

An Analysis and Research Challenges: Fusion of 5G Cellular Network and Cloud Computing in Internet of Things

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ABSTRACT

Internet of Things (IoT) is a worldwide rapid growing technology. It provides a seamless connectivity via smart devices all over the world. Lot of communication mechanisms are playing important role in Machine Type Communication (MTC) to achieve the modern IoT vision. Cellular network is a key factor for long range communication in IoT. 5G cellular network overcome the limitations of previous cellular technologies and provide a large research scope in future IoT. Cloud computing also plays an significant role in IoT. An extensive good communication can be established at a low cost using the cloud service of IoT. This paper presets the research challenges collaborating the 5G cellular network and cloud computing in IoT.

1. INTRODUCTION

IoT is the concept of devices which independently communicate with other devices without any human interruption. It is a booming field with bright future ahead. IoT transforms the world into a smart world. One could get anything, anywhere with less effort. Varied quality smart devices are interconnected for the implementation of any IoT application like smart homes, smart city, smart power systems, agricultural and shipping monitoring environment. Frequent updating of data is needed at low cost.

Heterogeneous data formats are needed along with multiple protocols for achieving seamless communication of IoT devices. The low power sensor nodes are used in the IoT. Therefore, the use case of MTC framework concentrates on low power operation, energy efficient and secure. The smart device connected in the IoT communicates all the sensitive information through Internet. So Security is an important requirement of IoT communication.

5G IoT deployment generates various forms of traffic, reliability, bit rates, energy consumption and security and privacy. The key motivation for developing IoT over 5G cellular networks is predicted and massive number of devices are expected to be deployed which requires significant data rates. 5G cellular networks ensure Authentication, Authorization and Accounting (AAA) security mechanism to enhance the security issues.

Cloud provides distributed accessibility and availability of computing resources through Internet [1,2]. Provisioning reliable, scalable, on-demand computing services available in distributed environments is the main goal of cloud computing [3,4]. Cloud computing allows the availability of resources and computing services in a shared network composed of remote software and servers for online users. Through the Internet portals, cloud services are available for users by cloud providers [5]. Through virtualization, severe scale computation is provided. Thus, cloud computing provides dynamic computing resources supporting extreme dynamic data combination from multiple data sources [6]. To set up a distributed real-time system for managing and handling IoT objects, cloud computing layers and software components could be customized [7].

2. IOT REQUIREMENTS

There are different kinds of applications deployed in IoT. Each of these applications is having their own characteristics and requirements. The smart home application requires energy optimization based on clever scheduling mechanism and automatic switch on and off smart appliances [8]. Data reliability is high in Industrial Internet of Things (IIoT) [9].

From the generations of cellular devices, we could predict that the cost of the device will be low which may not be at the beginning, but as time progresses the cost reduces. A least revenue is generated per user in such condition. IoT extends a huge geography and facilitates with a least cost. Usage of recent LPWA from the existing cellular networks would reduce the price of the hardware as well.

Low deployment cost is also the requirement of IoT. Extended Range is the one of the most important requirements which should be taken care of. The location of the devices must receive the proper signal and so forth they must be kept in appropriate places. Hindrances such as walls, lifts, doors must be overviewed and the signal must be captured [10].

Energy efficiency and battery power are considered as an important requirement. As the IoT devices and the 5G networks are power hungry, they tend to use lot of battery. Since we expect the device to be functional without the intervention of human, it is necessary to use the energy efficiently. Using the devices in a cyclic way i.e. for a period of time when they actually needed. For example a heater in summer seasons is of no use.

Security and Privacy are the very big concern in the Iot. It is mandatory to maintain a well-defined password in order to be secured. Encryption should be strong which should stop hackers from entering into our network.

3. 5G CELLULAR NETWORK IN IOT

Development of 5G enable Iot requires advance solutions with suitable Broadband spectrum to meet the demands of rapidly growing network traffic. As the preexisting LTE will not meet the requirements of the 5G, a new interface is developed from the scratch, specially designed for 5G which is called New Radio (NR). NR is defined by the 3GPP standardization for the 5G. Its spectrum range can be divided as FR1 and FR2. FR1 consists of spectrum frequency below 6GHz. FR2 uses the mmWave which falls between 30GHz to 300GHz has a significant unused space with large bandwidths which will be suitable for 5G.

