supposed to be, when they are supposed to be there.
- **Good work habits:** Employees should always be well groomed, never use inappropriate language, conduct themselves professionally at all times, etc.
- **Initiative:** Doing the bare minimum is not enough. Every team member needs to be proactive and show initiative.
- **Trustworthiness:** Trust is non-negotiable. If an employee cannot be trusted, it's time to let that employee go.
- **Respect:** Employees need to respect the company, the law, their work, their colleagues and themselves.
- **Integrity:** Each and every team member should be completely ethical and must display above board behaviour at all times.
- **Efficiency:** Efficient employees help a company grow while inefficient employees result in a waste of time and resources.

Tips

- Don't get angry when someone tells you the truth and you don't like what you hear.
- Always be willing to accept responsibility for your mistakes.

14.1.5 Creativity & Innovation : What is Creativity?

Creativity means thinking outside the box. It means viewing things in new ways or from different perspectives, and then converting these ideas into reality. Creativity involves two parts: thinking and producing. Simply having an idea makes you imaginative, not creative. However, having an idea and acting on it makes you creative.

Characteristics of Highly Creative People

Some characteristics of creative people are:

- They are imaginative and playful
- They see issues from different angles
- They notice small details
- They have very little tolerance for boredom
- They detest rules and routine
- They love to daydream
- They are very curious

What is Innovation ?

There are many different definitions of innovation. In simple terms, innovation means turning an idea into a solution that adds value. It can also mean adding value by implementing a new product, service or process, or significantly improving on an existing product, service or process.

Characteristics of Highly Innovative People

Some characteristics of highly innovative people are:

- They embrace doing things differently
- They don't believe in taking shortcuts
- They are not afraid to be unconventional
- They are highly proactive and persistent
- They are organized, cautious and risk-averse

Tips

- Take regular breaks from your creative work to recharge yourself and gain fresh perspective.
- Build prototypes frequently, test them out, get feedback, and make the required changes.

14.1.6 Time Management: What is Time Management?

Time management is the process organizing your time, and deciding how to allocate your time between different activities. Good time management is the difference between working smart (getting more done in less time) and working hard (working for more time to get more done).

Effective time management leads to an efficient work output, even when you are faced with tight deadlines and high pressure situations. On the other hand, not managing your time effectively results in inefficient output and increases stress and anxiety.

Benefits of Time Management

Time management can lead to huge benefits like:

- Greater productivity
- Better professional reputation
- Higher chances for career advancement
- Higher efficiency
- Reduced stress
- Greater opportunities to achieve goals

Not managing time effectively can result in undesirable consequences like:

- Missing deadlines
- Substandard work quality
- Stalled career
- Inefficient work output
- Poor professional reputation
- Increase in stress and anxiety

Traits of Effective Time Managers

Some traits of effective time managers are:

- They begin projects early
- They set daily objectives
- They modify plans if required, to achieve better results
- They are flexible and open-minded
- They inform people in advance if their help will be required
- They know how to say no
- They break tasks into steps with specific deadlines
- They continually review long term goals
- They think of alternate solutions if and when required
- They ask for help when required
- They create backup plans

Effective Time Management Techniques

You can manage your time better by putting into practice certain time management techniques.

Some helpful tips are:

- Plan out your day as well as plan for interruptions. Give yourself at least 30 minutes to figure out your time plan. In your plan, schedule some time for interruptions.
- Put up a “Do Not Disturb” sign when you absolutely have to complete a certain amount of work.
- Close your mind to all distractions. Train yourself to ignore ringing phones, don’t reply to chat messages and disconnect from social media sites.
- Delegate your work. This will not only help your work get done faster, but will also show you the unique skills and abilities of those around you.
- Stop procrastinating. Remind yourself that procrastination typically arises due to the fear of failure or the belief that you cannot do things as perfectly as you wish to do them.
- Prioritize. List each task to be completed in order of its urgency or importance level. Then focus on completing each task, one by one.
- Maintain a log of your work activities. Analyze the log to help you understand how efficient you are, and how much time is wasted every day.
- Create time management goals to reduce time wastage.

Tips



- Always complete the most important tasks first.
- Get at least 7 – 8 hours of sleep every day.
- Start your day early.
- Don’t waste too much time on small, unimportant details.
- Set a time limit for every task that you will undertake.
- Give yourself some time to unwind between tasks.

14.1.7 Anger Management: What is Anger Management?

Anger management is the process of:

1. Learning to recognize the signs that you, or someone else, is becoming angry
2. Taking the best course of action to calm down the situation in a positive way

Anger management does not mean suppressing anger.

Importance of Anger Management

Anger is a perfectly normal human emotion. In fact, when managed the right way, anger can be considered a healthy emotion. However, if it is not kept in check, anger can make us act inappropriately and can lead to us saying or doing things that we will likely later regret.

Extreme anger can:

- **Hurt you physically:** It leads to heart disease, diabetes, a weakened immune system, insomnia, and high blood pressure.
- **Hurt you mentally:** It can cloud your thinking and lead to stress, depression and mental health issues.
- **Hurt your career:** It can result in alienating your colleagues, bosses, clients and lead to the loss of respect.
- **Hurt your relationships:** It makes it hard for your family and friends to trust you, be honest with you and feel comfortable around you.

This is why anger management, or managing anger appropriately, is so important.

Anger Management Strategies

Here are some strategies that can help you control your anger:

Strategy 1: Relaxation

Something as simple as breathing deeply and looking at relaxing images works wonders in calming down angry feelings. Try this simple breathing exercise:

1. Take a deep breath from your diaphragm (don't breathe from your chest)
2. Visualize your breath coming up from your stomach
3. Keep repeating a calming word like 'relax' or 'take it easy' (remember to keep breathing deeply while repeating the word)
4. Picture a relaxing moment (this can be from your memory or your imagination)

Follow this relaxation technique daily, especially when you realize that you're starting to feel angry.

Strategy 2: Cognitive Restructuring

Cognitive restructuring means changing the manner in which you think. Anger can make you curse, swear, exaggerate and act very dramatically. When this happens, force yourself to replace your angry thoughts with more logical ones. For instance, instead of thinking 'Everything is ruined' change your mindset and tell yourself 'It's not the end of the world and getting angry won't solve this'.

Strategy 3: Problem Solving

Getting angry about a problem that you cannot control is a perfectly natural response. Sometimes, try as you may, there may not be a solution to the difficulty you are faced with. In such cases, stop focusing on solving the problem, and instead focus on handling and facing the problem. Remind yourself that you will do your best to deal with the situation, but that you will not blame yourself if you don't get the solution you desire.

Strategy 4: Better Communication

When you're angry, it is very easy to jump to inaccurate conclusions. In this case, you need to force yourself to stop reacting, and think carefully about what you want to say, before saying it. Avoid saying the first thing that enters your head. Force yourself to listen carefully to what the other person is saying. Then think about the conversation before responding.

Strategy 5: Changing Your Environment

If you find that your environment is the cause of your anger, try and give yourself a break from your surroundings. Make an active decision to schedule some personal time for yourself, especially on days that are very hectic and stressful. Having even a brief amount of quiet or alone time is sure to help calm you down.

Tips for Anger Management

The following tips will help you keep your anger in check:

- Take some time to collect your thoughts before you speak out in anger.
- Express the reason for your anger in an assertive, but non-confrontational manner once you have calmed down.
- Do some form of physical exercise like running or walking briskly when you feel yourself getting angry.
- Make short breaks part of your daily routine, especially during days that are stressful.
- Focus on how to solve a problem that's making you angry, rather than focusing on the fact that the problem is making you angry.

Tips



- Try to forgive those who anger you, rather than hold a grudge against them.
- Avoid using sarcasm and hurling insults. Instead, try and explain the reason for your frustration in a polite and mature manner.

14.1.8 Stress Management: What is Stress?

We say we are 'stressed' when we feel overloaded and unsure of our ability to deal with the pressures placed on us. Anything that challenges or threatens our well-being can be defined as a stress. It is important to note that stress can be good and bad. While good stress keeps us going, negative stress undermines our mental and physical health. This is why it is so important to manage negative stress effectively.

Causes of Stress

Stress can be caused by internal and external factors.

Internal causes of stress

- Constant worry
- Rigid thinking
- Unrealistic expectations
- Pessimism
- Negative self-talk
- All in or all out attitude

External causes of stress

- Major life changes
- Difficulties at work or in school
- Difficulties with relationships
- Financial difficulties
- Having too much to do
- Worrying about one's children and/or family

Symptoms of Stress

Stress can manifest itself in numerous ways. Take a look at the cognitive, emotional, physical and behavioral symptoms of stress.

Cognitive Symptoms	Emotional Symptoms
<ul style="list-style-type: none"> Memory problems Concentration issues Lack of judgement Pessimism Anxiety Constant worrying 	<ul style="list-style-type: none"> Depression Agitation Irritability Loneliness Anxiety Anger
Physical Symptoms	Behavioral Symptoms
<ul style="list-style-type: none"> Aches and pain Diarrhea or constipation Nausea Dizziness Chest pain and/or rapid heartbeat Frequent cold or flu like feelings 	<ul style="list-style-type: none"> Increase or decrease in appetite Over sleeping or not sleeping enough Withdrawing socially Ignoring responsibilities Consumption of alcohol or cigarettes Nervous habits like nail biting, pacing etc.

Tips to Manage Stress

The following tips can help you manage your stress better:

- Note down the different ways in which you can handle the various sources of your stress.
- Remember that you cannot control everything, but you can control how you respond.
- Discuss your feelings, opinions and beliefs rather than reacting angrily, defensively ~~passively~~.
- Practice relaxation techniques like meditation, yoga or tai chi when you start ~~feeling~~ stressed.
- Devote a part of your day towards exercise.
- Eat healthy foods like fruits and vegetables. Avoid unhealthy foods especially those containing large amounts of sugar.
- Plan your day so that you can manage your time better, with less stress.
- Say no to people and things when required.
- Schedule time to pursue your hobbies and interests.
- Ensure you get at least 7-8 hours of sleep.
- Reduce your caffeine intake.
- Increase the time spent with family and friends.

Tips



- Force yourself to smile even if you feel stressed. Smiling makes us feel relaxed and happy.
- Stop yourself from feeling and thinking like a victim. Change your attitude and focus on being proactive.

14.2: Digital Literacy: A Recap

Unit Objectives



At the end of this unit, you will be able to:

1. Identify the basic parts of a computer
2. Identify the basic parts of a keyboard
3. Recall basic computer terminology
4. Recall the functions of basic computer keys
5. Discuss the main applications of MS Office
6. Discuss the benefits of Microsoft Outlook
7. Discuss the different types of e-commerce
8. List the benefits of e-commerce for retailers and customers
9. Discuss how the Digital India campaign will help boost e-commerce in India
10. Describe how you will sell a product or service on an e-commerce platform

14.2.1 Computer and Internet basics: Basic Parts of a Computer

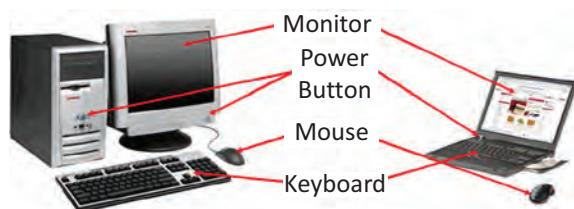


Fig.14.2.1. Parts of a Computer

- **Central Processing Unit (CPU):** The brain of the computer. It interprets and carries out program instructions.
- **Hard Drive:** A device that stores large amounts of data.
- **Monitor:** The device that contains the computer screen where the information is visually displayed.
- **Mouse:** A hand-held device used to point to items on the monitor.
- **Speakers:** Devices that enable you to hear sound from the computer.
- **Printer:** A device that converts output from a computer into printed paper documents.

Basic Parts of a Keyboard



Fig.14.2.2. Parts of a Keyboard

- **Arrow Keys:** Press these keys to move your cursor.
- **Space bar:** Adds a space.

- **Enter/Return:** Moves your cursor to a new line.
- **Shift:** Press this key if you want to type a capital letter or the upper symbol of a key.
- **Caps Lock:** Press this key if you want all the letters you type to be capital letters. Press it again to revert back to typing lowercase letters.
- **Backspace:** Deletes everything to the left of your cursor.

Basic Internet Terms

- **The Internet:** A vast, international collection of computer networks that transfers information.
- **The World Wide Web:** A system that lets you access information on the Internet.
- **Website:** A location on the World Wide Web (and Internet) that contains information about a specific topic.
- **Homepage:** Provides information about a website and directs you to other pages on that website.
- **Link/Hyperlink:** A highlighted or underlined icon, graphic, or text that takes you to another file or object.
- **Web Address/URL:** The address for a website.
- **Address Box:** A box in the browser window where you can type in a web address.

Tips



- When visiting a .com address, there is no need to type http:// or even www. Just type the name of the website and then press Ctrl + Enter. (Example: Type 'apple' and press Ctrl + Enter to go to www.apple.com)
- Press the Ctrl key and press the + or - to increase and decrease the size of text.
- Press F5 or Ctrl + R to refresh or reload a web page.

14.2.2 MS Office and Email: About MS Office

MS Office or Microsoft Office is a suite of computer programs developed by Microsoft. Although meant for all users, it offers different versions that cater specifically to students, home users and business users. All the programs are compatible with both, Windows and Macintosh.

Most Popular Office Products

Some of the most popular and universally used MS Office applications are:

- **Microsoft Word:** Allows users to type text and add images to a document.
- **Microsoft Excel:** Allows users to enter data into a spreadsheet and create calculations and graphs.
- **Microsoft PowerPoint:** Allows users to add text, pictures and media and create slideshows and presentations.
- **Microsoft Outlook:** Allows users to send and receive email.
- **Microsoft OneNote:** Allows users to make drawings and notes with the feel of a pen on paper.
- **Microsoft Access:** Allows users to store data over many tables.

Why Choose Microsoft Outlook?

A popular email management choice especially in the workplace, Microsoft Outlook also includes an address book, notebook, web browser and calendar. Some major benefits of this program are:

- **Integrated search function:** You can use keywords to search for data across all Outlook programs.
- **Enhanced security:** Your email is safe from hackers, junk mail and phishing website email.
- **Email syncing:** Sync your mail with your calendar, contact list, notes in One Note and...your phone!
- **Offline access to email:** No Internet? No problem! Write emails offline and send them when you're connected again.

Tips

- Press Ctrl+R as a shortcut method to reply to email.
- Set your desktop notifications only for very important emails.
- Flag messages quickly by selecting messages and hitting the Insert key.
- Save frequently sent emails as a template to reuse again and again.
- Conveniently save important emails as files.

14.2.3 E-Commerce: What is E-Commerce?

E-commerce is the buying or selling of goods and services, or the transmitting of money or data, electronically on the internet. E-Commerce is the short form for “electronic commerce.”

Examples of E-Commerce

Some examples of e-commerce are:

- Online shopping
- Online auctions
- Online ticketing
- Electronic payments
- Internet banking

Types of E-Commerce

E-commerce can be classified based on the types of participants in the transaction. The main types of e-commerce are:

- **Business to Business (B2B):** Both the transacting parties are businesses.
- **Business to Consumer (B2C):** Businesses sell electronically to end-consumers.
- **Consumer to Consumer (C2C):** Consumers come together to buy, sell or trade items to other consumers.
- **Consumer-to-Business (C2B):** Consumers make products or services available for purchase to companies looking for exactly those services or products.
- **Business-to-Administration (B2A):** Online transactions conducted between companies and public administration.
- **Consumer-to-Administration (C2A):** Online transactions conducted between individuals and public administration.

Benefits of E-Commerce

The e-commerce business provides some benefits for retailers and customers.

Benefits for retailers

- Establishes an online presence
- Reduces operational costs by removing overhead costs
- Increases brand awareness through the use of good keywords
- Increases sales by removing geographical and time constraints

Benefits for customers:

- Offers a wider range of choice than any physical store
- Enables goods and services to be purchased from remote locations
- Enables consumers to perform price comparisons

Digital India Campaign

Prime Minister Narendra Modi launched the Digital India campaign in 2015, with the objective of offering every citizen of India access to digital services, knowledge and information. The campaign aims to improve the country's online infrastructure and increase internet connectivity, thus boosting the e-commerce industry.

Currently, the majority of online transactions come from tier 2 and tier 3 cities. Once the Digital India campaign is in place, the government will deliver services through mobile connectivity, which will help deliver internet to remote corners of the country. This will help the e-commerce market to enter India's tier 4 towns and rural areas.

E-Commerce Activity

Choose a product or service that you want to sell online. Write a brief note explaining how you will use existing e-commerce platforms, or create a new e-commerce platform, to sell your product or service.

