# Internet of Things

## Introduction:

Wireless Technologies have given rise to a number of useful technologies of which Internet of Things is one of them. Internet of things has enabled the development of a large number of applications that are connected by sensors to accomplish different tasks. The number of devices that are connected to IoT and increasing to a very large extent. Technology needs to find its place in every day life and IoT has made it possible.

It combines the sensors and the networks in such a way that they provide the necessary resources to make an application. IoT can make our Lives more easy and secure by building huge applications that affect the day to day activities of the human life. IoT embeds the devices, things that are smartly connected to each other and the application of the knowledge to enable and drive the devices.

The establishment of connection is not only among vehicles, or devices but also other wireless nodes are the important aspects of IoT .IoT not only provides economical but also financial assistance in the development process. Logistics, health, transport , smart cities are some of the applications that are provided by IoT. The infrastructure can also be improved enormously by the introduction of the IoT devices. The time to update the information by manually can also be avoided by the use of the IoT devices.

The IoT devices comprises of the sensors or the devices that transmit the information to other devices. These devices play a very active role in connecting to the networks. The sensors of the devices have to connect to the other devices.

Not only the establishment of the connection but also the storage of the data should

also be included in the network. The location of the devices also play an important role in the receiving and the transferring of the data. The devices may be spread across different locations and need to communicate with each other.

## 5g services

5g services are enabled to provide low interference and high bandwidth and a use of wide variety of standards how to provide standards to handle radio waves . IoT needs to be equipped with a more efficient technology that 5g services can provide.

5g services provide better efficiency among the other technologies and provide the maximum throughput to the users. It has the capability to connect devices, objects and machines to each other.

When the services of the 5g networks are combined with the capabilities of IoT they will provide the required purpose for connecting devices together . 5G is capable

Of providing high speed data in the form of gigabits, more reliability , more network

Capacity and power efficiency while providing lower latency capacities.

Device to device communication can be well established among the devices using the services of the 5g .Even the capability to establish multicast and broad cast services is well established using the services of the 5g networks. The 5g services provides certain features to register, connect and manage different devices across the network .They provide higher amounts of bandwidth , providing better energy efficiency , increased availability , and high amount of network bandwidth. 5g provides the base for the development of other new technologies that help the enhancement of IoT services.

## Architecture of 5g

The 5g services utilize the MiMo,Multiple input multiple output data stream technology to be applied to the IoT devices. It applies a group of antennas to come together and provide the necessary service. The maximum benefits should be extracted from the system and supplied to the devices[22].

The 5g services provide a range of wider technologies to enhance the applications and provide a framework for the efficiency of the solutions .In a normal network the base station provides the area for the access of the radio networks .These networks are within the range of the base station and continuously transfer the signals to each other .The 5g networks provide a large number of radio access networks virtually and provide the efficient capacity to access the network .

The 3gpp provides the required service for the 5g services and also enhances the public infrastructure .It also provides the device to device communication among the

Networks. The release 15 of the 3gpp services provide the support for the 5g communication systems . It also helps to provide the assistance for the IoT based devices. Control signals are transmitted among the devices to communicate with each other in a given area and allowed to transfer the information between the devices.

Device to device communication is one of means to achieve the standardization of the 3gpp services. The Device to device communication understands the public and the private infrastructure of the IoT devices and communicates with them to achieve the desired results. A server can be deployed among the devices and they can communicate with each other sending and receiving the data .The required protocols should be implemented and the applications should be well enhanced to give the desired results.

## IoT and 5g

IoT devices require very high amount of data to be transferred to enable the device to deliver the required amount of information. The rate of transfer of data should be also very high to achieve the required performance.

The 5g services transmit huge amount of data to the IoT devices. This data is available in the form of small cells that are transferred in a timely manner. The data has to be received in the proper sequence at the destination to compute the allotted task. The data that has to be transferred has to be structured and no errors should be contained in the data. The data must be clean and ready to use.

The data that are transmitted from the 5g signals are received by the base station and the base station transmits the signals to the available IoT devices. The 5g will provide the necessity device to device technology and transmit the data to the network stations. The receiving data should process the signals and store the available data in a proper format to carry out the required task .

The task of the areas of sensing the required information is to be available to find the required signals and process the required task that may range from the mobile devices, laptops , tabs ,or any other portable devices.

The other devices that are connected to the network will be the non portable devices that may range from the sensors that are connected to the home security system ,

Retail management system , heavy machinery system etc..

## Applications of IOT and 5g

### Edge Computing:

Mobile Edge computing is one of the most important features of 5g technologies. It provides an open edge environment where the applications can interact with the protocols of the 5g networks.

