Future enhancements and propensities in forthcoming communication system – 5G Network Technology

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Abstract. Network technology and mobile technologies are two essential and booming technologies in today's scenario that have emerged and quickly evaluated in terms of hardware, communication media, and architecture. Based on the communication system there are massive developments in underlying devices with hardware, software, and entire architecture. All we experienced with 2G, 3G, and 4G communication system, and in the future, we will going to experience next-generation communication system 5G. In underlying technology there have been many improvements and advances, mainly with data transfer speed and unlimited bandwidth that we have never experienced before. Not only is this technology limited to voice and data, but we also expect some IoT revolutions, a system for mobile communication, automated vehicles, industrial and manufacturing automation, human-machine interface, logistics and warehousing, etc. So this 5G technology gives the opportunity for researchers to perform research in related technologies. Here we analyzed the need, concept, service and features of fifth generation communication technologies in this paper. It was proposed the core technology incorporated with 5G and their architecture. Future trends and applications influenced by the 5G communication system were analysed.

Keywords: 5G, fifth generation, Network, IoT, Network, Security, LTE, Communication Technology.

1. Introduction
The very first generation of an analog signal-placed mobile communication network was built in the 1980s and backed people to get rid of telephone line shackles. Most effective second-generation (2G) mobile communication systems based on digital communication emerged in the 1990s, and personal mobile communications grew rapidly on a larger scale. After 2000, people can appreciate rapid mobile Internet experience with the implementation of 3G systems, like video telephony. By 2010 deployment of the 4G commercial network based on Long Term Evolution (LTE) in addition...
heightened user experience and system capacity. The Global TD-LTE Initiative (GTI) statistics conveys, by the third quarter of 2015, 364 LTE commercial networks were started. The 5th-Generation (5G) mobile communication technologies are up coming into research fields with the IMT-Advanced (IMT-A) systems being set up in the world.

Intensive implementation of the Fifth-Generation Mobile Communications System (5G) have been driven globally as a systematic upgrade of current mobile communications systems focused on extensive industry dynamics analysis and potential demands for mobile communications systems towards 2020s. European Union’s initiative METIS began 5G research work by the end of 2012 to accelerate potential progress of mobile communications techniques. In China, the sponsor team IMT-2020 was formed in April 2013. Promotion community IMT-2020 will act as a forum to support the 5G report. Its goal is to plan domestic factions to constantly engage in international cooperation and collectively support 5G global development. In Korea, Samsung certified and documented millimeter wave technical expediency is around 28 GHz bands. Other possible contender technologies like massive MIMO have increasingly drawn attention. The International Telecommunications Union (ITU) has begun their research towards 2020 on the International Mobile Telecommunications Network.

1.1. Overview
LTE’s global introduction cultivates the smartphone consumers to make massive use of cellular data in their day to day affairs. For example, the video services and social apps like WeChat, Facebook, and Twitter, greatly alternated our lives with LTE’s effectiveness, especially with huge data rates and low latency. Mobile communication is believed to penetrate into every facet of the prospective society and create an all-dimensional, user-centric knowledge ecosystem. In the near future, a fully mobile and wired society is anticipated which will be characterized by exponential advancement in connectivity, traffic volume and wider field of user scenarios. The Mobile Broadband (MBB) and Internet of Things (IoT) services will have two prominent key drivers in the prospective development of mobile communications, providing a wider perspective over the next generation of mobile communications (5G).

1.2. Need
Mobile broadband service has changed the traditional mobile communications business model, allowing for unparalleled user experiences and having a significant effect on whole form of the life and work of people. Moving forward to 2020 and maybe beyond, MBB service will facilitate the continuing transformation of how people communicate and provide consumers with the ideal opportunity through more technological innovations such as augmented reality (AR), virtual reality (VR), ultrahigh-definition (UHD) 3D content, and mobile cloud services. An added advancement of the mobile Internet will activate the expansion of digital traffic in the future by amplitude of thousands, promoting a new age of modifications and an insurgency in mobile communications technology and the whole industry. Going forward to 2020 and beyond, mobile data traffic is expected to surge explosively. The worldwide traffic is believed to rise more than 200 times between 2010 and 2020, and nearly 20,000 times between 2010 and 2030.