Tips



- Before launching your e-commerce platform, test everything.
- Pay close and personal attention to your social media.

14.3: Money Matters

Unit Objectives



At the end of this unit, you will be able to:

1. Discuss the importance of saving money
2. Discuss the benefits of saving money
3. Discuss the main types of bank accounts
4. Describe the process of opening a bank account
5. Differentiate between fixed and variable costs
6. Describe the main types of investment options
7. Describe the different types of insurance products
8. Describe the different types of taxes
9. Discuss the uses of online banking
10. Discuss the main types of electronic funds transfers

14.3.1 Personal Finance – Why to Save?: Importance of Saving

We all know that the future is unpredictable. You never know what will happen tomorrow, next week or next year. That's why saving money steadily through the years is so important. Saving money will help improve your financial situation over time. But more importantly, knowing that you have money stashed away for an emergency will give you peace of mind. Saving money also opens the door to many more options and possibilities.

Benefits of Saving

Inculcating the habit of saving leads to a vast number of benefits. Saving helps you:

- **Become financially independent:** When you have enough money saved up to feel secure you can start making your choices, from taking a vacation whenever you want, to switching careers or starting your own business.
- **Invest in yourself through education:** Through saving, you can earn enough to pay up for courses that will add to your professional experience and ultimately result in higher paying jobs.
- **Get out of debt:** Once you have saved enough as a reserve fund, you can use your savings to pay off debts like loans or bills that have accumulated over time.
- **Be prepared for surprise expenses:** Having money saved enables you to pay for unforeseen expenses like sudden car or house repairs, without feeling financially stressed.
- **Pay for emergencies:** Saving helps you deal with emergencies like sudden health issues or emergency trips without feeling financially burdened.
- **Afford large purchases and achieve major goals:** Saving diligently makes it possible to place down payments towards major purchases and goals, like buying a home or a car.
- **Retire:** The money you have saved over the years will keep you comfortable when you no longer have the income you would get from your job.

Tips



- Break your spending habit. Try not spending on one expensive item per week, and put the money that you would have spent into your savings.
- Decide that you will not buy anything on certain days or weeks and stick to your word.

14.3.2 Types of Bank Accounts, Opening a Bank Account: Types of Bank Accounts

In India, banks offer four main types of bank accounts. These are:

- Current Accounts
- Savings Accounts
- Recurring Deposit Accounts
- Fixed Deposit Accounts

Current Accounts

Current accounts offer the most liquid deposits and thus, are best suited for businessmen and companies. As these accounts are not meant for investments and savings, there is no imposed limit on the number or amount of transactions that can be made on any given day. Current account holders are not paid any interest on the amounts held in their accounts. They are charged for certain services offered on such accounts.

Saving Accounts

Savings accounts are meant to promote savings, and are therefore the number one choice for salaried individuals, pensioners and students. While there is no restriction on the number and amount of deposits made, there are usually restrictions on the number and amount of withdrawals. Savings account holders are paid interest on their savings.

Recurring Deposit Accounts

Recurring Deposit accounts, also called RD accounts, are the accounts of choice for those who want to save an amount every month, but are unable to invest a large sum at one time. Such account holders deposit a small, fixed amount every month for a pre-determined period (minimum 6 months). Defaulting on a monthly payment results in the account holder being charged a penalty amount. The total amount is repaid with interest at the end of the specified period.

Fixed Deposit Accounts

Fixed Deposit accounts, also called FD accounts, are ideal for those who wish to deposit their savings for a long term in return for a high rate of interest. The rate of interest offered depends on the amount deposited and the time period, and also differs from bank to bank. In the case of an FD, a certain amount of money is deposited by the account holder for a fixed period of time. The money can be withdrawn when the period expires. If necessary, the depositor can break the fixed deposit prematurely. However, this usually attracts a penalty amount which also differs from bank to bank.

Opening a Bank Account



Opening a bank account is quite a simple process. Take a look at the steps to open an account of your own:

Step 1: Fill in the Account Opening Form

This form requires you to provide the following information:

- Personal details (name, address, phone number, date of birth, gender, occupation, address)
- Method of receiving your account statement (hard copy/email)
- Details of your initial deposit (cash/cheque)
- Manner of operating your account (online/mobile banking/traditional via cheque, slip books)

Ensure that you sign wherever required on the form.

Step 2: Affix your Photograph

Stick a recent photograph of yourself in the allotted space on the form.

Step 3: Provide your Know Your Customer (KYC) Details

KYC is a process that helps banks verify the identity and address of their customers. To open an account, every individual needs to submit certain approved documents with respect to photo identity (ID) and address proof. Some Officially Valid Documents (OVDs) are:

- Passport
- Driving License
- Voters' Identity Card
- PAN Card
- UIDAI (Aadhaar) Card

Step 4: Submit All your Documents

Submit the completed Account Opening Form and KYC documents. Then wait until the forms are processed and your account has been opened!

Tips

- Select the right type of account.
- Fill in complete nomination details.
- Ask about fees.
- Understand the rules.
- Check for online banking – it's convenient!
- Keep an eye on your bank balance.

14.3.3 Costs: Fixed vs Variable: What are Fixed and Variable Costs?

Fixed costs and variable costs together make up a company's total cost. These are the two types of costs that companies have to bear when producing goods and services.

A fixed cost does not change with the volume of goods or services a company produces. It always remains the same.

A variable cost, on the other hand, increases and decreases depending on the volume of goods and services produced. In other words, it varies with the amount produced.

Differences Between Fixed and Variable Costs

Let's take a look at some of the main differences between fixed and variable costs:

Criteria	Fixed Costs	Variable Costs
Meaning	A cost that stays the same, regardless of the output produced.	A cost that changes when the output produced changes.
Nature	Time related.	Volume related.
Incurred	Incurred irrespective of units being produced.	Incurred only when units are produced.
Unit cost	Inversely proportional to the number of units produced.	Remains the same, per unit.
Examples	Depreciation, rent, salary, insurance, tax etc.	Material consumed, wages, commission on sales, packing expenses, etc.

Tips

- When trying to determine whether a cost is fixed or variable, simply ask the following question: Will the particular cost change if the company stopped its production activities? If the answer is no, then it is a fixed cost. If the answer is yes, then it is probably a variable cost.

14.3.4 Investment, Insurance and Taxes: Investment

Investment means that money is spent today with the aim of reaping financial gains at a future time. The main types of investment options are as follows:

- **Bonds:** Bonds are instruments used by public and private companies to raise large sums of money – too large to be borrowed from a bank. These bonds are then issued in the public market and are bought by lenders.
- **Stocks:** Stocks or equity are shares that are issued by companies and are bought by the general public.
- **Small Savings Schemes:** Small Savings Schemes are tools meant to save money in small amounts. Some popular schemes are the Employees Provident Fund, Sukanya Samriddhi Scheme and National Pension Scheme.
- **Mutual Funds:** Mutual Funds are professionally managed financial instruments that invest money in different securities on behalf of investors.
- **Fixed Deposits:** A fixed amount of money is kept aside with a financial institution for a fixed amount of time in return for interest on the money.
- **Real Estate:** Loans are taken from banks to purchase real estate, which is then leased or sold with the aim of making a profit on the appreciated property price.
- **Hedge Funds:** Hedge funds invest in both financial derivatives and/or publicly trade securities.
- **Private Equity:** Private Equity is trading in the shares of an operating company that is not publicly listed and whose shares are not available on the stock market.

Insurance

There are two types of insurance – Life Insurance and Non-Life or General Insurance.

Life Insurance

Life Insurance deals with all insurance covering human life.

Life Insurance Products

The main life insurance products are:

- **Term Insurance:** This is the simplest and cheapest form of insurance. It offers financial protection for a specified tenure, say 15 to 20 years. In the case of your death, your family is paid the sum assured. In the case of your surviving the term, the insurer pays nothing.
- **Endowment Policy:** This offers the dual benefit of insurance and investment. Part of the premium is allocated towards the sum assured, while the remaining premium gets invested in equity and debt. It pays a lump sum amount after the specified duration or on the death of the policyholder, whichever is earlier.
- **Unit-Linked Insurance Plan (ULIP):** Here part of the premium is spent on the life cover, while the remaining amount is invested in equity and debt. It helps develop a regular saving habit.
- **Money Back Life Insurance:** While the policyholder is alive, periodic payments of the partial survival benefits are made during the policy tenure. On the death of the insured, the insurance company pays the full sum assured along with survival benefits.
- **Whole Life Insurance:** It offers the dual benefit of insurance and investment. It offers insurance cover for the whole life of the person or up to 100 years whichever is earlier.

General Insurance

General Insurance deals with all insurance covering assets like animals, agricultural crops, goods, factories, cars and so on.

General Insurance Products

The main general insurance products are:

- **Motor Insurance:** This can be divided into Four Wheeler Insurance and Two Wheeler insurance.

- **Health Insurance:** The main types of health insurance are individual health insurance, family floater health insurance, comprehensive health insurance and critical illness insurance.
- **Travel Insurance:** This can be categorised into Individual Travel Policy, Family Travel Policy, Student Travel Insurance and Senior Citizen Health Insurance.
- **Home Insurance:** This protects the house and its contents from risk.
- **Marine Insurance:** This insurance covers goods, freight, cargo etc. against loss or damage during transit by rail, road, sea and/or air.

Taxes

There are two types of taxes – Direct Taxes and Indirect Taxes.

Direct Tax

Direct taxes are levied directly on an entity or a person and are non-transferrable.

Some examples of Direct Taxes are:

- **Income Tax:** This tax is levied on your earning in a financial year. It is applicable to both, individuals and companies.
- **Capital Gains Tax:** This tax is payable whenever you receive a sizable amount of money. It is usually of two types – short term capital gains from investments held for less than 36 months and long term capital gains from investments held for longer than 36 months.
- **Securities Transaction Tax:** This tax is added to the price of a share. It is levied every time you buy or sell shares.
- **Perquisite Tax:** This tax is levied on perks that have been acquired by a company or used by an employee.
- **Corporate Tax:** Corporate tax is paid by companies from the revenue they earn.

Indirect Tax

Indirect taxes are levied on goods or services.

Some examples of Indirect Taxes are:

- **Sales Tax:** Sales Tax is levied on the sale of a product.
- **Service Tax:** Service Tax is added to services provided in India.
- **Value Added Tax:** Value Added Tax is levied at the discretion of the state government. The tax is levied on goods sold in the state. The tax amount is decided by the state.
- **Customs Duty & Octroi:** Customs Duty is a charge that is applied on purchases that are imported from another country. Octroi is levied on goods that cross state borders within India.
- **Excise Duty:** Excise Duty is levied on all goods manufactured or produced in India.

Tips



- Think about how quickly you need your money back and pick an investment option accordingly.
- Ensure that you are buying the right type of insurance policy for yourself.
- Remember, not paying taxes can result in penalties ranging from fines to imprisonment.

14.3.5 Online Banking, NEFT, RTGS etc.: What is Online Banking?

Internet or online banking allows account holders to access their account from a laptop at any location. In this way, instructions can be issued. To access an account, account holders simply

Internet banking can be used to:

- Find out an account balance
- Transfer amounts from one account to another
- Arrange for the issuance of cheques
- Instruct payments to be made
- Request for a cheque book
- Request for a statement of accounts
- Make a fixed deposit

Electronic Funds Transfers

Electronic funds transfer is a convenient way of transferring money from the comfort of one's own home, using integrated banking tools like internet and mobile banking.

Transferring funds via an electronic gateway is extremely convenient. With the help of online banking, you can choose to:

- Transfer funds into your own accounts of the same bank.
- Transfer funds into different accounts of the same bank.
- Transfer funds into accounts in different bank, using NEFT.
- Transfer funds into other bank accounts using RTGS.
- Transfer funds into various accounts using IMPS.

NEFT

NEFT stands for National Electronic Funds Transfer. This money transfer system allows you to electronically transfer funds from your respective bank accounts to any other account, either in the same bank or belonging to any other bank. NEFT can be used by individuals, firms and corporate organizations to transfer funds between accounts.

In order to transfer funds via NEFT, two things are required:

- A transferring bank
- A destination bank

Before you can transfer funds through NEFT, you will need to register the beneficiary who will be receiving the funds. In order to complete this registration, you will require the following information:

- | | |
|--|---|
| <ul style="list-style-type: none"> • Recipient's name • Recipient's account number | <ul style="list-style-type: none"> • Recipient's bank's name • Recipient's bank's IFSC code |
|--|---|

RTGS

RTGS stands for Real Time Gross Settlement. This is a real time funds transfer system which enables you to transfer funds from one bank to another, in real time or on a gross basis. The transferred amount is immediately deducted from the account of one bank, and instantly credited to the other bank's account. The RTGS payment gateway is maintained by the Reserve Bank of India. The transactions between banks are made electronically. RTGS can be used by individuals, companies and firms to transfer large sums of money. Before remitting funds through RTGS, you will need to add the beneficiary and his bank account details via your online banking account. In order to complete this registration, you will require the

- | | |
|---|--|
| <ul style="list-style-type: none"> • Name of the beneficiary • Beneficiary's bank address | <ul style="list-style-type: none"> • Beneficiary's account number • Beneficiary's bank's IFSC code |
|---|--|

IMPS

IMPS stands for Immediate Payment Service. This is a real-time, inter-bank, electronic funds transfer system used to transfer money instantly within banks across India. IMPS enables users to make instant electronic transfer payments using mobile phones through both, Mobile Banking and SMS. It can also be used through ATMs and online banking. IMPS is available 24 hours a day and 7 days a week. The system features a secure transfer gateway and immediately confirms orders that have been fulfilled.

- Register for IMPS with your bank
- Receive a Mobile Money Identifier (MMID) from the bank
- Receive a MPIN from the bank

To transfer money through IMPS, you need to:

Once you have both these, you can login or make a request through SMS to transfer a particular amount to a beneficiary.

For the beneficiary to receive the transferred money, he must:

1. Link his mobile number with his respective account
2. Receive the MMID from the bank

In order to initiate a money transfer through IMPS, you will need to enter the following information:

1. The beneficiary's mobile number
2. The beneficiary's MMID
3. The transfer amount
4. Your MPIN

As soon as money has been deducted from your account and credited into the beneficiary's account, you will be sent a confirmation SMS with a transaction reference number, for future reference.

Differences Between NEFT, RTGS & IMPS

Criteria	NEFT	RTGS	IMPS
Settlement	Done in batches	Real-time	Real-time
Full form	National Electronic Fund Transfer	Real Time Gross Settlement	Immediate Payment Service
Timings on Monday – Friday	8:00 am – 6:30 pm	9:00 am – 4:30 pm	24x7
Timings on Saturday	8:00 am – 1:00 pm	9:00 am – 1:30 pm	24x7
Minimum amount of money transfer limit	₹1	₹2 lacs	₹1
Maximum amount of money transfer limit	₹10 lacs	₹10 lacs per day	₹2 lacs
Maximum charges as per RBI	Upto 10,000 – ₹2.5 above 10,000 – 1 lac – ₹5 above 1 – 2 lacs – ₹15 above 2 – 5 lacs – ₹25 above 5 – 10 lacs – ₹25	above 2 – 5 lacs – ₹25 above 5 – 10 lacs – ₹50	Upto 10,000 – ₹5 above 10,000 – 1 lac – ₹5 above 1 – 2 lacs – ₹15

Tips



- Never click on any links in any e-mail message to access your online banking website.
- You will never be asked for your credit or debit card details while using online banking.
- Change your online banking password regularly.

14.4: Preparing for Employment & Self Employment

Unit Objectives



At the end of this unit, you will be able to:

1. Discuss the steps to prepare for an interview
2. Discuss the steps to create an effective Resume
3. Discuss the most frequently asked interview questions
4. Discuss how to answer the most frequently asked interview questions
5. Discuss basic workplace terminology

14.4.1 Interview Preparation: How to Prepare for an Interview ?

The success of your getting the job that you want depends largely on how well your interview for that job goes. Therefore, before you go in for your interview, it is important that you prepare for it with a fair amount of research and planning. Take a look at the steps to follow in order to be well prepared for an interview:

- 1. Research the organization that you are having the interview with.**
 - Studying the company beforehand will help you be more prepared at the time of the interview. Your knowledge of the organization will help you answer questions at the time of the interview, and will leave you looking and feeling more confident. This is sure to make you stand out from other, not as well informed, candidates.
 - Look for background information on the company. Try and find an overview of the company and its industry profile.
 - Visit the company website to get a good idea of what the company does. A company website offers a wealth of important information. Read and understand the company's mission statement. Pay attention to the company's products/services and client list. Read through any press releases to get an idea of the company's projected growth and stability.
 - Note down any questions that you have after your research has been completed.
- 2. Think about whether your skills and qualifications match the job requirements.**
 - Carefully read through and analyze the job description.
 - Make a note of the knowledge, skills and abilities required to fulfill the job requirements.
 - Take a look at the organization hierarchy. Figure out where the position you are applying for fits into this hierarchy.
- 3. Go through the most typical interview questions asked, and prepare your responses.**
 - Remember, in most interviews a mix of resume-based, behavioral and case study questions are asked.
 - Think about the kind of answers you would like to provide to typical questions asked in these three areas.
 - Practice these answers until you can express them confidently and clearly.
- 4. Plan your attire for the interview.**
 - It is always safest to opt for formal business attire, unless expressly informed to dress in business casual (in which case you should use your best judgement).

