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Challenges in the deployment of 5G Networks in India

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Abstract: *Telecom sector in India has to compute with the world and bring Innovation with advent of new technologies. 5G deployments start globally and India also must have to start the deployment process in coming years. 5G will provide enhanced connectivity and help in digitalizing various industrial verticals. In this paper we are going to discuss about the specifications of the 5G, architecture of 5G network, spectrum requirements for 5G and finally try to identify the challenges for 5G deployment in India*
Keywords: *5G Network, Innovation, Architecture, Challenges, IoT*

I. Introduction

The 5G technology attribute following characteristics seamless coverage, high data rate, low latency, and highly reliable communications. It enable billions of Internet of Things (IoT) devices, allow higher quality video services with mobility at high speed, business automation delivered through billions of connected devices, Tele-surgery & connected cars.

5G will help to cater the growing demand for high speed internet. Moreover, it will unleash new business opportunities and bring substantial socioeconomic benefits through increase in productivity, improvements in service delivery, optimum use of scarce resources as well as creation of new jobs.

II. 5G Technical Specifications

IMT2020 (5G) is intended to provide far more enhanced capabilities than those provided by IMT Advanced (4G). It is expected to make available much greater throughput, much lower latency, ultra-high reliability, much higher connectivity density, and higher mobility range. Figure1 shows the comparison of design targets between 4G and 5G. The 5G networks are envisioned to provide a flexible, scalable, agile, and programmable network platform over which different services with varying requirements can be provisioned and managed within strict performance bounds.

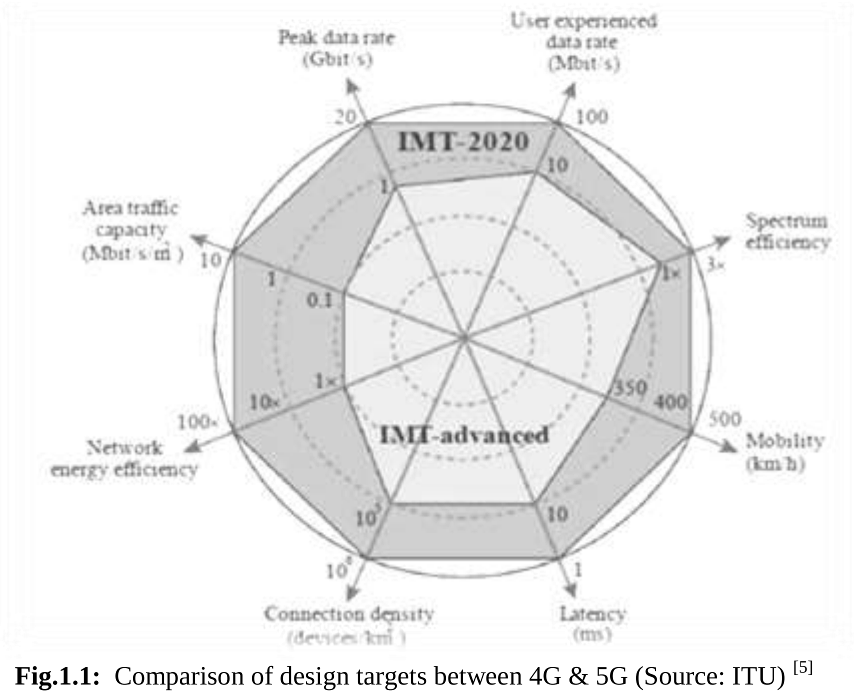

Fig.1.1: Comparison of design targets between 4G & 5G (Source: ITU) [5]

a. 5G Use Cases

5G use cases [4] can be categorized into three different use case classes namely- enhanced Mobile Broadband (eMBB), massive Machine-Type Communication (mMTC), and Ultra-Reliable Low-Latency Communications (UR-LLC). The requirements for the use case classes and the use cases within each class vary significantly. Figure1.2 shows the key performance requirements in different usage scenarios.