1.3. Scope
The IoT has broadened its reach of mobile communications services from interpersonal communications to the intelligent interconnection amidst subjects as well as between people and things, letting mobile communications innovations enter toward larger disciplines as well as sectors. Considering 2020 and well beyond, technologies like mobile safety, the smart home, environmental monitoring, Internet of Vehicles (IoV), and industrial control would accelerate the exponential production of IoT applications, enabling the linking of billions and billions of users to a network creating an accurate "Internet of everything." It creates unprecedented-scale of newly surfacing industries and will inculcate limitless creativity in mobile communications. In the meantime, mobile
communications will however face new obstacles due to a large sum of interconnected devices and the diversified IoT networks.

1.4. Features
To order to satisfy service and customer demand by 2020 and beyond, the IMT-2020 is expected to be launched by 2020 (5G) to satisfy current to unparalleled demands beyond previous generation systems' capabilities. 5 G will develop and leap the constraint, space and time in order to allow an innovative as well as engaging user experience. 5 G would provide consumers with a fiber-like data access rate and a user experience of "zero" latency. It will also be able to communicate 100 billion devices and will be efficient of distributing seamless experience among a range of scenarios which include ultra-high mobility, ultra-high connection density and ultra-high traffic volume density. It also offers strategic optimization focused purely on resources as well as user experience, which definitely increases energy which cost efficiency through more than a hundred times, helping to understand 5G's dream, "information a finger away, everything in touch."

1.5. Services
The impending cellular communication system is going to reach all the fields of community or population and offer the seamless experience of users. In order to obtain the specifications for the 5 G network, the standard infrastructure and customer demand will be the required specifications for the 5 G, although the usual implementation circumstances would also present certain impediments to be addressed by the 5 G system, in particular private and commercial application viewpoint, by its price and efficiency.

1.6. Sustainability and Efficiency Requirements
To afford the users with the mesmerizing services in a more economical manner, when dispatched and sustained after commercial deployment, the expense and reliability of the 5 G system must be regarded. Mobile data traffic by 2020 may rise more than 1000 times, although the consumer cannot compensate roughly to the data volume for the mobile data. To do that, a key to making a good 5 G would be the network's high price-efficient. The 5 G spectrum performance, the agility to adjust to diverse use circumstances and facilities, and streamlined network optimization and maintenance are eagerly anticipated from 5 G to the value per bit of 5G.

1.7. 5G mobile network Concept
Having considered the actual introduction of 5G mobile communications networks, it would include both cellular networks and fixed network dimension, consideration will be given to the value of technical advancement regarding the design of the entire communication network. In Japan, the mission of the 5G network committee is to perform out the studies mentioned above. The Committee paid particular consideration to end on communication aspect and observed the need to create fixed network technologies in order to facilitate a reduced latency in transmitting or wider bandwidth properties in the core network segment, as essential requirements of 5G networks, highly malleable resource control similar to radio networks accessibility.

2. Network Architecture
Initially, 1G is a wireless technology Analog Telecommunication standard here radio signals were transmitted with analog system, and speed of these lies in the range 2.4 kbps. These systems often encounter problems such as poor battery life and low voice quality this would finally result in problems such as dropped calls. Finally to get rid of this problem 2G Cellular technology was introduced in which radio signals were transmitted in digital form and speed of these devices range in 64 kbps. The 3G then provides 144 kbps-2 mbps capacity, while 4 G provides 100 Mbps-1 Gbps and is based on LTE technology. The 5 G infrastructure is improved. the network components and different end-points are upgraded to provide a new situation. Consequently, new technologies to
incorporate value added services must be implemented for service providers. The 5G architecture is entirely IP-based and for Wi-Fi and mobile networks. The 5G model primarily includes a user terminal and then a range of different radio access technologies. Each radio technology is regarded as an IP link for the outside world. It also continues to distinguish the changes in its environment and thus react to the continuous quality of service. As the system is more reliable, less complex, and more effective as it handles all new implementations based on 5G.