The problem with the mmWave is that they cannot travel through objects and they tend to be observed by plants and rain. To overcome this problem small cellular networks such as micro-, pico- or femto- cell are used. These low powered cellular Base Stations (BS) transmits signals all around obstacles to reach the specific target. These station's antennas are small and so these base stations are easily fitted on the buildings, poles, etc.

To enhance and reduce the complexities of extensive cells and antennas, M-MIMO technology is incorporated. MIMO stands for Multiple Inputs and Multiple Outputs which consists of many antennas in a single base station rather than many. This technology must be useful as the 5G requires more antennas for communication.

The M-MIMO creates a new problem called Interference due to the congestion of the signals. This could be overcome by the beam-forming technology. Instead of broadcasting signals in every direction it will allow the base station to send a focus stream of data to a specific user, which will divide the beam as per the position of the device. It prevents interference and it is way more efficient which results in handling more incoming and outgoing data streams at ones.

5G should be capable of sending and receiving signals at the same time on the same frequency, hence the transceiver should be full-duplex. This can be done by the silicon transistors by fast switching of the transmitting and receiving signals on the same frequency.

These five technologies are still in their research and development stages and there is long way to overcome all their drawbacks and merge with our day to day life. Yet these promising technologies have shown better future for the 5G.

4. CLOUD COMPUTING IN IOT

IoT consist of large number of sensors which depends the cloud computing to store and process data [8]. The aim of the integration of IoT and cloud computing is turning some ordinary resources like sensors, work processes, and machines to smart things, and entitling customers with reliable and flexible deciding tools [11].

The IoT architecture consists of smart things, network, gateways data warehouse. Cloud computing provides a valuable solution for managing IoT services and tackling applications and service composition [12].

As virtualization technique used in cloud computing, IoT overcome its limitations such as energy, processing and storage. The data resources and data produced by those devices are maintained in cloud. Indeed, IoT service management and composition also maintained in cloud. However, the dynamic and distributed techniques for rendering new services in cloud helps to extent the physical sensors to a huge amount of real scenarios.

5. RESEARCH CHALLENGES

In this section we can discuss about research challenges in IoT. These challenges are in order to overcome the limitations of IoT with 5G cellular network and cloud computing.

5.1 Scalability

Scalability is the ability of managing the overall performance of the growing network without any significant degrade in the network. This can be seen as major issue when we consider the present Long-Term Evolution (LTE) systems for the Machine to Machine (M2M) communication. The Iot scalability refers to the ability of providing new heterogeneous devices without compromising the quality of the existing services. The management of the huge number of device's data is also an issue that needs to be concerned. The use of Internet Protocol version 6 (IPv6) will provide sample amount of space for present and future devices of IoT.

5.2 Network Management

Due to the heterogenic nature of IoT, a light-weight management technique is required to accomplish efficient network. The solution should b energy efficient because of the constrained nature of the IoT devices. It is also taken account of system monitoring, maintenance of connected devices, system configuration etc.

5.3 Security and Privacy

Due to the lack of knowledge around Service Level Agreements (SLA) and trust in service providers, concerns have arisen when crucial IoT applications shift to cloud computing. The Machine to Machine devices have a processing ability with a resource-constraint which makes the security mechanism least used in the current Internet scenario.

5.4 Network Mobility and Coverage

The growth of the IoT Network must be monitored and supervised by an overwhelming mechanism as it is interconnected with multiple smart devices. Enormous base stations have to be deployed due to the increased usage of the IoT devices in order to facilitate the connectivity of the networks. The mobility issue in IoT has to be considered when the 5G mobile network are dealt with.

5.5 Network Congestion and Overload

While Comparing the human-to-human traffic , the mobile network requires heavy signaling capacity which is the crucial player in connecting the smart devices in a IoT network. Congestion of a network and overload of network are few factors affecting the performance of the IoT network as well as Quality of Service (QoS). Accommodating a heavy traffic is again hazardous that results in the congestion problem among the MTC devices. In order to clear the traffic Internet Protocol(IP) can be implemented.

6. CONCLUSION

This paper discussed various key factors of IoT and its research challenges. Many advanced applications in IoT with 5G wireleses like smart cities, internet of vehicle, smart industries, smart agriculture and smart healthcare leads to IoT revolution. The integration of cloud computing and IoT can be extremely profitable in several fields. Since IoT facilitate

connecting heterogeneous objects, this will allow the cloud to connect to physical objects. Collaboration of 5G cellular networks and Cloud computing in IoT provide drastic change in IoT future vision.

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