- Ensure that your clothes are clean and well-ironed. Pick neutral colours – nothing too bright or flashy.
 - The shoes you wear should match your clothes, and should be clean and suitable for an interview.
 - Remember, your aim is to leave everyone you meet with the impression that you are a professional and highly efficient person.
5. **Ensure that you have packed everything that you may require during the interview.**
- Carry a few copies of your resume. Use a good quality paper for your resume print outs.
 - Always take along a notepad and a pen.
 - Take along any information you may need to refer to, in order to fill out an application form.
 - Carry a few samples of your work, if relevant.
6. **Remember the importance of non-verbal communication.**
- Practice projecting confidence. Remind yourself to smile and make eye contact. Practice giving a firm handshake.
 - Keep in mind the importance of posture. Practice sitting up straight. Train yourself to stop nervous gestures like fidgeting and foot-tapping.
 - Practice keeping your reactions in check. Remember, your facial expressions provide a good insight into your true feelings. Practice projecting a positive image.
7. **Make a list of questions to end the interview with.**
- Most interviews will end with the interviewer(s) asking if you have any questions. This is your chance to show that you have done your research and are interested in learning more about the company.
 - If the interviewer does not ask you this question, you can inform him/her that you have some queries that you would like to discuss. This is the time for you to refer to the notes you made while studying the company.
 - Some good questions to ask at this point are:
 - What do you consider the most important criteria for success in this job?
 - How will my performance be evaluated?
 - What are the opportunities for advancement?
 - What are the next steps in the hiring process?
 - Remember, never ask for information that is easily available on the company website.

Tips

- Ask insightful and probing questions.
- When communicating, use effective forms of body language like smiling, making eye contact, and actively listening and nodding. Don't slouch, play with nearby items, fidget, chew gum, or mumble.

14.4.2 Preparing an Effective Resume: How to Create an Effective Resume?



A resume is a formal document that lists a candidate's work experience, education and skills. A good resume gives a potential employer enough information to believe the applicant is worth interviewing. That's why it is so important to create a résumé that is effective. Take a look at the steps to create an effective resume:

Step 1: Write the Address Section

The Address section occupies the top of your resume. It includes information like your name, address,

phone number and e-mail address. Insert a bold line under the section to separate it from rest of your resume.

Example:

Khyati Mehta
Breach Candy, Mumbai – India
Contact No: +91 2223678270
Email: jasmine.watts@gmail.com

Step 2: Add the Profile Summary Section

This part of your resume should list your overall experiences, achievements, awards, certifications and strengths. You can make your summary as short as 2-3 bullet points or as long as 8-10 bullet points.

Example:

Profile Summary

- A Floor Supervisor graduated from University of Delhi having 6 years of experience in managing a retail outlet.
- Core expertise lies in managing retail staff, including cashiers and people working on the floor.

Step 3: Include Your Educational Qualifications

When listing your academic records, first list your highest degree. Then add the second highest qualification under the highest one and so on. To provide a clear and accurate picture of your educational background, it is critical that include information on your position, rank, percentage or CPI for every degree or certification that you have listed.

If you have done any certifications and trainings, you can add a Trainings & Certifications section under your Educational Qualifications section.

Example:

Educational Qualifications

- <Enter qualification> <enter date of qualification> from <enter name of institute> with <enter percentage or any other relevant scoring system>.

Step 4: List Your Technical Skills

When listing your technical skills, start with the skills that you are most confident about. Then add the skills that you do not have as good a command over. It is perfectly acceptable to include just one skill, if you feel that particular skill adds tremendous value to your résumé. If you do not have any technical skills, you can omit this step.

Example:

Technical Skills

- <Enter your technical skill here, if applicable>

Step 5: Insert Your Academic Project Experience

List down all the important projects that you have worked on. Include the following information in this section:

- | | | |
|--|--|---|
| <ul style="list-style-type: none">• Project title• Contribution | <ul style="list-style-type: none">• Organization• Description | <ul style="list-style-type: none">• Platform used |
|--|--|---|

Example:

Academic Projects

Project Title: <Insert project title>

Organization: <Insert the name of the organization for whom you did the project>

Platform used: <Insert the platform used, if any>

Contribution: <Insert your contribution towards this project>

Description: <Insert a description of the project in one line>

Step 6: List Your Strengths

This is where you list all your major strengths. This section should be in the form of a bulleted list.

Example:

Strengths

- Excellent oral, written and presentation skills
- Action-oriented and result-focused
- Great time management skills

Step 7: List Your Extracurricular Activities

It is very important to show that you have diverse interests and that your life consists of more than academics. Including your extracurricular activities can give you an added edge over other candidates who have similar academic scores and project experiences. This section should be in the form of a bulleted list.

Example:

- <Insert your extracurricular activity here. E.g.: Member of, _____ played (name of sport) at _____ level, won (name of prize/award) for _____>

Step 8: Write Your Personal Details

The last section of your résumé must include the following personal information:

- | | |
|-----------------|---------------------------|
| • Date of birth | • Gender & marital status |
| • Nationality | • Languages known |

Example:

Personal Details

- | | |
|----------------------------|-------------------------------|
| • Date of birth: | 25 th May, 1981 |
| • Gender & marital status: | Female, Single |
| • Nationality: | Indian |
| • Languages known: | English, Hindi, Tamil, French |

Tips



- Keep your resume file name short, simple and informational.
- Make sure the resume is neat and free from typing errors.
- Always create your resume on plain white paper.

14.4.3 Interview FAQs

Take a look at some of the most frequently asked interview questions, and some helpful tips on how to answer them.

Q1. Can you tell me a little about yourself?

Tips to answer:

- Don't provide your full employment or personal history.
- Offer 2-3 specific experiences that you feel are most valuable and relevant.
- Conclude with how those experiences have made you perfect for this specific role.

Q2. How did you hear about the position?

Tips to answer:

- Tell the interviewer how you heard about the job – whether it was through a friend (name the friend), event or article (name them) or a job portal (say which one).
- Explain what excites you about the position and what in particular caught your eye about this role.

Q3. What do you know about the company?

Tips to answer:

- Don't recite the company's About Us page.
- Show that you understand and care about the company's goals.
- Explain why you believe in the company's mission and values.

Q4. Why do you want this job?

Tips to answer:

- Show that you are passionate about the job.
- Identify why the role is a great fit for you.
- Explain why you love the company.

Q5. Why should we hire you?

Tips to answer:

- Prove through your words that you can not only do the work, but can definitely deliver excellent results.
- Explain why you would be a great fit with the team and work culture.
- Explain why you should be chosen over any other candidate.

Q6. What are your greatest professional strengths?

Tips to answer:

- Be honest – share some of your real strengths, rather than give answers that you think sound good.
- Offer examples of specific strengths that are relevant to the position you are applying for.
- Provide examples of how you've demonstrated these strengths.

Q7. What do you consider to be your weaknesses?

Tips to answer:

- The purpose of this question is to gauge your self-awareness and honesty.
- Give an example of a trait that you struggle with, but that you're working on to improve.

Q8. What are your salary requirements?

Tips to answer:

- Do your research beforehand and find out the typical salary range for the job you are applying for.
- Figure out where you lie on the pay scale based on your experience, education, and skills.
- Be flexible. Tell the interviewer that you know your skills are valuable, but that you want the job and are willing to negotiate.

Q9. What do you like to do outside of work?

Tips to answer:

- The purpose of this question is to see if you will fit in with the company culture.
- Be honest – open up and share activities and hobbies that interest and excite you.

Q10. If you were an animal, which one would you want to be?

Tips to answer:

- The purpose of this question is to see if you are able to think on your feet.
- There's no wrong answer – but to make a great impression try to bring out your strengths or personality traits through your answer.

Q11: What do you think we could do better or differently?

Tips to answer:

- The purpose of this question is to see if you have done your research on the company, and to test whether you can think critically and come up with new ideas.
- Suggest new ideas. Show how your interests and expertise would help you execute these ideas.

Q12: Do you have any questions for us?

Tips to answer:

- Do not ask questions to which the answers can be easily found on the company website or through a quick online search.
- Ask intelligent questions that show your ability to think critically.

Tips



- Be honest and confident while answering.
- Use examples of your past experiences wherever possible to make your answers more impactful.

14.4.4 Work Readiness – Terms & Terminologies: Basic Workplace Terminology

Every employee should be well versed in the following terms:

- **Annual leave:** Paid vacation leave given by employers to employees.
- **Background Check:** A method used by employers to verify the accuracy of the information provided by potential candidates.
- **Benefits:** A part of an employee's compensation package.
- **Breaks:** Short periods of rest taken by employees during working hours.

- **Compensation Package:** The combination of salary and benefits that an employer provides to his/her employees.
- **Compensatory Time (Comp Time):** Time off in lieu of pay.
- **Contract Employee:** An employee who works for one organization that sells said employee's service to another company, either on a project or time basis.
- **Contract of Employment:** When an employee is offered work in exchange for wages or salary, and accepts the offer made by the employer, a contract of employment exists.
- **Corporate Culture:** The beliefs and values shared by all the members of a company, and imparted from one generation of employees to another.
- **Counter Offer/Counter Proposal:** A negotiation technique used by potential candidates to increase the amount of salary offered by a company.
- **Cover Letter:** A letter that accompanies a candidate's resume. It emphasizes the important points in the candidate's resume and provides real examples that prove the candidate's ability to perform the expected job role.
- **Curriculum Vitae (CV)/Resume:** A summary of a candidate's achievements, educational background, work experience, skills and strengths.
- **Declining Letter:** A letter sent by an employee to an employer, turning down the job offer made by the employer to the employee.
- **Deductions:** Amounts subtracted from an employee's pay and listed on the employee's pay slip.
- **Discrimination:** The act of treating one person not as favourably as another person.
- **Employee:** A person who works for another person in exchange for payment.
- **Employee Training:** A workshop or in-house training that an employee is asked to attend by his or her superior, for the benefit of the employer.
- **Employment Gaps:** Periods of unemployed time between jobs.
- **Fixed-Term Contract:** A contract of employment which gets terminated on an agreed-upon date.
- **Follow-Up:** The act of contacting a potential employer after a candidate has submitted his or her resume.
- **Freelancer/Consultant/Independent Contractor:** A person who works for him or herself and pitches for temporary jobs and projects with different employers.
- **Holiday:** Paid time-off from work.
- **Hourly Rate:** The amount of salary or wages paid for 60 minutes of work.
- **Internship:** A job opportunity offered by an employer to a potential employee, called an intern, to work at the employer's company for a fixed, limited time period.
- **Interview:** A conversation between a potential employee and a representative of an employer, in order to determine if the potential employee should be hired.
- **Job Application:** A form which asks for a candidate's information like the candidate's name, address, contact details and work experience. The purpose of a candidate submitting a job application, is to show that candidate's interest in working for a particular company.
- **Job Offer:** An offer of employment made by an employer to a potential employee.
- **Job Search Agent:** A program that enables candidates to search for employment opportunities by selecting criteria listed in the program, for job vacancies.
- **Lay Off:** A lay off occurs when an employee is temporarily let go from his or her job, due to the employer not having any work for that employee.
- **Leave:** Formal permission given to an employee, by his or her employer, to take a leave of absence from work.

- **Letter of Acceptance:** A letter given by an employer to an employee, confirming the offer of employment made by the employer, as well as the conditions of the offer.
- **Letter of Agreement:** A letter that outlines the terms of employment.
- **Letter of Recommendation:** A letter written for the purpose of validating the work skills of a person.
- **Maternity Leave:** Leave taken from work by women who are pregnant, or who have just given birth.
- **Mentor:** A person who is employed at a higher level than you, who offers you advice and guides you in your career.
- **Minimum wage:** The minimum wage amount paid on an hourly basis.
- **Notice:** An announcement made by an employee or an employer, stating that the employment contract will end on a particular date.
- **Offer of Employment:** An offer made by an employer to a prospective employee that contains important information pertaining to the job being offered, like the starting date, salary, working conditions etc.
- **Open-Ended Contract:** A contract of employment that continues till the employer or employee terminates it.
- **Overqualified:** A person who is not suited for a particular job because he or she has too many years of work experience, or a level of education that is much higher than required for the job, or is currently or was previously too highly paid.
- **Part-Time Worker:** An employee who works for fewer hours than the standard number of hours normally worked.
- **Paternity Leave:** Leave granted to a man who has recently become a father.
- **Recruiters/Headhunters/Executive Search Firms:** Professionals who are paid by employers to search for people to fill particular positions.
- **Resigning/Resignations:** When an employee formally informs his or her employer that he or she is quitting his or her job.
- **Self-Employed:** A person who has his or her own business and does not work in the capacity of an employee.
- **Time Sheet:** A form that is submitted to an employer, by an employee, that contains the number of hours worked every day by the employee.

14.5: Understanding Entrepreneurship

Unit Objectives



1. Discuss the concept of entrepreneurship
2. Discuss the importance of entrepreneurship
3. Describe the characteristics of an entrepreneur
4. Describe the different types of enterprises
5. List the qualities of an effective leader
6. Discuss the benefits of effective leadership
7. List the traits of an effective team
8. Discuss the importance of listening effectively
9. Discuss how to listen effectively
10. Discuss the importance of speaking effectively
11. Discuss how to speak effectively
12. Discuss how to solve problems
13. List important problem solving traits
14. Discuss ways to assess problem solving skills
15. Discuss the importance of negotiation
16. Discuss how to negotiate
17. Discuss how to identify new business opportunities
18. Discuss how to identify business opportunities within your business
19. Explain the meaning of entrepreneur
20. Describe the different types of entrepreneurs
21. List the characteristics of entrepreneurs
22. Recall entrepreneur success stories
23. Discuss the entrepreneurial process
24. Describe the entrepreneurship ecosystem
25. Discuss the purpose of the Make in India campaign
26. Discuss key schemes to promote entrepreneurs
27. Discuss the relationship between entrepreneurship and risk appetite
28. Discuss the relationship between entrepreneurship and resilience
29. Describe the characteristics of a resilient entrepreneur
30. Discuss how to deal with failure

14.5.1 Concept Introduction (Characteristic of an Entrepreneur, types of firms / types of enterprises)

Entrepreneurs and Entrepreneurship

Anyone who is determined to start a business, no matter what the risk, is an entrepreneur. Entrepreneurs run their own start-up, take responsibility for the financial risks and use creativity, innovation and vast reserves of self-motivation to achieve success. They dream big and are determined to do whatever it takes to turn their idea into a viable offering. The aim of an entrepreneur is to create an enterprise. The process of creating this enterprise is known as entrepreneurship.

Importance of Entrepreneurship

Entrepreneurship is very important for the following reasons:

1. It results in the creation of new organizations
2. It brings creativity into the marketplace
3. It leads to improved standards of living
4. It helps develop the economy of a country

Characteristics of Entrepreneurs

All successful entrepreneurs have certain characteristics in common.

They are all:

- Extremely passionate about their work
- Confident in themselves
- Disciplined and dedicated
- Motivated and driven
- Highly creative
- Visionaries
- Open-minded
- Decisive

Entrepreneurs also have a tendency to:

- Have a high risk tolerance
- Thoroughly plan everything
- Manage their money wisely
- Make their customers their priority
- Understand their offering and their market in detail
- Ask for advice from experts when required
- Know when to cut their losses

Examples of Famous Entrepreneurs

Some famous entrepreneurs are:

- Dhirubhai Ambani (Reliance)
- Dr. Karsanbhai Patel (Nirma)
- Azim Premji (Wipro)
- Anil Agarwal (Vedanta Resources)

Types of Enterprises

As an entrepreneur in India, you can own and run any of the following types of enterprises:

Sole Proprietorship

In a sole proprietorship, a single individual owns, manages and controls the enterprise. This type of business is the easiest to form with respect to legal formalities. The business and the owner have no separate legal existence. All profit belongs to the proprietor, as do all the losses the liability of the entrepreneur is unlimited.