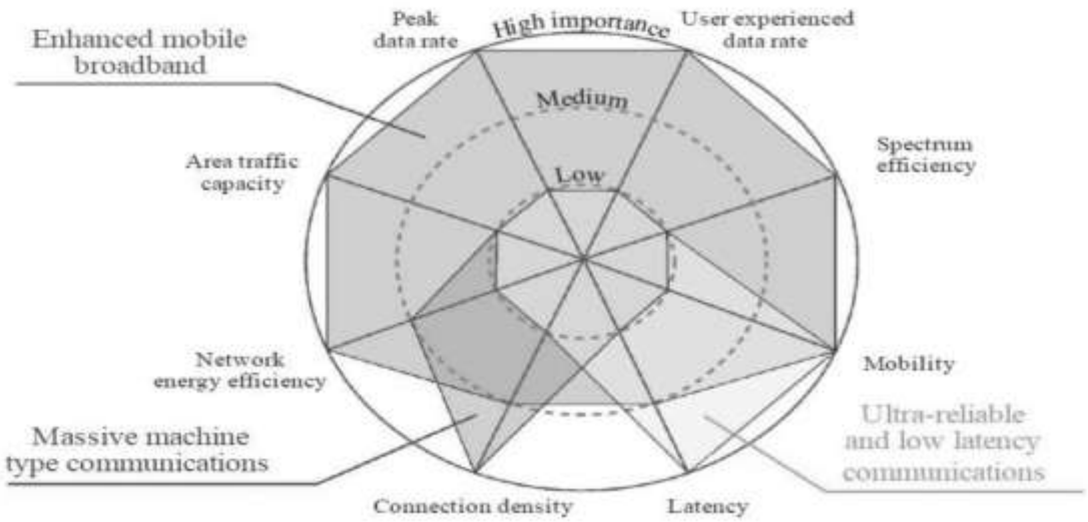

Fig. 1.2: Key performance requirements in different usage scenario (Source: ITU)

eMBB: It addresses the human-centric data driven use cases for access to multi-media content, services and data. This usage scenario comes with new application areas such as virtual reality, video monitoring, mobile cloud computing, 360o Ultra-High-Definition (UHD) video streaming, real-time gaming, etc and new requirements such as hotspot, wide area coverage, etc

UR-LLC: This use case has stringent requirements for capabilities such as throughput, latency and availability. It will support the delivery of critical communications. Some examples include wireless control of industrial manufacturing or production processes, remote medical surgery, distribution automation in a smart grid, transportation safety, autonomous cars etc.

mMTC: This use case is characterized by a very large number of connected devices typically transmitting a relatively low volume of non-delay-sensitive data. Devices are required to be low cost and have a very long battery life. This use case covers IoT applications. Some examples include health monitoring wearables, smart cities with smart grids, smart transport systems and smart homes, etc.

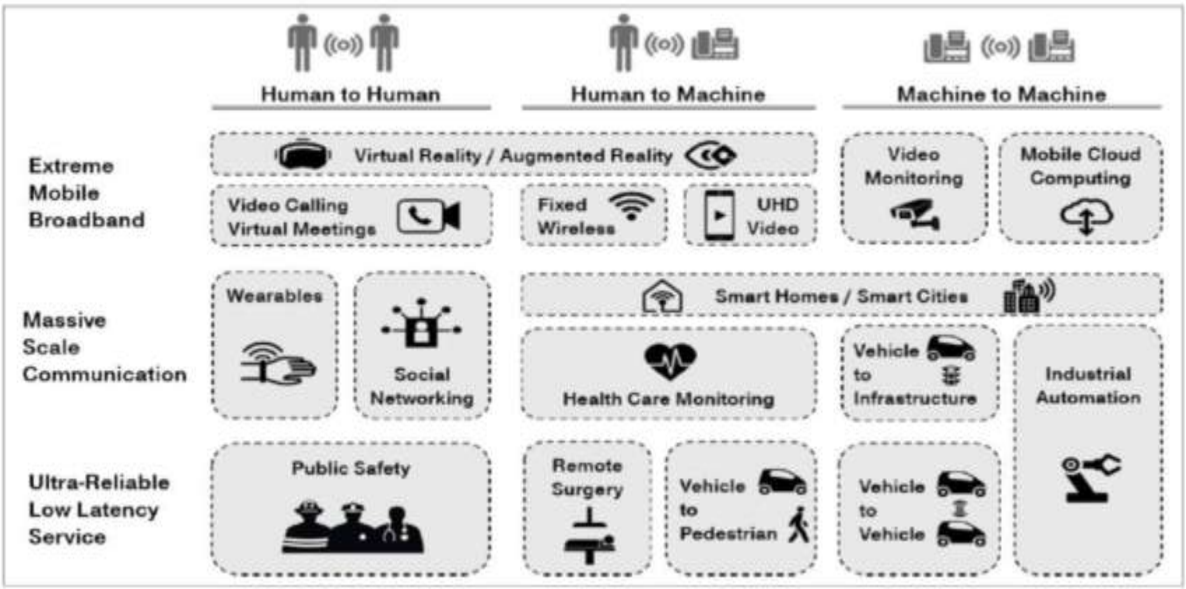

Fig. 1.3:5G Use Cases type of interaction and different performance requirements

b. Key Enablers for 5G

Mobile network functions are being split up, distributed and virtualized to provide the best combination of latency, throughput and cost effectiveness for various potential applications.