There are three major categories of the use case for 5G:

1. The Internet of Things (IoT) has also been named massive machine-to-machine contact, involving connectivity of billions of devices on an unparalleled scale without human interference. It will revolutionize current industrial processes and systems, including agricultural, manufacturing and corporate communications.
2. Important tasks include real-time computer controls, industrial robotics, vehicle communications and safety systems, autonomous driving and stable transport systems. In the field of remote education, treatments, and treatment, low-latency contact also presents new possibilities.
3. Better mobile broadband that provides much faster data rates and higher worldwide availability. Current features provide free Wi-Fi Internet access for domestic consumers, outdoor TV systems with no need for cable transporters and greater smartphone connectivity.

![5G Network Architecture](image)

**Fig.1.** Network architecture of 5G communication system.

3. SECURITY SERVICES

The 5G networks provide opportunities for new technologies, business models, and mobile market entry for emerging players. 5G's key goal is to create a robust and trustworthy innovation platform for companies and industries to build and offer innovative, value added technologies for mission-critical uses like Power, Tr. This network facilitates flexibility and cost-effectiveness of multiple networks for different customers with varying infrastructure and safety requirements. It mainly works on a trust model of three parties consisting of network operator, service provider and end user. This method extends from the consumer interface across the network to the point where the operator finishes its services. At network level, the transportation layer network plays an important role in 5G systems as it offers high-speed connections and low latency between all 5G network functions. The accessibility of
the transportation network is consequently linked to the 5G and its service providers. In failure: Geo-redundant tracks permit the routing of traffic in the event of a track failure. Link redundancy solutions will recover if fast failure, connection failure or port failure occurs. Port-based authentication to check whether approved network devices are linked to network. Error identification and mitigation methods are available.

5G will link critical infrastructure requiring greater protection, as well as critical infrastructure to ensure the security of the entire community. For example, a security breach in online power systems can be devastating for all the electrical and electronic systems on which society depends. We are also aware that it is important to have data for decision-making, but what about critical information being corrupted during 5G networks. It is therefore more essential that primary security challenges in 5G networks are examined and highlighted and that potential solutions can lead to 5G secure systems overviewed.

The basic challenges in 5G highlighted and heavily discussed in literature by the Next Generation Mobile Networks (NGMN) [2] are:

- Network flash: large number and new (IoT) end-user apps.
- Radio interface security: radio coding keys sent through unsafe channels.
- Integration of the user plane: no defense of user plane cryptographic integrity.
- Mandated network security: service-driven security architecture limitations that allow security measures to optionally be utilized.
- Password roaming: The roaming from one operating network to another cannot adjust user security parameters which compromise the threat to roaming.
- Denial of Infrastructure Service Attack (DoS): accessible and non-encrypted network control networks.
- Storm signaling: central control systems, for example. The Non-Access Stratum (NAS) framework of Third-Generation Partnership Project (3GPP).
- DoS attacks on end user devices: No controls, programs and user configuration details of the operating system.

4. Applications and Future Trends

5G communication technology laid a foundation for future research and innovations. The existing 4G technology has some drawbacks on some large scale networking services, so that lacking gap can be fulfilled in the next generation, and the result of that some new applications are developed and proposed.

   a. Network communication technology: The communication technology and capacity of the network tremendously improved with high speed and great efficiency of the 5G network.

   b. Mobile Internet: The very fast development of mobile data transfer technology and a data storage technology allows the people to use mobile internet using mobile devices. The other wireless technologies like radio waves, infrared rays and electromagnetic communications are integrated with 5G wireless communication to establish high end network communication technology.

   c. Camera and video support: The data movement speed, data storage capacity, and rich surveillance of video and image contents are tremendously increased through light field cameras influenced by the 5G communication system.

   d. Automatic vehicles: It enables vehicles to communicate with other devices that enable the vehicle to automatically locate, navigate, and move without human intervention. In this technology, Vehicle to Vehicle (V2V) and Vehicle to Internet (V2I) way of communication supported by 5G enables huge revolution in vehicle that move without human, can able to communicate with traffic signal, can detect accidental objects and bad atmospheric condition at road.
e. Intelligent manufacturing: The current industry 4.0 scenario enhances the mobile broadband connection, machine to machine communication, and ultra-reliable low latency communication that were enabled by the 5G communication system. It also improves the performance of industry by more connection establishment, less electricity usage, high performance, potential to work at any condition and huge data transmission.