Partnership

A partnership firm is formed by two or more people. The owners of the enterprise are called partners. A partnership deed must be signed by all the partners. The firm and its partners have no separate legal existence. The profits are shared by the partners. With respect to losses, the liability of the partners is unlimited. A firm has a limited life span and must be dissolved when any one of the partners dies, retires, claims bankruptcy or goes insane.

Limited Liability Partnership (LLP)

In a Limited Liability Partnership or LLP, the partners of the firm enjoy perpetual existence as well as the advantage of limited liability. Each partner's liability is limited to their agreed contribution to the LLP. The partnership and its partners have a separate legal existence.

Tips



- Learn from others' failures.
- Be certain that this is what you want.
- Search for a problem to solve, rather than look for a problem to attach to your idea.

14.5.2 Leadership & Teamwork: Leadership and Leaders

Leadership means setting an example for others to follow. Setting a good example means not asking someone to do something that you wouldn't willingly want to do yourself. Leadership is about figuring out what to do in order to win as a team, and as a company.

Leaders believe in doing the right things. They also believe in helping others to do the right things. An effective leader is someone who:

- Creates an inspiring vision of the future.
- Motivates and inspires his team to pursue that vision.

Leadership Qualities That All Entrepreneurs Need

Building a successful enterprise is only possible if the entrepreneur in charge possesses excellent leadership qualities. Some critical leadership skills that every entrepreneur must have are:

1. **Pragmatism:** This means having the ability to highlight all obstacles and challenges, in order to resolve issues and reduce risks.
2. **Humility:** This means admitting to mistakes often and early, and being quick to take responsibility for your actions. Mistakes should be viewed as challenges to overcome, not opportunities to point blame.
3. **Flexibility:** It is critical for a good leader to be very flexible and quickly adapt to change. It is equally critical to know when to adapt and when not to.
4. **Authenticity:** This means showing both, your strengths and your weaknesses. It means being human and showing others that you are human.
5. **Reinvention:** This means refreshing or changing your leadership style when necessary. To do this, it's important to learn where your leadership gaps lie and find out what resources are required to close them.
6. **Awareness:** This means taking the time to recognize how others view you. It means understanding how your presence affects those around you.

Benefits of Effective Leadership

Effective leadership results in numerous benefits. Great leadership leads to the leader successfully:

- Gaining the loyalty and commitment of the team members
- Motivating the team to work towards achieving the company's goals and objectives
- Building morale and instilling confidence in the team members
- Fostering mutual understanding and team-spirit among team members
- Convincing team members about the need to change when a situation requires adaptability

Teamwork and Teams

Teamwork occurs when the people in a workplace combine their individual skills to pursue a common goal. Effective teams are made up of individuals who work together to achieve this common goal. A great team is one who holds themselves accountable for the end result.

Importance of Teamwork in Entrepreneurial Success

For an entrepreneurial leader, building an effective team is critical to the success of a venture. An entrepreneur must ensure that the team he builds possesses certain crucial qualities, traits and characteristics. An effective team is one which has:

1. **Unity of purpose:** All the team members should clearly understand and be equally committed to the purpose, vision and goals of the team.
2. **Great communication skills:** Team members should have the ability to express their concerns, ask questions and use diagrams, and charts to convey complex information.
3. **The ability to collaborate:** Every member should feel entitled to provide regular feedback on new ideas.
4. **Initiative:** The team should consist of proactive individuals. The members should have the enthusiasm to come up with new ideas, improve existing ideas, and conduct their own research.
5. **Visionary members:** The team should have the ability to anticipate problems and act on these potential problem before they turn into real problems.
6. **Great adaptability skills:** The team must believe that change is a positive force. Change should be seen as the chance to improve and try new things.
7. **Excellent organizational skills:** The team should have the ability to develop standard work processes, balance responsibilities, properly plan projects, and set in place methods to measure progress and ROI.

Tips



- Don't get too attached to your original idea. Allow it to evolve and change.
- Be aware of your weaknesses and build a team that will complement your shortfalls.
- Hiring the right people is not enough. You need to promote or incentivize your most talented people to keep them motivated.
- Earn your team's respect.

14.5.3 Communication Skills: Listening & Speaking: The Importance of Listening Effectively

Listening is the ability to correctly receive and understand messages during the process of communication. Listening is critical for effective communication. Without effective listening skills, messages can easily be misunderstood. This results in a communication breakdown and can lead to the sender and the receiver of the message becoming frustrated or irritated. It's very important to note that listening is not the same as hearing. Hearing just refers to sounds that you hear. Listening is a whole lot more than that. To listen, one requires focus. It means not only paying attention to the story, but also focusing on how the story is relayed, the way language and voice is used, and even how the speaker uses their body language. The ability to listen depends on how effectively one can perceive and understand both, verbal and non-verbal cues.

How to Listen Effectively?

To listen effectively you should:

- Stop talking
- Stop interrupting
- Focus completely on what is being said
- Nod and use encouraging words and gestures
- Be open-minded
- Think about the speaker's perspective
- Be very, very patient
- Pay attention to the tone that is being used
- Pay attention to the speaker's gestures, facial expressions and eye movements
- Not try and rush the person
- Not let the speaker's mannerisms or habits irritate or distract you

The Importance of Speaking Effectively

How successfully a message gets conveyed depends entirely on how effectively you are able to get it through. An effective speaker is one who enunciates properly, pronounces words correctly, chooses the right words and speaks at a pace that is easily understandable. Besides this, the words spoken out loud need to match the gestures, tone and body language used. What you say, and the tone in which you say it, results in numerous perceptions being formed. A person who speaks hesitantly may be perceived as having low self-esteem or lacking in knowledge of the discussed topic. Those with a quiet voice may very well be labelled as shy. And those who speak in commanding tones with high levels of clarity, are usually considered to be extremely confident. This makes speaking a very critical communication skill.

How to Speak Effectively?

To speak effectively you should:

- Incorporate body language in your speech like eye contact, smiling, nodding, gesturing etc.
- Build a draft of your speech before actually making your speech.
- Ensure that all your emotions and feelings are under control.
- Pronounce your words distinctly with the correct pitch and intensity. Your speech should be crystal clear at all times.
- Use a pleasant and natural tone when speaking. Your audience should not feel like you are putting on an accent or being unnatural in any way.
- Use precise and specific words to drive your message home. Ambiguity should be avoided at all costs.
- Ensure that your speech has a logical flow.
- Be brief. Don't add any unnecessary information.
- Make a conscious effort to avoid irritating mannerisms like fidgeting, twitching etc.

- Choose your words carefully and use simple words that the majority of the audience will have no difficulty understanding.
- Use visual aids like slides or a whiteboard.
- Speak slowly so that your audience can easily understand what you're saying. However, be careful not to speak too slowly because this can come across as stiff, unprepared or even condescending.
- Remember to pause at the right moments.

Tips

- If you're finding it difficult to focus on what someone is saying, try repeating their words in your head.
- Always maintain eye contact with the person that you are communicating with, when speaking as well as listening. This conveys and also encourages interest in the conversation.

14.5.4 Problem Solving & Negotiation Skills: What is a Problem?

As per The Concise Oxford Dictionary (1995), a problem is, "A doubtful or difficult matter requiring a solution" All problems contain two elements:

1. Goals
2. Obstacles

The aim of problem solving is to recognize the obstacles and remove them in order to achieve the goals.

How to Solve Problems ?



Solving a problem requires a level of rational thinking. Here are some logical steps to follow when faced with an issue:

- | | |
|--|--|
| Step 1: Identify the problem | Step 2: Study the problem in detail |
| Step 3: List all possible solutions | Step 4: Select the best solution |
| Step 5: Implement the chosen solution | Step 6: Check that the problem has really been solved |

Important Traits for Problem Solving

Highly developed problem solving skills are critical for both, business owners and their employees. The following personality traits play a big role in how effectively problems are solved:

- | | |
|------------------------------|---------------------------------|
| • Being open minded | • Not panicking |
| • Asking the right questions | • Having a positive attitude |
| • Being proactive | • Focusing on the right problem |

How to Assess for Problem Solving Skills?

As an entrepreneur, it would be a good idea to assess the level of problem solving skills of potential candidates before hiring them. Some ways to assess this skill are through:

1. Application forms: Ask for proof of the candidate's problem solving skills in the application form.
2. Psychometric tests: Give potential candidates logical reasoning and critical thinking tests and see how they fare.
3. Interviews: Create hypothetical problematic situations or raise ethical questions and see how the candidates respond.
4. Technical questions: Give candidates examples of real life problems and evaluate their thought process.

What is Negotiation?

Negotiation is a method used to settle differences. The aim of negotiation is to resolve differences through a compromise or agreement while avoiding disputes. Without negotiation, conflicts are likely to lead to resentment between people. Good negotiation skills help satisfy both parties and go a long way towards developing strong relationships.

Why Negotiate?

Starting a business requires many, many negotiations. Some negotiations are small while others are critical enough to make or break a startup. Negotiation also plays a big role inside the workplace. As an entrepreneur, you need to know not only how to negotiate yourself, but also how to train employees in the art of negotiation.

How to Negotiate?

Take a look at some steps to help you negotiate:

Step 1: Pre-Negotiation Preparation	Agree on where to meet to discuss the problem, decide who all will be present and set a time limit for the discussion.
Step 2: Discuss the Problem	This involves asking questions, listening to the other side, putting your views forward and clarifying doubts.
Step 3: Clarify the Objective	Ensure that both parties want to solve the same problem and reach the same goal.
Step 4: Aim for a Win-Win Outcome	Try your best to be open minded when negotiating. Compromise and offer alternate solutions to reach an outcome where both parties win.
Step 5: Clearly Define the Agreement	When an agreement has been reached, the details of the agreement should be crystal clear to both sides, with no scope for misunderstandings.
Step 6: Implement the Agreed Upon Solution	Agree on a course of action to set the solution in motion

Tips

- Know exactly what you want before you work towards getting it
- Give more importance to listening and thinking, than speaking
- Focus on building a relationship rather than winning
- Remember that your people skills will affect the outcome
- Know when to walk away – sometimes reaching an agreement may not be possible

14.5.5 Business Opportunities Identification: Entrepreneurs and Opportunities

“The entrepreneur always searches for change, responds to it and exploits it as an opportunity.”

Peter Drucker

The ability to identify business opportunities is an essential characteristic of an entrepreneur.

What is an Opportunity?

The word opportunity suggests a good chance or a favourable situation to do something offered by circumstances.

A business opportunity means a good or favourable change available to run a specific business in a given environment, at a given point of time.

Common Questions Faced by Entrepreneurs

A critical question that all entrepreneurs face is how to go about finding the business opportunity that is right for them.

Some common questions that entrepreneurs constantly think about are:

- Should the new enterprise introduce a new product or service based on an unmet need?
- Should the new enterprise select an existing product or service from one market and offer it in another where it may not be available?
- Should the enterprise be based on a tried and tested formula that has worked elsewhere?

It is therefore extremely important that entrepreneurs must learn how to identify new and existing business opportunities and evaluate their chances of success.

When is an Idea an Opportunity?

An idea is an opportunity when:

- It creates or adds value to a customer
- It solves a significant problem, removes a pain point or meets a demand
- Has a robust market and profit margin
- Is a good fit with the founder and management team at the right time and place

Factors to Consider When Looking for Opportunities

Consider the following when looking for business opportunities:

- | | |
|---|---|
| <ul style="list-style-type: none">• Economic trends• Changes in funding• Changing relationships between vendors, partners and suppliers | <ul style="list-style-type: none">• Market trends• Changes in political support• Shift in target audience |
|---|---|

Ways to Identify New Business Opportunities

1. Identify Market Inefficiencies

When looking at a market, consider what inefficiencies are present in the market. Think about ways to correct these inefficiencies.

2. Remove Key Hassles

Rather than create a new product or service, you can innovatively improve a product, service or process.

3. Create Something New

Think about how you can create a new experience for customers, based on existing business models.

4. Pick a Growing Sector/Industry

Research and find out which sectors or industries are growing and think about what opportunities you can tap in the same.

5. Think About Product Differentiation

If you already have a product in mind, think about ways to set it apart from the existing ones.

Ways to Identify Business Opportunities Within Your Business

1. SWOT Analysis

An excellent way to identify opportunities inside your business is by creating a SWOT analysis. The acronym SWOT stands for strengths, weaknesses, opportunities, and threats. SWOT analysis framework:

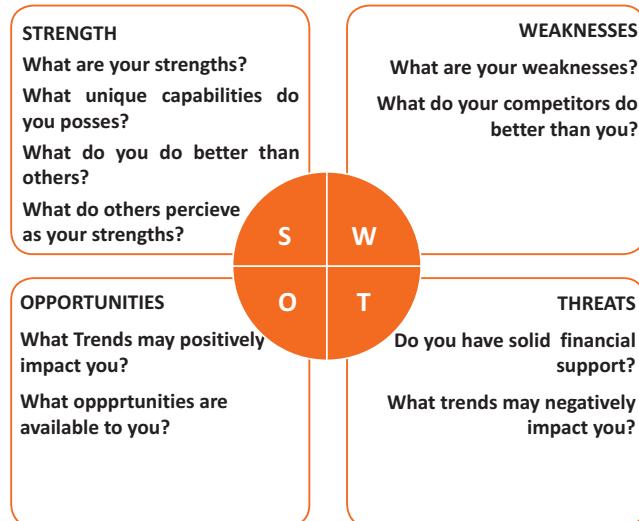


Fig.14.5.1. SWOT Analysis

Consider the following when looking for business opportunities:

By looking at yourself and your competitors using the SWOT framework, you can uncover opportunities that you can exploit, as well as manage and eliminate threats that could derail your success.

2. Establishing Your USP

Establish your USP and position yourself as different from your competitors. Identify why customers should buy from you and promote that reason.

Opportunity Analysis

Once you have identified an opportunity, you need to analyze it.

To analyze an opportunity, you must:

- Focus on the idea
- Focus on the market of the idea
- Talk to industry leaders in the same space as the idea
- Talk to players in the same space as the idea

Tips



- Remember, opportunities are situational.
- Look for a proven track record.
- Avoid the latest craze.
- Love your idea.

14.5.6 Entrepreneurship Support Eco - System: Who is an Entrepreneur?

An entrepreneur is a person who:

- Does not work for an employee
- Runs a small enterprise
- Assumes all the risks and rewards of the enterprise, idea, good or service

Types of Entrepreneurs

There are four main types of entrepreneurs:

1. The Traditional Entrepreneur: This type of entrepreneur usually has some kind of skill –they can be a carpenter, mechanic, cook etc. They have businesses that have been around for numerous years like restaurants, shops and carpenters. Typically, they gain plenty of experience in a particular industry before they begin their own business in a similar field.

2. **The Growth Potential Entrepreneur:** The desire of this type of entrepreneur is to start an enterprise that will grow, win many customers and make lots of money. Their ultimate aim is to eventually sell their enterprise for a nice profit. Such entrepreneurs usually have a science or technical background.
3. **The Project-Oriented Entrepreneur:** This type of entrepreneur generally has a background in the Arts or psychology. Their enterprises tend to be focus on something that they are very passionate about.
4. **The Lifestyle Entrepreneur:** This type of entrepreneur has usually worked as a teacher or a secretary. They are more interested in selling something that people will enjoy, rather than making lots of money.

Characteristics of an Entrepreneur

Successful entrepreneurs have the following characteristics:

- They are highly motivated
- They are creative and persuasive
- They are mentally prepared to handle each and every task
- They have excellent business skills – they know how to evaluate their cash flow, sales and revenue
- They are willing to take great risks
- They are very proactive – this means they are willing to do the work themselves, rather than wait for someone else to do it
- They have a vision – they are able to see the big picture
- They are flexible and open-minded
- They are good at making decisions

Entrepreneur Success Stories

Dhiru Bhai Ambani

Dhirubhai Ambani began his entrepreneurial career by selling “bhajias” to pilgrims in Mount Girnar on weekends. At 16, he moved to Yemen where he worked as a gas-station attendant, and as a clerk in an oil company. He returned to India with Rs. 50,000 and started a textile trading company. Reliance went on to become the first Indian company to raise money in global markets and the first Indian company to feature in Forbes 500 list.

Dr. Karsanbhai Patel

Karsanbhai Patel made detergent powder in the backyard of his house. He sold his product door-to-door and offered a money back guarantee with every pack that was sold. He charged Rs. 3 per kg when the cheapest detergent at that time was Rs.13 per kg. Dr. Patel eventually started Nirma which became a whole new segment in the Indian domestic detergent market.

The Entrepreneurial Process



Let's take a look at the stages of the entrepreneurial process.

Stage 1: Idea Generation. The entrepreneurial process begins with an idea that has been thought of by the entrepreneur. The idea is a problem that has the potential to be solved.