It provides an API framework where the apps, platform and the system management level ae integrated in one module. The Mobile Edge computing apis are designed to provide an user friendly environment

Where the users can deploy all the services easily. The operating system is provided with the highest level of the service to be operated to include

the services to be provided to the user.The Mobile edge computing is widely used and one of the most enhanced features of the 5g technologies.

### Smart homes , smart power grids:

IoT helps to develop homes that are smart enough to provide the

Security ,good amount of resource management , excellent features,

Utilization of economy etc..They also provide a better way to handle the congestion of the traffic and provide easy transport facility to the users.

They also provide access and easy retrieval of data to the users connected to their devices .They provide better data security and also safeguard the privacy of the user.A smart grid combines demand , power quality and the generation of the power as per the requirement of the user.

**Health care Monitoring**:

IoT finds a place in the health care system as well. Most of the individuals are concerned about their health and continuously monitor it to find any inconvenience that need to be examined as soon as possible . IoT helps to analyze an individual health condition and stores the available data and also intimates the corned health practioner who responds as soon as the

Emergency situation arise. This may be in the form of a digital watch or a band that monitors the individual's health.

**Self driving cars**:

Self driving cars that were a dream are now a reality based on the techniques used by IoT .The maps are to be analysed and the rules of the traffic are stored in the device .The machine learning algorithm's helps to understand the situation that may arise as it works in real time environment and provides the optimum solution when required.

**Virtual reality and Augmented reality** :

Virtual reality gains a lot of momentum as it provides the user with a real time environment .Augmented reality has also gained its momentum and provides a

good experience for the user .IoT devices aid to provide a better experience of theses facilities to an individual with the help of their devices connected with the 5g network services.

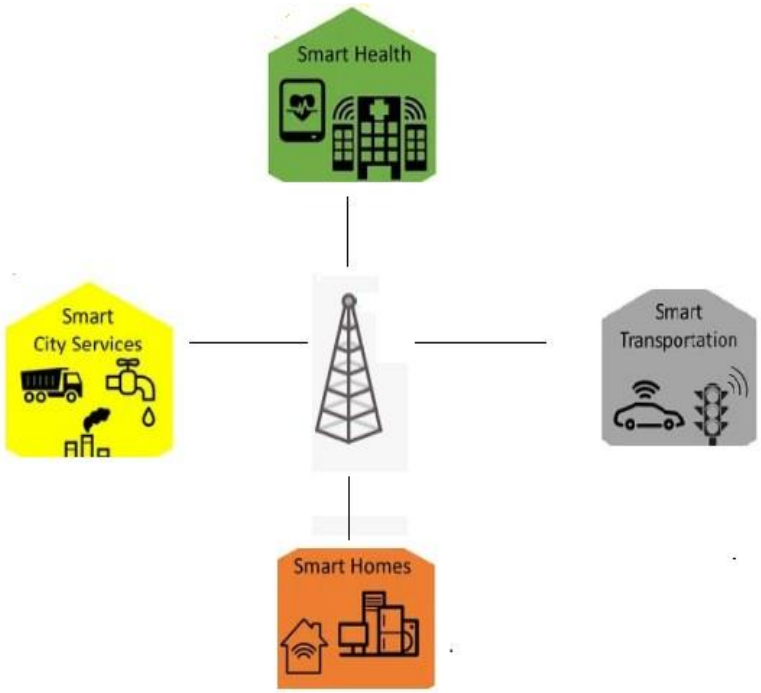


Fig1. Different applications for smart cities

**Challenges**:

Data Mining: Data mining can be defined as the process of extracting useful amount of data from a large form data that is available. The 5g services which are available transfer the data at a low latency and higher amount of bandwidth but if the data that is supplied is not clean, prone from error , redundant these may cause a lot problems. The IoT aims to provide better experience to the users with the help of providing a more useful means with faster transfer of data .Data mining is to done at a very faster rate as the data is being processed and searched to get the final results.

Security :

Security is major concern with the IoT .The IoT stores a large amount of real time data from the user and analyzes the data to provide the adequate amount of results .The infrastructure of the IoT should be provided in such a way such as the privacy of the data is maintained as most of the data is individuals private information .The sensors are open environment and needs to be taken into consideration as they access the resources of the user.

Environment:

Climatic changes may affect the transfer of the information and also the

Reception of the data where the devices act as receptors and analyze the data to execute an individual task . Certain climatic conditions should be considered and the data should be received properly. Maintaince of grids specially requires more care and consideration as it may affect the people.

Management:

The New 5g Devices should work properly with the implementation of the IoT networks. The Integration, propagation and connection should be well maintained in these devices. The applications should provide endless connectivity and error free connection to the user. As the 5g devices are new the establishment of the connection n and the transfer of information may cause a problem and hindrance for the implementation of the IoT devices.