f. Human-Machine Interface: It enables the one to one interaction between the human and typical machine robot. It mainly utilizes 5G connection in 2 modules such as augmented reality-based glasses that gets an inside the image of the robot to accomplish the operation. It requires a high transmission rate, so it utilizes 5G eMBB slice. One more module it utilizes is Remote access and Control is appropriate for micro production and hazard scenario. The cooperating human-machine control realizes the actual-period synchronization in inside and outside of the factory that utilizes 5G uRLLC slice.

g. Process Automation: In the process, automation requires to observe and regulate the different process aspects like pressure, temperature, and liquid level, etc. It requires interconnection of human, machineries, real time objects, and computer and other systems with strong network connectivity with 5G mMTC slice.

h. Factory automation: It covers a huge wireless sensor network that makes the functionality of the factory very smart. Were the sensors are deployed at processing level, security level, and configuration level.

i. Logistic and warehousing: Mobile robots and platforms are used to achieve automation in logistics and warehousing processes such as distribution, transportation, and storing logistic resources. Here 5G uRLLC plays a major role in warehousing to maximize moving flexibility and response. Also, 5G mMTC slice is useful in logistics to operate indoor and outdoor. Both indoor and outdoor require interaction at every level with a public network, where 5G mMTC plays a very important role.

j. Device to Device (D2D) communication: In smart city concept the wireless sensor network technology is combined with a 5G communication network using D2D communication. D2D communication enables direct and fast communication between nearby user equipment (UEs) using the cellular links. In smart cities, the integration of WSN and 5G system is an open issue that can deploy in every aspect ranging from water reservation to public safety. D2D improves the speed of the communication between vehicles and enhance the system’s spectral efficiency, system capacity, and throughput, on the whole.

5. Future Scope
It is the right time to perform research and development in the field of 5G communication technology. This 5G network technology is the junction of other related technologies like nanotechnology, privacy and security technology, rapid technology and communication and transmission technology. So it was predicted that the usage and data traffic will be thousand times more in next ten years. Due to Internet of Things (IoT), Artificial Intelligence (AI) and other innovative applications more number of devices gets connected each other that mainly depends 5G. So such a large expansion in network connection, there is the requirement of adding more and more advanced functions for next-generation mobile communication technology that performs a more secure, reliable, efficient, and comfortable way of sharing information takes place efficiently in terms of capacity, energy, and spectrum. When it was commercialized after 2020, it leads to the development of mobile inter-services in the future. The five future development scenarios if 5G communication technology includes:
• Ultra-high-speed scenario: should provide high-speed data networks to the user devices in future.
• Supporting large scale population: must provide good quality mobile broadband experience in all types of areas and all types of weather conditions.
• Best quality: It ensures that the user still enjoys high-speed data experience when he is moving around to different places or when he was in travel.
• Ultra reliability real-time connectivity: It guarantees that new application meets all rigid principles in the form of potential with consistence.
• Universal object communication: It guarantees machine type equipment communication and sensor communication.

So in this rapid development of technological scenario, 5G communication technology plays an important role that upholds the social and economic benefits. It is very much required by the researchers to strengthen research activities on 5G technology that should lead the technology towards standards in different aspects of application, service, and quality of communication service.

6. Conclusion
With continuous growth in science and technology, there is more and more research is required in the communication system to fulfill future requirements. 5G communications is evolved versions of the previous generation with a lot of changes that alter the entire scenario in the communication system definitely satisfy the requirements of people in every sector throughout the world. The revolutionary changes can happen in people to machine communication, machine to machine (M2M) communication, Internet of Things (IoT) application, Artificial Intelligence (AI), media and information, and industry sector. The future 5G network is combined with a cellular network and local area networks (LAN) that leads the very fast improvements in sector like media and information. The main technical aim of the 5G network is to intensification the data speed and frequency bandwidth by ten times than the existing network infrastructure.

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