Stage 2: Germination or Recognition. In this stage a possible solution to the identified problem is thought of.

Stage 3: Preparation or Rationalization. The problem is studied further and research is done to find out how others have tried to solve the same problem.

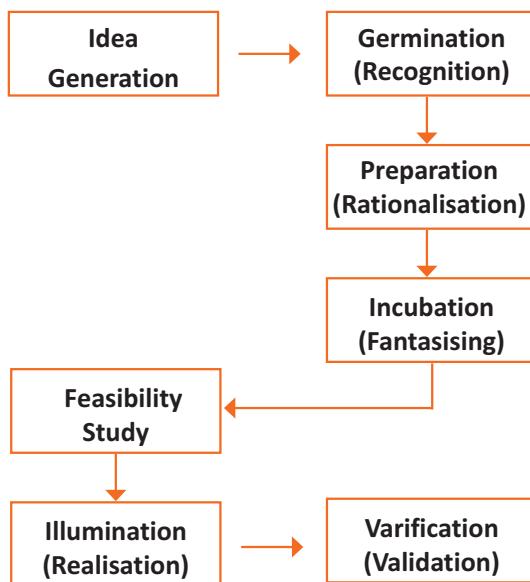
Stage 4: Incubation or Fantasizing. This stage involves creative thinking for the purpose of coming up with more ideas. Less thought is given to the problem areas.

Stage 5: Feasibility Study: The next step is the creation of a feasibility study to determine if the idea will make a profit and if it should be seen through.

Stage 6: Illumination or Realization. This is when all uncertain areas suddenly become clear. The entrepreneur feels confident that his idea has merit.

Stage 7: Verification or Validation. In this final stage, the idea is verified to see if it works and if it is useful.

Take a look at the diagram below to get a better idea of this process.

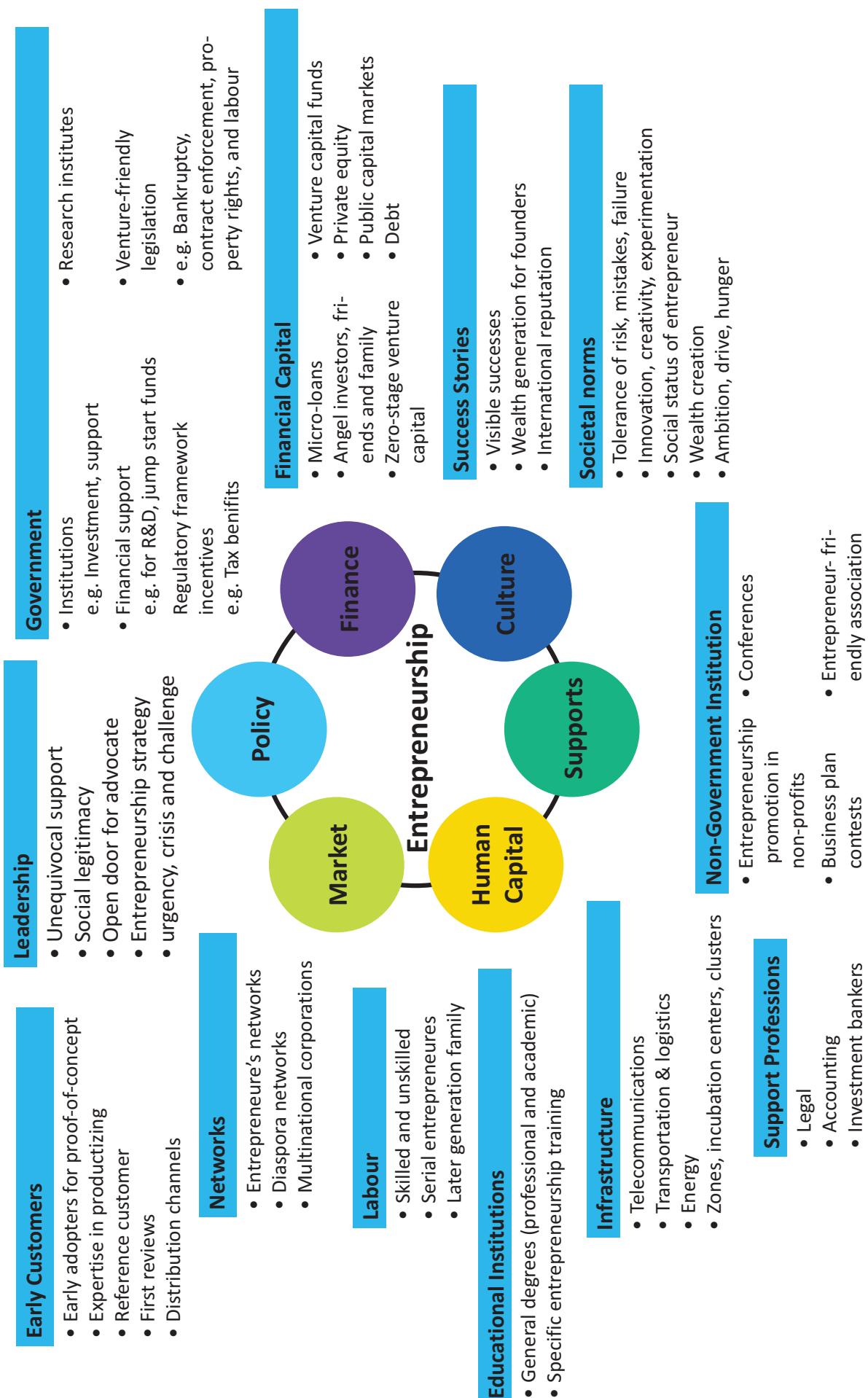


Introduction to the Entrepreneurship Ecosystem

The entrepreneurship support ecosystem signifies the collective and complete nature of entrepreneurship. New companies emerge and flourish not only because of the courageous, visionary entrepreneurs who launch them, but they thrive as they are set in an environment or 'ecosystem' made of private and public participants. These players nurture and sustain the new ventures, facilitating the entrepreneurs' efforts. An entrepreneurship ecosystem comprises of the following six domains:

1. **Favourable Culture:** This includes elements such as tolerance of risk and errors, valuable networking and positive social standing of the entrepreneur.
2. **Facilitating Policies & Leadership:** This includes regulatory framework incentives and existence of public research institutes.
3. **Financing Options:** Angel financing, venture capitalists and micro loans would be good examples of this.
4. **Human Capital:** This refers to trained and untrained labour, entrepreneurs and entrepreneurship training programmes, etc.
5. **Conducive Markets for Products & Services:** This refers to an existence or scope of existence of a market for the product/service.
6. **Institutional & Infrastructural Support:** This includes legal and financing advisers, telecommunications, digital and transportation infrastructure, and entrepreneurship networking programmes.

These domains indicate whether there is a strong entrepreneurship support ecosystem and what actions should the government put in place to further encourage this ecosystem. The six domains and their various elements have been graphically depicted.



Every entrepreneurship support ecosystem is unique and all the elements of the ecosystem are interdependent. Although every region's entrepreneurship ecosystem can be broadly described by the above features, each ecosystem is the result of the hundred elements interacting in highly complex and particular ways.

Entrepreneurship ecosystems eventually become (largely) self-sustaining. When the six domains are resilient enough, they are mutually beneficial. At this point, government involvement can and should be significantly minimized. Public leaders do not need to invest a lot to sustain the ecosystem. It is imperative that the entrepreneurship ecosystem incentives are formulated to be self-liquidating, hence focussing on sustainability of the environment.

Make in India Campaign

Every entrepreneur has certain needs. Some of their important needs are:

- To easily get loans
- To easily find investors
- To get tax exemptions
- To easily access resources and good infrastructure
- To enjoy a procedure that is free of hassles and is quick
- To be able to easily partner with other firms

The Make in India campaign, launched by Prime Minister Modi aims to satisfy all these needs of young, aspiring entrepreneurs. Its objective is to:

- Make investment easy
- Support new ideas
- Enhance skill development
- Safeguard the ideas of entrepreneurs
- Create state-of-the-art facilities for manufacturing goods

Key Schemes to Promote Entrepreneurs

The government offers many schemes to support entrepreneurs. These schemes are run by various Ministries/Departments of Government of India to support First Generation Entrepreneurs. Take a look at a few key schemes to promote entrepreneurship:

SI. Name of the Scheme

1. Pradhan Mantri MUDRA Yojana - Micro Units Development and Refinance Agency (MUDRA),
2. STAND UP INDIA
3. Prime Minister Employment Generation Programme (PMEGP)
4. International Cooperation
5. Performance and Credit Rating
6. Marketing Assistance Scheme
7. Reimbursement of Registration Fee for Bar Coding
8. Enable Participation of MSMEs in State/District level Trade Fairs and Provide Funding Support
9. Capital Subsidy Support on Credit for Technology up gradation
10. Credit Guarantee Fund for Micro and Small Enterprise (CGFMSE)
11. Reimbursement of Certification Fees for Acquiring ISO Standards
12. Agricultural Marketing
13. Small Agricultural Marketing
14. Mega Food Park
15. Adivasi Mahila Sashaktikaran Yojana

1. Pradhan Mantri MUDRA Yojana, - Micro Units Development and Refinance Agency (MUDRA),**Description**

Under the aegis support of Pradhan Mantri MUDRA Yojana, MUDRA has already created its initial products/schemes. The interventions have been named 'Shishu', 'Kishor' and 'Tarun' to signify the stage of growth/development and funding needs of the beneficiary micro unit/entrepreneur and also provide a reference point for the next phase of graduation/growth to look forward to:

- a. Shishu: Covering loans upto Rs.50,000/-
- b. Kishor: Covering loans above Rs. 50,000/- and upto Rs.5 lakh
- c. Tarun: Covering loans above Rs. 5 lakh to Rs.10 lakh

Who can apply?

Any Indian citizen who has a business plan for a non-farm sector income generating activity such as manufacturing, processing, trading or service sector and whose credit need is less than Rs.10 lakh can approach either a Bank, MFI, or NBFC for availing of MUDRA loans under Pradhan Mantri Mudra Yojana (PMMY).

2. Stand Up India**Description**

The objective of the Standup India scheme is to facilitate bank loans between Rs.10 lakh and Rs.1 crore to at least one Schedule Caste (SC) or Scheduled Tribe (ST) borrower and at least one woman borrower per bank branch for setting up a Greenfield enterprise. This enterprise may be in manufacturing, services or the trading sector. In case of non-Individual enterprises at least 51% of the shareholding and controlling stake should be held be either an SC/ST or Woman Entrepreneur.

Who can apply?

ST, SC & Women

3. Prime Minister Employment Generation Programme (PMEGP)**Description**

The Scheme is implemented by Khadi and Village Industries Commission (KVIC), as the nodal agency at the National level. At the State level, the Scheme is implemented through State KVIC Directorates, State Khadi and Village Industries Boards (KVICBs) and District Industries Centres (DICs) and banks. The Government subsidy under the Scheme is routed. by KVIC through identified banks for eventual distribution to the beneficiaries/entrepreneurs in their bank accounts.

Nature of assistance

The maximum cost of the project/unit admissible under manufacturing sector is Rs.25 lakh and under business/service sector is Rs.10 lakh. Levels of funding under PMEGP

Categories of beneficiaries under PMEGP	Beneficiary's contribution (of project cost)	Rate of Subsidy (of project cost)
Area (location of project/unit)		Urban Rural
General Category	10%	15% 25%
Special (including SC / ST / OBC / Minorities / Women, Ex-servicemen, Physically handicapped, NER, Hill and Border areas, etc.	05%	25% 35%

The balance amount of the total project cost will be provided by Banks as term loan as well as working capital.

Who can apply?

Any individual, above 18 years of age. At least VIII standard pass for projects costing above Rs.10 lakh in the manufacturing sector and above Rs.5 lakh in the business/service sector. Only new projects are considered for sanction under PMEGP. Self Help Groups (including those belonging to BPL provided that they have not availed benefits under any other Scheme), Institutions registered under Societies Registration Act,1860; Production Co-operative Societies, and Charitable Trusts are also eligible. Existing Units (under PMRY, REGP or any other scheme of Government of India or State Government) and the units that have already availed Government Subsidy under any other scheme of Government of India or State Government are NOT eligible.

4. International Cooperation

Description

The Scheme would cover the following activities:

- a. Deputation of MSME business delegations to other countries for exploring new areas of technology infusion/upgradation, facilitating joint ventures, improving market of MSMEs products, foreign collaborations, etc.
- b. Participation by Indian MSMEs in international exhibitions, trade fairs and buyer-seller meets in foreign countries as well as in India, in which there is international participation.
- c. Holding international conferences and seminars on topics and themes of interest to the MSME.

Nature of assistance

IC Scheme provides financial assistance towards the airfare and space rent of entrepreneurs. Assistance is provided on the basis of size and the type of the enterprise.

Who can apply?

- a. State/Central Government Organisations;
- b. Industry/Enterprise Associations; and
- c. Registered Societies/Trusts and Organisations associated with the promotion and development of MSMEs

5. Performance and Credit Rating for Micro and Small Enterprises

Description

The objective of the Scheme is to create awareness amongst micro & small enterprises about the strengths and weaknesses of their operations and also their credit worthiness.

Nature of assistance

Turn Over	Fee to be reimbursed by Ministry of MSME
Up to Rs.50 lacs	75% of the fee charged by the rating agency subject to a ceiling Rs.15,000/-
Above Rs.50 lacs to Rs.200 lacs	75% of the fee charged by the rating agency subject to a ceiling of Rs.30,000/-
Above Rs.200 lacs	75% of the fee charged by the rating agency subject

Who can apply?

Any enterprise registered in India as a micro or small enterprise is eligible to apply.

6. Marketing Assistance Scheme

Description

The assistance is provided for the following activities:

- a. Organizing exhibitions abroad and participation in international exhibitions/trade fairs
- b. Co-sponsoring of exhibitions organized by other organisations/industry associations/agencies
- c. Organizing buyer-seller meets, intensive campaigns and marketing promotion events

Nature of assistance

Financial assistance of up to 95% of the airfare and space rent of entrepreneurs. Assistance is provided on the basis of size and the type of the enterprise. Financial assistance for co-sponsoring would be limited to 40% of the net expenditure, subject to maximum amount of Rs.5 lakh.

Who can apply?

MSMEs, Industry Associations and other organizations related to MSME sector.

7. Reimbursement of Registration Fee for Bar Coding**Description**

The financial assistance is provided towards 75% reimbursement of only one-time registration fee and 75% of annual recurring fee for first three years paid by MSEs to GS1 India for using bar coding.

Nature of assistance

Funding support for reimbursement of 75% of one time and recurring bar code registration fees.

Who can apply?

All MSMEs with EM registration.

8. Enabling Participation of MSMEs in State/District Level Trade Fairs and Provide Funding Support**Description**

Provide marketing platform to manufacturing MSMEs by enabling their participation in state/district level exhibitions being organized by state/district authorities/associations.

Nature of assistance

1. Free registration for participating in trade fairs

Note: The selection of participants would be done by the MSME-DIs post the submission of application.

2. Reimbursement of 50% of to and fro actual fare by shortest distance/direct train (limited to AC II tier class) from the nearest railway station/bus fare to the place of exhibition and 50% space rental charges for MSMEs (General category entrepreneurs).
3. For Women/SC/ST entrepreneurs & entrepreneurs from North Eastern Region Govt. of India will reimburse 80% of items listed above in Point (2).

Note: The total reimbursement will be max. Rs.30,000/- per unit for the SC/ST/Women/Physically Handicapped entrepreneurs, while for the other units the max. limit will be Rs.20,000/- per person per MSME unit.

Note: The participant is required to submit follow-up proofs post attending the event to claim reimbursement. The proofs can be submitted after logging in online under the section "My Applications" or directly contacting a DI office.

Who can apply?

All MSMEs with EM registration.

9. Capital Subsidy Support on Credit for Technology Upgradation**Description**

MSMEs can get a capital subsidy (~15%) on credit availed for technology upgradation.

Nature of assistance

Financial assistance for availing credit and loan.

Who can apply?

1. Banks and financial institutions can apply to DC-MSME for availing support.
2. MSMEs need to directly contact the respective banks for getting credit and capital subsidy.

How to apply?

If you are a financial institution, click on the "Apply Now" button or else you can also directly contact the Office of DC-MSME. You can view the contact details of Office of DC-MSME. If you are an MSME, directly contact the respective banks/financial institutions as listed in the scheme guidelines.

10. Provision of Collateral Free Credit for MSMEs**Description**

Banks and financial institutions are provided funding assistance under this scheme so that they can in turn lend collateral free credit to MSMEs.