- ➢ Network Function Virtualization (NFV)
- ➢ Software Defined Networking (SDN)
- ➢ Cloud Radio Access Network (Cloud RAN)
- ➢ Massive Multiple Input Multiple Output (MIMO) and Beam forming solution
- ➢ Spectrum sharing technique such as Licensed Shared Access (LSA)
- ➢ Real time machine learning and Artificial Intelligence
- ➢ Network densification through small cells
- ➢ New band of 3.5GHz.
- ➢ New front haul, Mid haul, Back haul Solutions

The 5G NG core will have the following characteristics:

- Virtualization and NF modularization
- Service based architecture and interface
- Control plane and user plane separation
- Mobility management and session management function decoupling
- New QOS architecture for introducing the new services
- Network slicing for supporting the new business domains

c. Spectrum for 5G

High frequencies (above 6 GHz) offer real promise for the provision of very high data rates and high system capacity in dense deployments. The three key spectrum frequency ranges required for 5G can be summarized as shown in figure 1.4.

Fig. 1.4

III. Key challenges and potential solutions

Meeting the network demands of the future, network densification will be required, which involves addition of more macro cells and small cells in the network. 5G capabilities depend on hyper dense network; small cells will be required to be deployed at every 200-250 meters.

KEY CHALLENGE	SCF RECOMMENDED SOLUTIONS
Streamlining the regulatory approval for small cell equipment	Standard industry classifications of equipment with common documentation of compliance and conformity to be used when defining related policies. Some of the classes can be exempt from approval process or to light regulatory regime
Scaling the planning application process to support large numbers of cells	Common rules on which equipment classes can be exempt or subject to fast track approval. Batch process for groups of cells, to decrease the approval time and reduce workload of local administrations.
Securing sufficient suitable sites with power and backhaul	Simplified common frameworks to ease the opening up of access to street furniture and other existing assets. Census of available assets per municipality. Open access toadministrative buildings.
Cost of installation	Adopt simplified rules of installation that would enable non-skilled workers to deploy (based on classes of equipment and complexity of installation). Reduce administrative charges (e.g. installation, operation, periodical revision taxes).
Radiofrequency compliance	Follow international recommendations for installation classes and provide information
Administrative complexity	Single executive to coordinate all approvals (e.g., in a smart city program). Streamlined paperwork and filing to minimize the approval processes and reduce the workload of the administration.

Table 3.1

The challenges in deploying small cells are not addressed in a timely fashion, many of the benefits which Indian government, regulator and cities hope to derive from 5G. Indian TSPs will have to deploy small cells at a faster pace and at greater density. Since public infrastructure such as street lights, traffic lights, metro pillars, electricity poles, public buildings/rooftops etc.

IV. Conclusion

5G is expected to be broadly based on the Service Based Architecture (SBA). The expectation will be high on the part of service providers to allow for fast creation of new service and extendibility without impacting the standards. Technology such as SDN and NFV enable the use of network slicing in 5G networks to meet many different requirements of the consumers, enterprises and industry use cases on the same physical infrastructure. These technologies also enable the programmability, agility of the infrastructure and the applications.

Keeping in view the scale and functional requirements of the future networks, it can be predicted that NFVs and SDNs alone cannot serve the purpose unless these are taken to next level. There are issues of fault tolerance and scalability in existing virtualized environment which need to be taken care of in order to enhance the required capability of future networks. To eliminate or overcome the infrastructural limitations of the core networks, a cloud-based Network Function Virtualization (NFV) framework will be essentially helpful that gives tenants the ability to transparently attach stateless, container-based network functions to their services hosted in network of cloud.

Security over the cloud is vital for adoption of cloud-based services. Without security, no cloud service could be effectively offered. Specially, the users should have confidence that their data is secure in the cloud.

Dynamic Spectrum Sharing (DSA) is a useful feature for evolving 4G to 5G; DSA enables deployment of 5G in the same spectrum as 4G.

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