Data Accuracy:

The IoT devices are used in the health care monitoring system and should provide accurate information as any misinterpretation may cause inconvenience to the user. The health conditions should be monitors continuously and the necessary precautions should be taken for the implementation. The Ever increasing devices could cause a lot of interaction among each other and the impact of intruders may also increase causing more problems .The data should also be secured in a proper way as it is in regard with the health of the user.

Compatibility:

The IoT devices should be compatible to deploy any of the changes of the software or the hardware that are encountered to carry out the task. The ever-increasing trend of the technology should provide a lot of scope for the new technologies to be adapted without any inconvenience. The new devices must be easy to configure and maintain without any problems.

Security challenges:

The 5g services would provide a higher bandwidth and maximum speed for the networks. The devices would be connected to each other and the

Propagation of small cells would pose more network functionalities and more number of devices that are connected to each other to carry out the task.

The attacks at the network level , botnets and the invasion of the privacy of the user provides for the necessary challenges that are posed.

These include high level of security challenges that are provided for the user to carry out the required task. As the number of IoT devices are increasing the attack caused will also increase and expand to a larger extent. The high amount of data traffic and the ever increasing demand of the network connectivity will cause a significant amount of data invasion .

Authenticated systems must provide the required amount of data security that has to be established within the system to provide the necessary connectivity .Cloud based connectivity will require more enhancement for the data and the user to carry out the required operation .Most of the security aspect are provided with the wifi system and the significant amount of changes are to be recorded to be analysed further.

## Literature Survey

[1]

The paper discusses the security techniques for 5g networks and the challenges related to the security and privacy of the networks. There are different services that support different devices where the different services involve the different people. Privacy is also an important matter of concern as most of the IoT devices store the personal data of the users. Passive attacks are active attacks are the different types of attacks that a user may have in the IoT enabled devices.

With the advancement of the network technology from 1g to 5g networks we need

New attacks may be deployed to pose a risk for the user. The use of cryptography will be based on the technology aspects of the 5G networks. Authentication, delay of the services attacks are the different types of challenges that are Faced by the user. Dos attacks will increase among the networks and the more number of connected devices will pose a major problem for the networks when are connected to the devices. If a device at a particular station is disturbed then it will disturb the rest of the devices also.

In the device to device communication each device would interact with the other device and communicate with each other. If the sensitive information is shared among the devices and the information is either leaked or attacked by intruders this may pose a greater risk of challenge as the data is now publicly available.

[2]

In this article some of the emerging technologies in 5G, presenting an introductory overview of them as well as their benefits, the challenges these present, along with their proposed solutions gathered from recent academic sources.

The 5g services have the following technologies that include the 5gpp , device to device communication , mobile edge computing , multicast broadcast devices , latency challenges .The 5g services must provide the low latency and higher bandwidth communication network and provide the required communication to the systems.

[3]

This article investigates the existing literature on user identity and location privacy and highlights the key parameters, issues, challenges, and future recommendations with potential solutions.

Every communication faces the challenges of the network that may include controlling the access, authentication, privacy, confidentiality etc. Active attacks and passive attacks are to be dealt with the wireless networks.

The techniques that are involved in the prevention of these attacks include the encryption of the radio resource control messages which may be either some part and whole part of the message. Periodic re allocation of the cells may also be one of the techniques that can be used to carry out the operation. The user privacy issues are dealt with in all the networks including from 1g to 5g services.

Paging producing privacy and location privacy are some of the concerns of the emerging 5g networks.

[4]

This paper discusses the impact and importance of 5G on IoT with its applications.

IoT provides the features to connect a large number of devices that are provided with sensors to carry out a particular task . A huge range of devices are connected to the IoT that may help to build smart citites ,health monitoring ,etc…

The 5g systems help to provide increased bandwidth and faster processing of data. The 5g services will provide a lot of potential to develop a huge number of IoT based devices. IoT faces a lot of challenges ranging from efficiency to be produced to a large extend of devices. Battery recharging and the replacement of batteries is also a concern for the IoT devices. The IoT devices should be scalable enough to accommodate a large number of new devices and technologies to be used for further improvements of technology. Cloud based computing and integration of different IoT devices are also to be considered.

Challenges ahead:

The 5g networks should provide the storage of large amount of data to be accessed by individuals and also devices. As more number of devices are connected the impact on the network size also increases and the devices capacity also increases.

[5]

This paper presents an exhaustive review for these key enabling technologies and also discusses the new emerging use cases of 5G-IoT driven by the advances in artificial intelligence, machine and deep learning, ongoing 5G initiatives,

quality of service (QoS) requirements in 5G.

The number of nodes that are connected to the IoT led technology will be increased tremendously causing and explosion in the IoT and 5g enables technology devices.