Nature of assistance

Funding support to banks and financial institutions for lending collateral-free credit to MSMEs.

Who can apply?

Banks and financial institutions can apply to office of DC-MSME/MSME-DIs for availing support. MSMEs need to directly contact the respective banks for getting credit.

11. Reimbursement of certification fees for acquiring ISO standards

ISO 9000/ISO 14001 Certification Reimbursement.

Description

The GoI assistance will be provided for one-time reimbursement of expenditure to such MSME manufacturing units which acquire ISO 18000/ISO 22000/ISO 27000 certification.

Nature of assistance

Reimbursement of expenditure incurred on acquiring ISO standards.

Who can apply?

MSMEs with EM registration.

12. Agricultural Marketing**Description**

A capital investment subsidy for construction/renovation of rural godowns.

Creation of scientific storage capacity and prevention of distress sale.

Nature of assistance

Subsidy @ 25% to farmers, 15% of project cost to companies.

Who can apply?

NGOs, SHGs, companies, co-operatives.

13. Small Agricultural Marketing**Description**

Business development description provides venture capital assistance in the form of equity, and arranges training and visits of agripreneurs

Farmers' Agriculture Business Consortium

Business development description provides venture capital assistance in the form of equity, and arranges training and visits of agripreneurs.

Nature of assistance

Financial assistance with a ceiling of Rs.5 lakh.

Who can apply?

Individuals, farmers, producer groups, partnership/proprietary firms, SGHs, agripreneurs, etc.

14. Mega Food Park**Description**

Mechanism to link agricultural production and market to maximize value addition, enhance farmers income, create rural employment.

Nature of assistance

One-time capital grant of 50% of project cost with a limit of Rs.50 crore.

Who can apply?

Farmers, farmer groups, SHGs.

15. Adivasi Mahila Sashaktikaran Yojana**Description**

Concessional scheme for the economic development of ST women.

Nature of assistance

Term loan at concessional rates upto 90% of cost of scheme.

Who can apply?

Scheduled Tribes Women.

Tips

- Research the existing market, network with other entrepreneurs, venture capitalists, angel investors, and thoroughly review the policies in place to enable your entrepreneurship.
- Failure is a stepping stone and not the end of the road. Review yours and your peers' errors and correct them in your future venture.
- Be proactive in your ecosystem. Identify the key features of your ecosystem and enrich them to ensure self-sustainability of your entrepreneurship support ecosystem.

14.5.7 Risk Appetite & Resilience: Entrepreneurship and Risk

Entrepreneurs are inherently risk takers. They are path-makers not path-takers. Unlike a normal, cautious person, an entrepreneur would not think twice about quitting his job (his sole income) and taking a risk on himself and his idea.

An entrepreneur is aware that while pursuing his dreams, assumptions can be proven wrong and unforeseen events may arise. He knows that after dealing with numerous problems, success is still not guaranteed.

Entrepreneurship is synonymous with the ability to take risks. This ability, called risk-appetite, is an entrepreneurial trait that is partly genetic and partly acquired.

What is Risk Appetite?

Risk appetite is defined as the extent to which a company is equipped to take risk, in order to achieve its objectives. Essentially, it refers to the balance, struck by the company, between possible profits and the hazards caused by changes in the environment (economic ecosystem, policies, etc.). Taking on more risk may lead to higher rewards but have a high probability of losses as well. However, being too conservative may go against the company as it can miss out on good opportunities to grow and reach their objectives. The levels of risk appetite can be broadly categorized as "low", "medium" and "high." The company's entrepreneur(s) have to evaluate all potential alternatives and select the option most likely to succeed. Companies have varying levels of risk appetites for different objectives.

The levels depend on:

- The type of industry
- Market pressures
- Company objectives

For example, a startup with a revolutionary concept will have a very high risk appetite. The startup can afford short term failures before it achieves longer term success. This type of appetite will not remain constant and will be adjusted to account for the present circumstances of the company.

Risk Appetite Statement

Companies have to define and articulate their risk appetite in sync with decisions made about their objectives and opportunities. The point of having a risk appetite statement is to have a framework that clearly states the acceptance and management of risk in business. It sets risk taking limits within the company. The risk appetite statement should convey the following:

- The nature of risks the business faces.
- Which risks the company is comfortable taking on and which risks are unacceptable.

- The nature of risks the business faces.
- Which risks the company is comfortable taking on and which risks are unacceptable.
- How much risk to accept in all the risk categories.
- The desired tradeoff between risk and reward.
- Measures of risk and methods of examining and regulating risk exposures.

Entrepreneurship and Resilience

Entrepreneurs are characterized by a set of qualities known as resilience. These qualities play an especially large role in the early stages of developing an enterprise. Risk resilience is an extremely valuable characteristic as it is believed to protect entrepreneurs against the threat of challenges and changes in the business environment.

What is Entrepreneurial Resilience?

Resilience is used to describe individuals who have the ability to overcome setbacks related to their life and career aspirations. A resilient person is someone who is capable of easily and quickly recovering from setbacks. For the entrepreneur, resilience is a critical trait.

Entrepreneurial resilience can be enhanced in the following ways:

- By developing a professional network of coaches and mentors
- By accepting that change is a part of life
- By viewing obstacles as something that can be overcome

Characteristics of a Resilient Entrepreneur

The characteristics required to make an entrepreneur resilient enough to go the whole way in their business enterprise are:

- | | |
|---|--|
| <ul style="list-style-type: none"> • A strong internal sense of control • Ability to diversify and expand • Strong social connections • Survivor attitude | <ul style="list-style-type: none"> • Skill to learn from setbacks • Cash-flow conscious habits • Ability to look at the bigger picture • Attention to detail |
|---|--|

Tips



- Cultivate a great network of clients, suppliers, peers, friends and family. This will not only help you promote your business, but will also help you learn, identify new opportunities and stay tuned to changes in the market.
- Don't dwell on setbacks. Focus on what you need to do next to get moving again.
- While you should try and curtail expenses, ensure that it is not at the cost of your growth.

14.5.8 Success & Failures: Understanding

Successes and Failures in Entrepreneurship

Shyam is a famous entrepreneur, known for his success story. But what most people don't know, is that Shyam failed numerous times before his enterprise became a success. Read his interview to get an idea of what entrepreneurship is really about, straight from an entrepreneur who has both, failed and succeeded.

Interviewer: Shyam, I have heard that entrepreneurs are great risk-takers who are never afraid of failing. Is this true?

Shyam: Ha ha, no of course it's not true! Most people believe that entrepreneurs need to be fearlessly enthusiastic. But the truth is, fear is a very normal and valid human reaction, especially when you are planning to start your own business! In fact, my biggest fear was the fear of failing. The reality is, entrepreneurs fail as much as they succeed. The trick is to not allow the fear of failing to stop you from going ahead with your plans. Remember, failures are lessons for future success!

Interviewer : What, according to you, is the reason that entrepreneurs fail?

Shyam: Well, there is no one single reason why entrepreneurs fail. An entrepreneur can fail due to numerous reasons. You could fail because you have allowed your fear of failure to defeat you. You could fail because you are unwilling to delegate (distribute) work. As the saying goes, "You can do anything, but not everything!" You could fail because you gave up too easily – maybe you were not persistent enough. You could fail because you were focusing your energy on small, insignificant tasks and ignoring the tasks that were most important. Other reasons for failing are partnering with the wrong people, not being able to sell your product to the right customers at the right time at the right price... and many more reasons!

Interviewer: As an entrepreneur, how do you feel failure should be looked at?

Shyam: I believe we should all look at failure as an asset, rather than as something negative. The way I see it, if you have an idea, you should try to make it work, even if there is a chance that you will fail. That's because not trying is failure right there, anyway! And failure is not the worst thing that can happen. I think having regrets because of not trying, and wondering 'what if' is far worse than trying and actually failing.

Interviewer: How did you feel when you failed for the first time?

Shyam: I was completely heartbroken! It was a very painful experience. But the good news is, you do recover from the failure. And with every subsequent failure, the recovery process gets a lot easier. That's because you start to see each failure more as a lesson that will eventually help you succeed, rather than as an obstacle that you cannot overcome. You will start to realize that failure has many benefits.

Interviewer: Can you tell us about some of the benefits of failing?

Shyam: One of the benefits that I have experienced personally from failing is that the failure made me see things in a new light. It gave me answers that I didn't have before. Failure can make you a lot stronger. It also helps keep your ego in control.

Interviewer: What advice would you give entrepreneurs who are about to start their own enterprises?

Shyam: I would tell them to do their research and ensure that their product is something that is actually wanted by customers. I'd tell them to pick their partners and employees very wisely and cautiously. I'd tell them that it's very important to be aggressive – push and market your product as aggressively as possible. I would warn them that starting an enterprise is very expensive and that they should be prepared for a situation where they run out of money. I would tell them to create long term goals and put a plan in action to achieve that goal. I would tell them to build a product that is truly unique. Be very careful and ensure that you are not copying another startup. Lastly, I'd tell them that it's very important that they find the right investors.

Interviewer: That's some really helpful advice, Shyam! I'm sure this will help all entrepreneurs to be more prepared before they begin their journey! Thank you for all your insight!

Tips



- Remember that nothing is impossible.
- Identify your mission and your purpose before you start.
- Plan your next steps – don't make decisions hastily.

14.6: Preparing to be an Entrepreneur

Unit Objectives



At the end of this unit, you will be able to:

1. Discuss how market research is carried out
2. Describe the 4 Ps of marketing
3. Discuss the importance of idea generation
4. Recall basic business terminology
5. Discuss the need for CRM
6. Discuss the benefits of CRM
7. Discuss the need for networking
8. Discuss the benefits of networking
9. Discuss the importance of setting goals
10. Differentiate between short-term, medium-term and long-term goals
11. Discuss how to write a business plan
12. Explain the financial planning process
13. Discuss ways to manage your risk
14. Describe the procedure and formalities for applying for bank finance
15. Discuss how to manage your own enterprise
16. List important questions that every entrepreneur should ask before starting an enterprise

14.6.1 Market Study / The 4 Ps of Marketing / Importance of an IDEA: Understanding Market Research

Market research is the process of gathering, analyzing and interpreting market information on a product or service that is being sold in that market. It also includes information on:

- Past, present and prospective customers
- Customer characteristics and spending habits
- The location and needs of the target market
- The overall industry
- Relevant competitors

Market research involves two types of data:

- Primary information. This is research collected by yourself or by someone hired by you.
- Secondary information. This is research that already exists and is out there for you to find and use.

Primary research

Primary research can be of two types:

- Exploratory: This is open-ended and usually involves detailed, unstructured interviews.
- Specific: This is precise and involves structured, formal interviews. Conducting specific

Secondary research

Secondary research uses outside information. Some common secondary sources are:

- Public sources: These are usually free and have a lot of good information. Examples are government departments, business departments of public libraries etc.
- Commercial sources: These offer valuable information but usually require a fee to be paid. Examples are research and trade associations, banks and other financial institutions etc.
- Educational institutions: These offer a wealth of information. Examples are colleges, universities, technical institutes etc.

The 4 Ps of Marketing

The 4 Ps of marketing are Product, Price, Promotion and Place. Let's look at each of these 4 Ps in detail.

Product

A product can be:

- A tangible good
- An intangible service

Whatever your product is, it is critical that you have a clear understanding of what you are offering, and what its unique characteristics are, before you begin with the marketing process.

Some questions to ask yourself are:

- What does the customer want from the product/service?
- What needs does it satisfy?
- Are there any more features that can be added?
- Does it have any expensive and unnecessary features?
- How will customers use it?
- What should it be called?
- How is it different from similar products?
- How much will it cost to produce?
- Can it be sold at a profit?

Price

Once all the elements of Product have been established, the Price factor needs to be considered.

The Price of a Product will depend on several factors such as profit margins, supply, demand and the marketing strategy.

Some questions to ask yourself are:

- What is the value of the product/service to customers?
- Do local products/services have established price points?
- Is the customer price sensitive?
- Should discounts be offered?
- How is your price compared to that of your competitors?

Promotion

Once you are certain about your Product and your Price, the next step is to look at ways to promote it. Some key elements of promotion are advertising, public relations, social media marketing, email marketing, search engine marketing, video marketing and more.

Some questions to ask yourself are:

- Where should you promote your product or service?
- What is the best medium to use to reach your target audience?
- When would be the best time to promote your product?
- How are your competitors promoting their products?

Place

According to most marketers, the basis of marketing is about offering the right product, at the right price, at the right place, at the right time. For this reason, selecting the best possible location is critical for converting prospective clients into actual clients.

Some questions to ask yourself are:

- Will your product or service be looked for in a physical store, online or both?
- What should you do to access the most appropriate distribution channels?
- Will you require a sales force?
- Where are your competitors offering their products or services?
- Should you follow in your competitors' footsteps?
- Should you do something different from your competitors?

Importance of an IDEA

Some questions to ask yourself are:

Ideas are the foundation of progress. An idea can be small or ground-breaking, easy to accomplish or extremely complicated to implement. Whatever the case, the fact that it is an idea gives it merit. Without ideas, nothing is possible. Most people are afraid to speak out their ideas, out for fear of being ridiculed. However, if you are an entrepreneur and want to remain competitive and innovative, you need to bring your ideas out into the light.

Some ways to do this are by:

- Establishing a culture of brainstorming where you invite all interested parties to contribute
- Discussing ideas out loud so that people can add their ideas, views, opinions to them
- Being open minded and not limiting your ideas, even if the idea seems ridiculous
- Not discarding ideas that don't work immediately, but instead making a note of them and shelving them so they can be revisited at a later date

Tips



- Keep in mind that good ideas do not always have to be unique.
- Remember that timing plays a huge role in determining the success of your idea.
- Situations and circumstances will always change, so be flexible and adapt your idea accordingly.

14.6.2 Business Entity Concepts:

Basic Business Terminology

If your aim is to start and run a business, it is crucial that you have a good understanding of basic business terms. Every entrepreneur should be well versed in the following terms:

- Accounting: A systematic method of recording and reporting financial transactions.
- Accounts payable: Money owed by a company to its creditors.
- Accounts Receivable: The amount a company is owed by its clients.
- Assets: The value of everything a company owns and uses to conduct its business.
- Balance Sheet: A snapshot of a company's assets, liabilities and owner's equity at a given moment.
- Bottom Line: The total amount a business has earned or lost at the end of a month.
- Business: An organization that operates with the aim of making a profit.
- Business to Business (B2B): A business that sells goods or services to another business.
- Business to Consumer (B2C): A business that sells goods or services directly to the end user.
- Capital: The money a business has in its accounts, assets and investments. The two main types of capital are debt and equity.
- Cash Flow: The overall movement of funds through a business each month, including income and expenses.
- Cash Flow Statement: A statement showing the money that entered and exited a business during a specific period of time.
- Contract: A formal agreement to do work for pay.

- Contract: A formal agreement to do work for pay.
- Depreciation: The degrading value of an asset over time.
- Expense: The costs that a business incurs through its operations.
- Finance: The management and allocation of money and other assets.
- Financial Report: A comprehensive account of a business' transactions and expenses.
- Fixed Cost: A one-time expense.
- Income Statement (Profit and Loss Statement): Shows the profitability of a business during a period of time.
- Liabilities: The value of what a business owes to someone else.
- Marketing: The process of promoting, selling and distributing a product or service.
- Net Income/Profit: Revenues minus expenses.
- Net Worth: The total value of a business.
- Payback Period: The amount of time it takes to recover the initial investment of a business.
- Profit Margin: The ratio of profit, divided by revenue, displayed as a percentage.
- Return on Investment (ROI): The amount of money a business gets as return from an investment.
- Revenue: The total amount of income before expenses are subtracted.
- Sales Prospect: A potential customer.
- Supplier: A provider of supplies to a business.
- Target Market: A specific group of customers at which a company's products and services are aimed.
- Valuation: An estimate of the overall worth of the business.
- Variable Cost: Expenses that change in proportion to the activity of a business.
- Working Capital: Calculated as current assets minus current liabilities.
- Business Transactions: There are three types of business transactions. These are:
 - Simple Transactions – Usually a single transaction between a vendor and a customer. For example: Buying a cup of coffee.
 - Complex Transactions – These transactions go through a number of events before they can be completed. For example: Buying a house.
 - Ongoing transactions – These transactions usually require a contract. For example: Contract with a vendor.

Basic Accounting Formulas

Take a look some important accounting formulas that every entrepreneur needs to know.

1. The Accounting Equation: This is value of everything a company owns and uses to conduct its business.
Formula: Assets = Liability + Owner's Equity
2. Net Income: This is the profit of the company.
Formula: Net Income = Revenues – Expenses
3. Break-Even Point: This is the point at which the company will not make a profit or a loss. The total cost and total revenues are equal.
Formula: Break-Even = Fixed Costs/Sales Price – Variable Cost per Unit
4. Cash Ratio: This tells us about the liquidity of a company.
Formula: Cash Ratio = Cash/Current Liabilities
5. Profit Margin: This is shown as a percentage. It shows what percentage of sales are left over after all the expenses are paid by the business.
Formula: Profit Margin = Net Income/Sales
6. Debt-to-Equity Ratio: This ratio shows how much equity and debt a company is using to finance its assets, and whether the shareholder equity can fulfill obligations to creditors if the business starts making a loss.
Formula: Debt-to-Equity Ratio = Total Liabilities/Total Equity

7. Cost of Goods Sold: This is the total of all costs used to create a product or service, which has been sold.
Formula: Cost of Goods Sold = Cost of Materials/Inventory – Cost of Outputs
8. Return on Investment (ROI): This is usually shown as a percentage. It calculates the profits of an investment as a percentage of the original cost.
Formula: $ROI = \frac{Net\ Profit}{Total\ Investment} * 100$
9. Simple Interest: This is money you can earn by initially investing some money (the principal).
Formula:
 $A = P(1 + rt); R = r * 100$
Where:
 A = Total Accrued Amount (principal + interest)
 P = Principal Amount
 I = Interest Amount
 r = Rate of Interest per year in decimal; $r = R/100$
 t = Time Period involved in months or years
10. Annual Compound Interest: This calculates the addition of interest to the principal sum of a loan or deposit.
Formula:
 $A = P (1 + r/n) ^ nt$:
Where:
 A = the future value of the investment/loan, including interest
 P = the principal investment amount (the initial deposit or loan amount)
 r = the annual interest rate (decimal)
 n = the number of times that interest is compounded per year
 t = the number of years the money is invested or borrowed for

14.6.3 CRM & Networking: What is CRM?

CRM stands for Customer Relationship Management. Originally the expression Customer Relationship Management meant managing one's relationship with customers. However, today it refers to IT systems and software designed to help companies manage their relationships.

The Need for CRM

The better a company can manage its relationships with its customers, the higher the chances of the company's success. For any entrepreneur, the ability to successfully retain existing customers and expand the enterprise is paramount. This is why IT systems that focus on addressing the problems of dealing with customers on a daily basis are becoming more and more in demand. Customer needs change over time, and technology can make it easier to understand what customers really want. This insight helps companies to be more responsive to the needs of their customers. It enables them to modify their business operations when required, so that their customers are always served in the best manner possible. Simply put, CRM helps companies recognize the value of their clients and enables them to capitalize on improved customer relations.

Benefits of CRM

CRM has a number of important benefits:

- It helps improve relations with existing customers which can lead to:
 - Increased sales
 - Identification of customer needs
 - Cross-selling of products
- It results in better marketing of one's products or services

- It results in better marketing of one's products or services
- It enhances customer satisfaction and retention
- It improves profitability by identifying and focusing on the most profitable customers

What is Networking?

In business, networking means leveraging your business and personal connections in order to bring in a regular supply of new business. This marketing method is effective as well as low cost. It is a great way to develop sales opportunities and contacts. Networking can be based on referrals and introductions, or can take place via phone, email, and social and business networking websites.

The Need for Networking

Networking is an essential personal skill for business people, but it is even more important for entrepreneurs. The process of networking has its roots in relationship building. Networking results in greater communication and a stronger presence in the entrepreneurial ecosystem. This helps build strong relationships with other entrepreneurs.

Business networking events held across the globe play a huge role in connecting like-minded entrepreneurs who share the same fundamental beliefs in communication, exchanging ideas and converting ideas into realities. Such networking events also play a crucial role in connecting entrepreneurs with potential investors. Entrepreneurs may have vastly different experiences and backgrounds but they all have a common goal in mind – they all seek connection, inspiration, advice, opportunities and mentors. Networking offers them a platform to do just that.

Benefits of Networking

Networking offers numerous benefits for entrepreneurs. Some of the major benefits are:

- Getting high quality leads
- Increased business opportunities
- Good source of relevant connections
- Advice from like-minded entrepreneurs
- Gaining visibility and raising your profile
- Meeting positive and enthusiastic people
- Increased self-confidence
- Satisfaction from helping others
- Building strong and lasting friendships

Tips



- Use social media interactions to identify needs and gather feedback.
- When networking, ask open-ended questions rather than yes/no type questions.

14.6.4 Business Plan: Why Set Goals?

Setting goals is important because it gives you long-term vision and short-term motivation. Goals can be short term, medium term and long term.

Short-Term Goals

- These are specific goals for the immediate future.

Example: Repairing a machine that has failed.

Medium-Term Goals

- These goals are built on your short term goals.
- They do not need to be as specific as your short term goals.

Example: Arranging for a service contract to ensure that your machines don't fail again.

Long-Term Goals

These goals require time and planning.

They usually take a year or more to achieve.

Example: Planning your expenses so you can buy new machinery

Why Create a Business Plan?

A business plan is a tool for understanding how your business is put together. It can be used to monitor progress, foster accountable and control the fate of the business. It usually offers a 3-5 year projection and outlines the plan that the company intends to follow to grow its revenues. A business plan is also a very important tool for getting the interest of key employees or future investors.

A business plan typically comprises of eight elements.

Elements of a Business Plan

Executive Summary

The executive summary follows the title page. The summary should clearly state your desires as the business owner in a short and businesslike way. It is an overview of your business and your plans. Ideally this should not be more than 1-2 pages.

Your Executive Summary should include:

- The Mission Statement: Explain what your business is all about.

Example: Nike's Mission Statement

Nike's mission statement is "To bring inspiration and innovation to every athlete in the world."

- Company Information: Provide information like when your business was formed, the names and roles of the founders, the number of employees, your business location(s) etc.
- Growth Highlights: Mention examples of company growth. Use graphs and charts where possible.
- Your Products/Services: Describe the products or services provided.
- Financial Information: Provide details on current bank and investors.
- Summarize future plans: Describe where you see your business in the future.

Business Description

The second section of your business plan needs to provide a detailed review of the different elements of your business. This will help potential investors to correctly understand your business goal and the uniqueness of your offering.

Your Business Description should include:

- A description of the nature of your business
- The market needs that you are aiming to satisfy
- The ways in which your products and services meet these needs
- The specific consumers and organizations that you intend to serve
- Your specific competitive advantages

Market Analysis

The market analysis section usually follows the business description. The aim of this section is to showcase your industry and market knowledge. This is also the section where you should lay down your research findings and conclusions.

Your Market Analysis should include:

- | | |
|--|--|
| <ul style="list-style-type: none"> • Your industry description and outlook • Information on your target market • The needs and demographics of your target audience • The size of your target market | <ul style="list-style-type: none"> • The amount of market share you want to capture • Your pricing structure • Your competitive analysis • Any regulatory requirements |
|--|--|

Organization & Management

This section should come immediately after the Market Analysis.

Your Organization & Management section should include:

- | | |
|--|--|
| <ul style="list-style-type: none"> • Your company's organizational structure • Details of your company's ownership • Details of your management team • Qualifications of your board of directors | <ul style="list-style-type: none"> • Detailed descriptions of each division/department and its function • The salary and benefits package that you offer your people |
|--|--|

Service or Product Line

The next section is the service or product line section. This is where you describe your service or product, and stress on their benefits to potential and current customers. Explain in detail why your product of choice will fulfill the needs of your target audience.

Your Service or Product Line section should include:

- A description of your product/service
- A description of your product or service's life cycle
- A list of any copyright or patent filings
- A description of any R&D activities that you are involved in or planning

Marketing & Sales

Once the Service or Product Line section of your plan has been completed, you should start on the description of the marketing and sales management strategy for your business.

Your Marketing section should include the following strategies:

- **Market penetration strategy:** This strategy focuses on selling your existing products or services in existing markets, in order to increase your market share.
- **Growth strategy:** This strategy focuses on increasing the amount of market share, even if it reduces earnings in the short-term.
- **Channels of distribution strategy:** These can be wholesalers, retailers, distributors and even the internet.
- **Communication strategy:** These can be written strategies (e-mail, text, chat), oral strategies (phone calls, video chats, face-to-face conversations), non-verbal strategies (body language, facial expressions, tone of voice) and visual strategies (signs, webpages, illustrations).

Your Sales section should include the following information:

- **A salesforce strategy:** This strategy focuses on increasing the revenue of the enterprise.
- **A breakdown of your sales activities:** This means detailing out how you intend to sell your products or services – will you sell it offline or online, how many units do you intend to sell, what price do you plan to sell each unit at, etc.

Funding Request

This section is specifically for those who require funding for their venture.

The Funding Request section should include the following information:

- How much funding you currently require.
- How much funding you will require over the next five years. This will depend on your long-term goals.
- The type of funding you want and how you plan to use it. Do you want funding that can be used only for a specific purpose, or funding that can be used for any kind of requirement?
- Strategic plans for the future. This will involve detailing out your long-term plans – what these plans are and how much money you will require to put these plans in motions.
- Historical and prospective financial information. This can be done by creating and maintaining all your financial records, right from the moment your enterprise started, to the present day. Documents required for this are your balance sheet which contains details of your company's assets and liabilities, your income statement which lists your company's revenues, expenses and net income for the year, your tax returns (usually for the last three years) and your cash flow budget which lists the cash that came in, the cash that went out and states whether you had a cash deficit (negative balance) or surplus (positive balance) at the end of each month.

Financial Planning



Before you begin building your enterprise, you need to plan your finances. Take a look at the steps for financial planning:

Step 1: Create a financial plan. This should include your goals, strategies and timelines for accomplishing these goals.

Step 2: Organize all your important financial documents. Maintain a file to hold your investment details, bank statements, tax papers, credit card bills, insurance papers and any other financial records.

Step 3: Calculate your net worth. This means figure out what you own (assets like your house, bank accounts, investments etc.), and then subtract what you owe (liabilities like loans, pending credit card amounts etc.) the amount you are left with is your net worth.

Step 4: Make a spending plan. This means write down in detail where your money will come from, and where it will go.

Step 5: Build an emergency fund. A good emergency fund contains enough money to cover at least 6 months' worth of expenses.

Step 6: Set up your insurance. Insurance provides long term financial security and protects you against risk.

Risk Management

As an entrepreneur, it is critical that you evaluate the risks involved with the type of enterprise that you want to start, before you begin setting up your company. Once you have identified potential risks, you can take steps to reduce them. Some ways to manage risks are:

- Research similar business and find out about their risks and how they were minimized.
- Evaluate current market trends and find out if similar products or services that launched a while ago are still being well received by the public.
- Think about whether you really have the required expertise to launch your product or service.
- Examine your finances and see if you have enough income to start your enterprise.
- Be aware of the current state of the economy, consider how the economy may change over time, and think about how your enterprise will be affected by any of those changes.
- Create a detailed business plan.

Tips



- Ensure all the important elements are covered in your plan.
- Scrutinize the numbers thoroughly.
- Be concise and realistic.
- Be conservative in your approach and your projections.
- Use visuals like charts, graphs and images wherever possible.

14.6.5 Procedure and Formalities for Bank Finance: The Need for Bank Finance

For entrepreneurs, one of the most difficult challenges faced involves securing funds for startups. With numerous funding options available, entrepreneurs need to take a close look at which funding methodology works best for them. In India, banks are one of the largest funders of startups, offering funding to thousands of startups every year.

What Information Should Entrepreneurs Offer Banks for Funding?

When approaching a bank, entrepreneurs must have a clear idea of the different criteria that banks use to screen, rate and process loan applications. Entrepreneurs must also be aware of the importance of providing banks with accurate and correct information. It is now easier than ever for financial institutions to track any default behaviour of loan applicants. Entrepreneurs looking for funding from banks must provide banks with information relating to their general credentials, financial situation and guarantees or collaterals that can be offered.

General Credentials

This is where you, as an entrepreneur, provide the bank with background information on yourself. Such information includes:

- Letter(s) of Introduction: This letter should be written by a respected business person who knows you well enough to introduce you. The aim of this letter is set across your achievements and vouch for your character and integrity.
- Your Profile: This is basically your resume. You need to give the bank a good idea of your educational achievements, professional training, qualifications, employment record and achievements.
- Business Brochure: A business brochure typically provides information on company products, clients, how long the business has been running for etc.
- Bank and Other References: If you have an account with another bank, providing those bank references is a good idea.
- Proof of Company Ownership or Registration: In some cases, you may need to provide the bank with proof of company ownership and registration. A list of assets and liabilities may also be required.

Financial Situation

Banks will expect current financial information on your enterprise. The standard financial reports you should be prepared with are:

- | | |
|---|--|
| <ul style="list-style-type: none"> • Balance Sheet • Cash-Flow Statement • Business Plan | <ul style="list-style-type: none"> • Profit-and-Loss Account • Projected Sales and Revenues • Feasibility Study |
|---|--|

Guarantees or Collaterals

Usually banks will refuse to grant you a loan without security. You can offer assets which the bank can seize and sell off if you do not repay the loan. Fixed assets like machinery, equipment, vehicles etc. are also considered to be security for loans.

The Lending Criteria of Banks

Your request for funding will have a higher chance of success if you can satisfy the following lending criteria:

- | | |
|--|--|
| <ul style="list-style-type: none"> • Good cash flow • Adequate security • Good reputation | <ul style="list-style-type: none"> • Adequate shareholders' funds • Experience in business |
|--|--|

The Procedure



To apply for funding the following procedure will need to be followed.

1. Submit your application form and all other required documents to the bank.
2. The bank will carefully assess your credit worthiness and assign ratings by analyzing your business information with respect to parameters like management, financial, operational and industry information as well as past loan performance.
3. The bank will make a decision as to whether or not you should be given funding.

Tips



- Get advice on funding options from experienced bankers.
- Be cautious and avoid borrowing more than you need, for longer than you need, at an interest rate that is higher than you are comfortable with.

14.6.6 Enterprise Management - An Overview:

How to Manage Your Enterprise?



To manage your enterprise effectively you need to look at many different aspects, right from managing the day-to-day activities to figuring out how to handle a large scale event. Let's take a look at some simple steps

to manage your company effectively.

Step 1: Use your leadership skills and ask for advice when required.

Let's take the example of Ramu, an entrepreneur who has recently started his own enterprise. Ramu has good leadership skills – he is honest, communicates well, knows how to delegate work etc. These leadership skills definitely help Ramu in the management of his enterprise. However, sometimes Ramu comes across situations that he is unsure how to handle. What should Ramu do in this case? One solution is for him to find a more experienced manager who is willing to mentor him. Another solution is for Ramu to use his networking skills so that he can connect with managers from other organizations, who can give him advice on how to handle such situations.

Step 2: Divide your work amongst others – realize that you cannot handle everything yourself.

Even the most skilled manager in the world will not be able to manage every single task that an enterprise will demand of him. A smart manager needs to realize that the key to managing his enterprise lies in his dividing all his work between those around him. This is known as delegation. However, delegating is not enough. A manager must delegate effectively if he wants to see results. This is important because delegating, when done incorrectly, can result in you creating even more work for yourself. To delegate effectively, you can start by making two lists. One list should contain the things that you know you need to handle yourself. The second list should contain the things that you are confident can be given to others to manage and handle. Besides incorrect delegation, another issue that may arise is over-delegation. This means giving away too many of your tasks to others. The problem with this is, the more tasks you delegate, the more time you will spend tracking and monitoring the work progress of those you have handed the tasks to. This will leave you with very little time to finish your own work.

Step 3: Hire the right people for the job.

Hiring the right people goes a long way towards effectively managing your enterprise. To hire the best people suited for the job, you need to be very careful with your interview process. You should ask potential candidates the right questions and evaluate their answers carefully. Carrying out background checks is always a good practice. Running a credit check is also a good idea, especially if the people you are planning to hire will be handling your money. Create a detailed job description for each role that you want filled and ensure that all candidates have a clear and correct understanding of the job description. You should also have an employee manual in place, where you put down every expectation that you have from your employees. All these actions will help ensure that the right people are approached for running your enterprise.

Step 4: Motivate your employees and train them well.

Your enterprise can only be managed effectively if your employees are motivated to work hard for your enterprise. Part of being motivated involves your employees believing in the vision and mission of your enterprise and genuinely wanting to make efforts towards pursuing the same. You can motivate your employees with recognition, bonuses and rewards for achievements. You can also motivate them by telling them about how their efforts have led to the company's success. This will help them feel pride and give them a sense of responsibility that will increase their motivation. Besides motivating your people, your employees should be constantly trained in new practices and technologies. Remember, training is not a one-time effort. It is a consistent effort that needs to be carried out regularly.