In handling all these technologies the amount of data and the storage and the processing there is a requirement of machine learning algorithms, artificial intelligence. A large number of applications of the IoT based systems help to increase the economy and reduce the intervention of individuals .The number of mobile users are also increasing largely enabling the intervention of 5g technology.

Heterogenous networks, Multiple input multiple output streams, device to device communications, architectural changes and the prevention of different types of attacks on the networks are some of the aspects of IoT based systems.

Artificial Intelligence helps to build health care system, intelligent networking systems, smart transportation systems.

Challenges ahead:

A lot of security issues may arise with the intervention of the 5g technologies and the connection of large number of networks. A large number of devices should be provided seamless connectivity to avoid any errors which should be provided by

the 5g services. Higher rate of data transfer and high density are some of the challenges that are faced by the IoT based devices.

[6]

This paper reviews the evolution and development of various generations of mobile wireless technology underscores the importance of 5G revolutionary networks, reviews its key enabling technologies, examines its trends and challenges, explores its applications in different manufacturing industries, and highlights its role in shaping the age of unlimited connectivity, intelligent automation, and industry digitization.

The networks have emerged from the 1g to 5g technologies. The 5g technologies provide the lower prices, lower battery consumption, lower latency than the 4g wireless networks. The 5g technologies provide greater spectrum to expand the available networks. There are a lot of systems involved ranging from application, management service, gateway and network , sensors connectivity ,actuators to enable the devices with sensors to communicate with the 5g technologies. The 5g systems can be helpful for automotive industry, manufacturing sector , health care industry , smart grids and smart cities.

[7]

The details of security requirements and attacks possible in this communication environment are further added. The different types of security protocols are also provided.

The development of the 5g network technology has been a boon for the IoT devices.

The Network model and threat model are some of the models that are provided by the 5g networks to enable the IoT based applications. These can also be based on the cloud-based systems so that the devices are connected to the possible sensors. A lot of security attacks can be handled by the 5g networks by providing authentication procedures, integrity, farward and backward secrecy property.

As the number of devices are increased the number of possible attacks are also increased, these can be handled by Key management protocols, Access control protocols, User authentication and Intrusion detection protocols.

Access control protocols, Key management protocols, Authentication protocols are some of accessing protocols of IoT .

Challenges:

Security of the protocols that are provided, privacy of the stored data, different types of device connectivity are some of the challenges faced by the 5g protocols.

[8]

This article introduces 5G technology, detailing its needs, infrastructure, features, and difficulties. In addition, it summarizes all the requirements and specifications of the 5G network based on the 3rd Generation Partnership Project (3GPP).

The 5G services provide higher performances and a new type of connectivity to the applications including IoT. It is also designed to provide low latency and higher bandwidth.5G services provide broadband experience every time when connected, smart vehicles transport system, IoT and anywhere access to information.

The 5G services provide enhanced radio waves signals to process the IoT devices.

The 5G provides Massive Multiple Input Multiple output technology, low latency, shared spectrum opportunities.

Challenges:

5g networks should provide wide frequency bandwidths, Huge volume of data,

Ultra low Latency ,security and privacy ,special protocols adapted with 5G.

5G System Overview for Ongoing Smart Applications: Structure,

Requirements, and Specifications

[9 ]

This paper explores the obstacles involved with upgrading to 5G implementation including challenges of infrastructure support, increased energy consumption, exploration of tower usage, positioning and beamforming, and hardware and software upgrades regarding timing and compatibility.

The 5G network has increased from a great extent from 4G to 5G. Most of the companies are highlighting the need for the 5G technology where the bandwidth is provided to a great extent .This will deliver the needed criteria for the implementation of the IoT technology. The 5G technology will provide more impact to the customers where specific needs of the users will be considered to perform a specific task.

[10]

This paper provides an extensive and complete survey on the process of detecting and preventing various types of IoT-based security attacks .IoT based systems can

be divided into different types of attacks.some of the most important types of attacks are denial of service , data manipulation and data disclosure. Since IoT based devices are connected via the sensors the intruders should gain entry into the devices and manipulate the data. This type of intrusion should be stopped at the starting point itself provided with more security features.

To prevent the Dos types of attacks the packet sniffers can be used to detect the data and the intrusion and prevent the attacks. Protocol attack, Man in Middle attack, Impersonation attack, Inference attack, Denial of service attack, Availability attack are some of the attacks that are encountered within the IoT based systems.

Cyber security testing tools are some of the devices that are necessary to carry out the testing of the systems.

Future work

There are more opportunities for future work. detection strategies, counter measures, are some of them. One area could be merging several existing solutions into a more robust solution. Another direction is exploring new ways to detect attacks with different techniques such as anomaly-based approaches. Other possibilities include extending our current analysis to different types of attacks, such as insider threats or side channel attacks. The last direction is investigating potential hybrid approaches that combine multiple detection methods.

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