Step 5: Train your people to handle your customers well.

Your employees need to be well-versed in the art of customer management. This means they should be able to understand what their customers want, and also know how to satisfy their needs. For them to truly understand this, they need to see how you deal effectively with customers. This is called leading by example. Show them how you sincerely listen to your clients and the efforts that you put into understand their requirements. Let them listen to the type of questions that you ask your clients so they understand which questions are appropriate.

Step 6: Market your enterprise effectively.

also hire a marketing agency if you feel you need help in this area. Now that you know what is required to run your enterprise effectively, put these steps into play, and see how much easier managing your enterprise becomes!

Tips

- Get advice on funding options from experienced bankers.
- Be cautious and avoid borrowing more than you need, for longer than you need, at an interest rate that is higher than you are comfortable with.

14.6.7 20 Questions to Ask Yourself Before Considering Entrepreneurship

1. Why am I starting a business?
2. What problem am I solving?
3. Have others attempted to solve this problem before? Did they succeed or fail?
4. Do I have a mentor or industry expert that I can call on?
5. Who is my ideal customer?
6. Who are my competitors?
7. What makes my business idea different from other business ideas?
8. What are the key features of my product or service?
9. Have I done a SWOT analysis?
10. What is the size of the market that will buy my product or service?
11. What would it take to build a minimum viable product to test the market?
12. How much money do I need to get started?
13. Will I need to get a loan?
14. How soon will my products or services be available?
15. When will I break even or make a profit?
16. How will those who invest in my idea make a profit?
17. How should I set up the legal structure of my business?
18. What taxes will I need to pay?
19. What kind of insurance will I need?
20. Have I reached out to potential customers for feedback?

Tips

- It is very important to validate your business ideas before you invest significant time, money and resources into it.
- The more questions you ask yourself, the more prepared you will be to handle the highs and lows of starting an enterprise.

Footnotes:

1. A mentor is a trusted and experienced person who is willing to coach and guide you.
2. A customer is someone who buys goods and/or services.
3. A competitor is a person or company that sells products and/or services similar to your products and/or services.
4. SWOT stands for Strengths, Weaknesses, Opportunities and Threats. To conduct a SWOT analysis of your company, you need to list down all the strengths and weaknesses of your company, the opportunities that are present for your company and the threats faced by your company.
5. A minimum viable product is a product that has the fewest possible features, that can be sold to customers, for the purpose of getting feedback from customers on the product.
6. A company is said to break even when the profits of the company are equal to the costs.
7. The legal structure could be a sole proprietorship, partnership or limited liability partnership.
8. There are two types of taxes – direct taxes payable by a person or a company, or indirect taxes charged on goods and/or services.
9. There are two types of insurance – life insurance and general insurance. Life insurance covers human life while general insurance covers assets like animals, goods, cars etc

Notes



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Projects



Project - 1

Title of the Project: _____

Problem statement:

Brief description of the project:

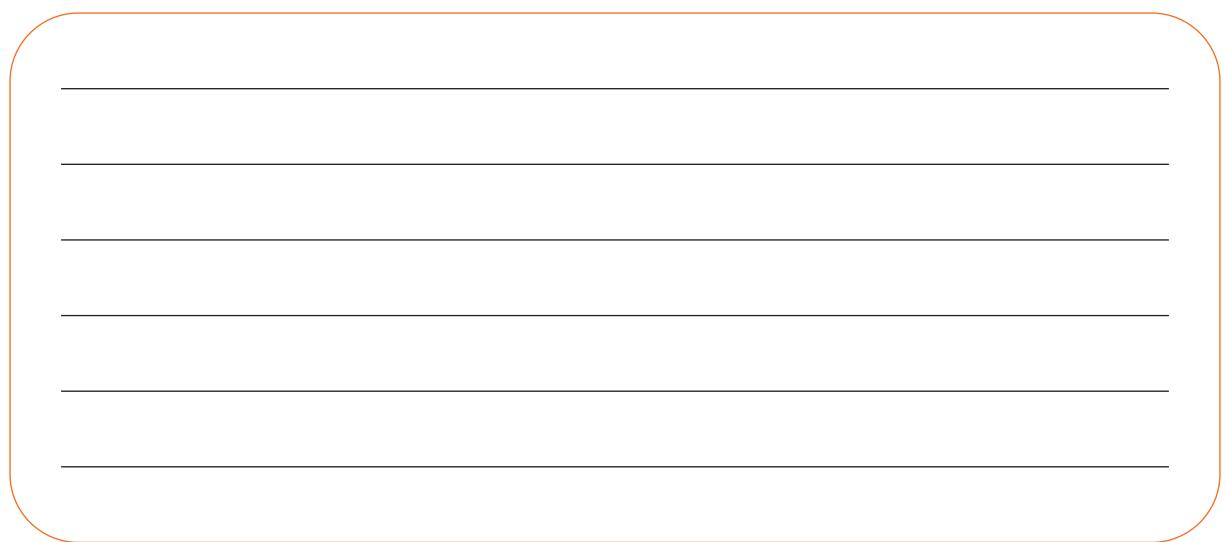
Approved by : _____

Name: _____

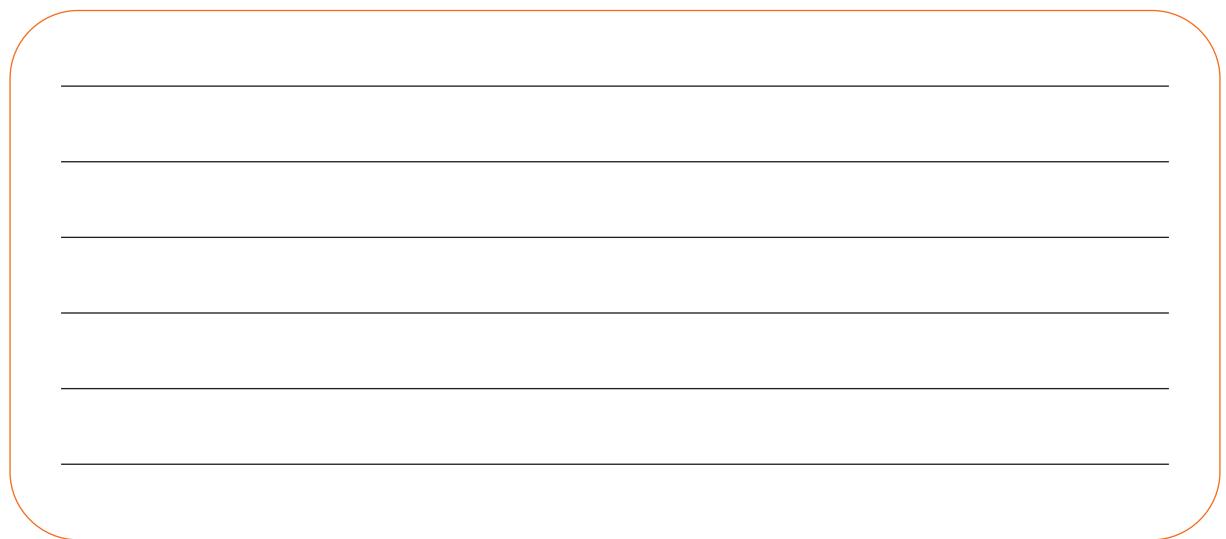
Signature: _____

Remarks (If any): _____

Design details:



Hardware components used (with specifications)



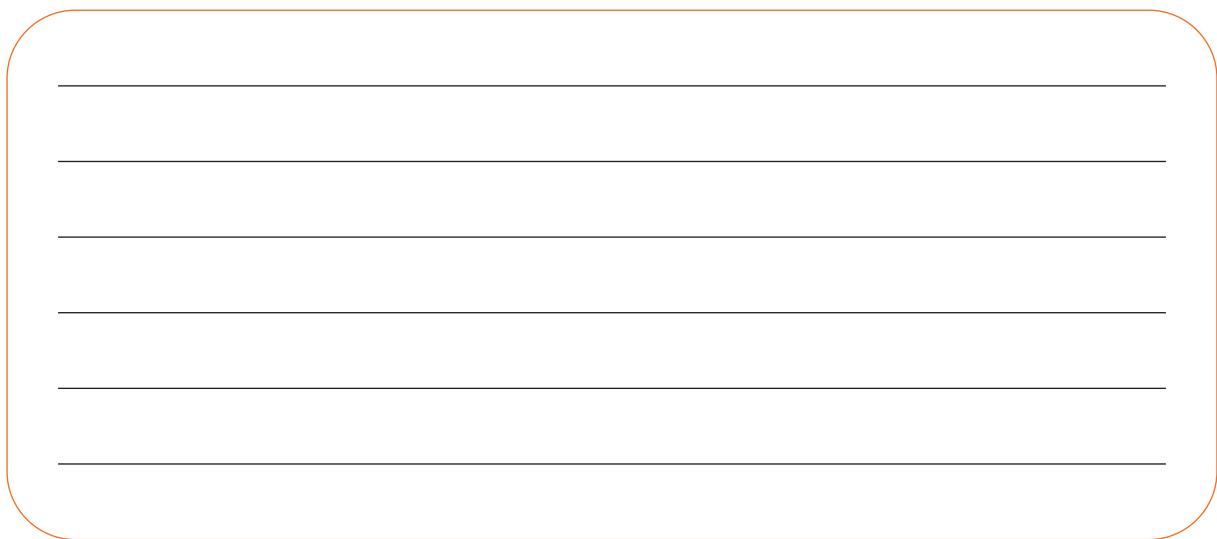
Software requirement:

Architecture:

Data gathering mechanism:

How will you ensure data security?

Results and Benefits:



A large rectangular area with rounded corners, outlined in orange, designed for writing results and benefits.

Project submitted by:

Name: _____

Signature: _____

Date: _____

Project approved by:

Name: _____

Signature: _____

Date: _____

Remarks: _____

Project - 2

Title of the Project: _____

Problem statement:

Brief description of the project:

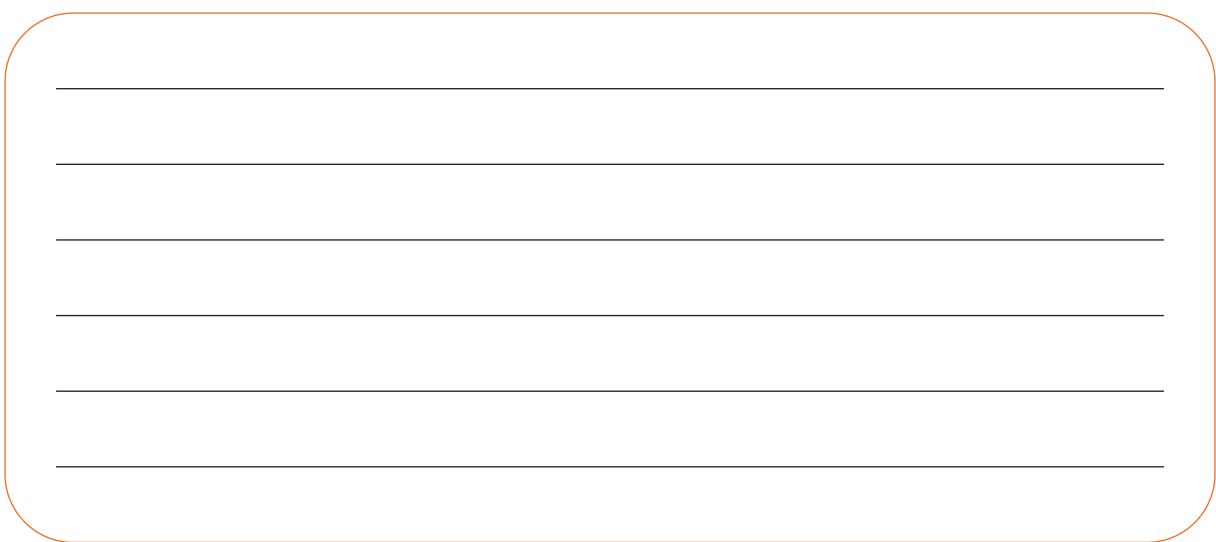
Approved by : _____

Name: _____

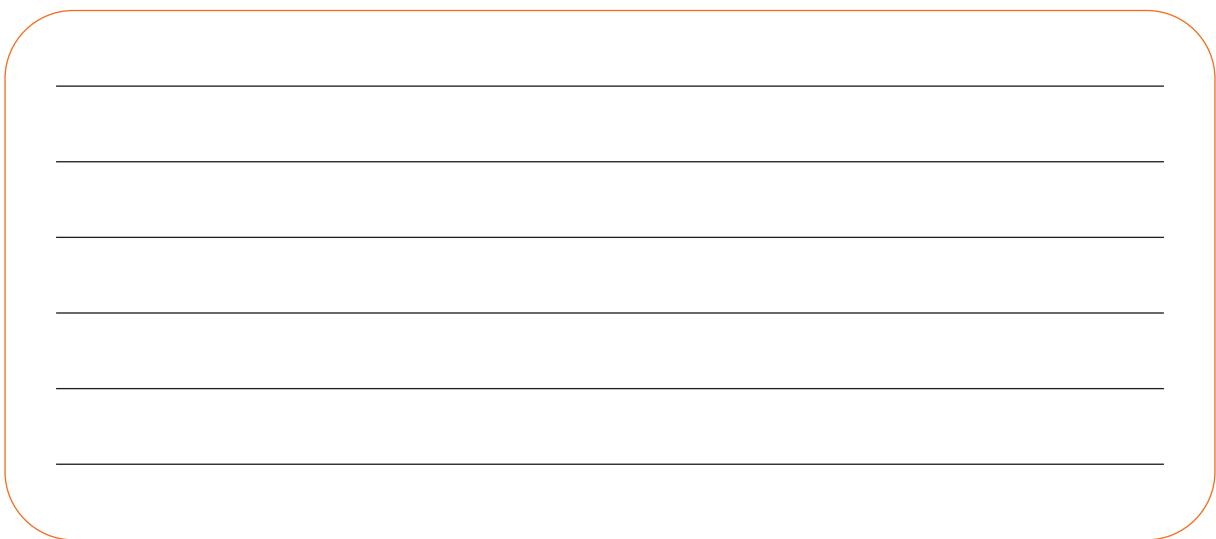
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Remarks (If any): _____

Design details:



Hardware components used (with specifications)

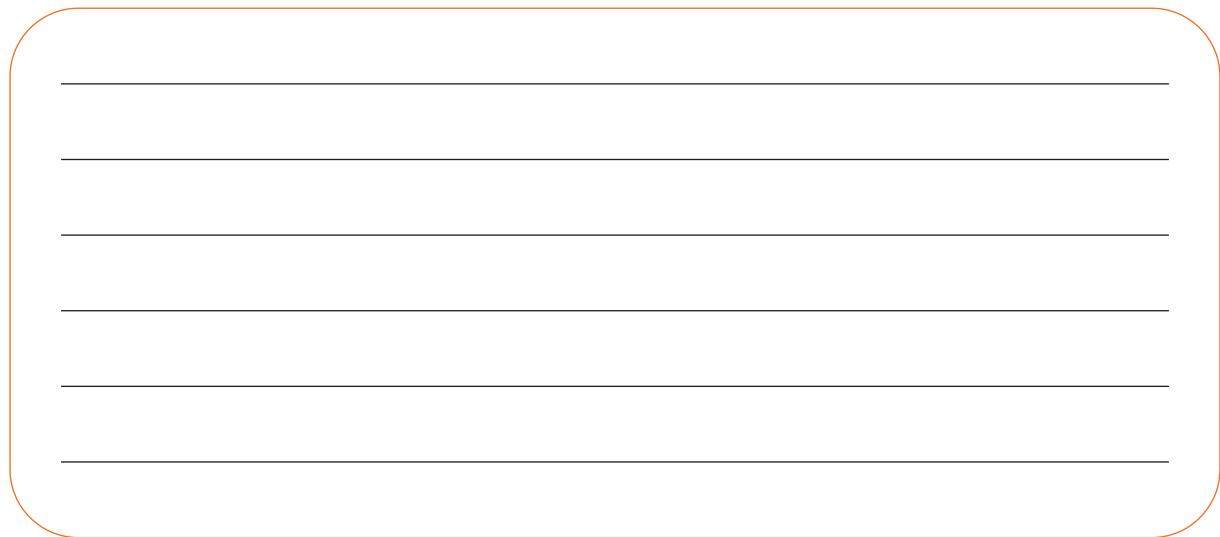


Software requirement:

Architecture:

Data gathering mechanism:

How will you ensure data security?

Results and Benefits:

Project submitted by:

Name: _____

Signature: _____

Date: _____

Project approved by:

Name: _____

Signature: _____

Date: _____

Remarks: _____

Notes







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