

### **13. Conclusion**

This white paper provided information on research into everyday uses of mobile applications, including use scenes in industry, transportation, education, logistics, medical, health and welfare services, safety, emergency, and disaster relief. The research presented looks at these mobile applications from many different viewpoints, clarifies the technical requirements for the mobile communication systems as a fundamental part of society. Additionally, it reports on high quality and cutting-edge services demanded by consumers, and results of research and analysis into the trends of society and markets. It also predicts on the use scene of the 2020s and applications that will be needed in that time frame. Then, based on these expected use scenes, key concepts of 5G, requirements, capabilities, architecture, and key technologies for 5G, and the desirable radio frequencies for 5G are discussed. Below is a description of some of the results about the main features of 5G that came out of this research.

5GMF proposed in this white paper two key concepts for 5G: “Satisfaction of End-to-End (E2E) quality” and “Extreme Flexibility.” “Satisfaction of E2E quality” means providing every user access to any application, anytime, anywhere, and under any circumstance. “Extreme Flexibility” is the communications system which will allow 5G networks to always achieve E2E quality.

This white paper identified two key technologies necessary to support the wide range of use cases expected in the 5G era through “Extreme Flexibility”. The first is an “Advanced Heterogeneous Network”. The second is “Network Softwarization and Slicing”.

It is hoped that 5G standards will allow for wireless and wired networks to have the ability continue to handle growing demand for larger capacity and higher speeds as previous mobile communication systems have. It is expected that data traffic in the 2020s will be 1,000 times larger than that of 2010, meaning 5G standards will need to be able to support this high level of data traffic. In addition, in order for users to be able to comfortably access rich, data-intensive content, 5G standards will need to support high speeds of more than 10Gbps.

Although transmission latency of 10s of milliseconds have already been realized by LTE/LTE-Advanced, new use cases in the 2020s such as haptic communication, robot control systems, and other control systems, will require lower latency in addition to

other possible use cases that will require both low latency and high reliability. Based on these use cases, E2E latency will need to be on the order of milliseconds. Transmission latency over wireless sections of the network will especially need to be kept at less than 1 millisecond while maintaining 99.999% reliability.

Previous generations of mobile communication systems did not design for handling massive number of devices with simultaneous connections. 5G will need to meet this requirement due in part to the expected dramatic increase of IoT devices in the near future, for which 5G will be expected to support 100 times or more simultaneous connections than that currently supported.

Key technologies corresponding to these requirements will be utilized up to its maximum potential and will enable us to support new use scenes for the 2020s and beyond. Examples of these use scenes include: an air ambulance that can support surgery en route to a hospital, which will require a high capacity, low latency, and a disaster resilient network; micro robots for use in next generation agriculture, requiring high capacity, massive number of devices with low power consumption; streaming HD video while moving at ultra-high speeds, which will require ultra-high speed mobility and high capacity; and experiencing sports events in the viewpoint of players through an HD 3D live feed, which will require high capacity, support of massive number of devices simultaneously connected, and low latency. 5G will provide the opportunity to provide these revolutionary services to everyone.

Using the above research as a base, the 5GMF has contributed to ITU and 3GPP in frequency coordination, standardization, and other related activities, built collaborative relationships with 5G related organizations internationally, and disseminated 5G related information to the relevant industry sector. Along with continuing to carry out these activities going forward, in order to support the successful implementation of 5G, 5GMF plans work with partners from Japan and abroad to hold 5G verification trials under the actual condition to attract the relevant industry to utilize 5G, to give demonstrations of 5G characteristics, to consider a platform where service providers will be able to easily offer 5G related services to their customers, and to acquire the necessary frequencies bands for 5G both domestically and internationally. These activities by 5GMF will accelerate the pace of actions needed to successfully implement 5G by the year 2020.

In addition, 5GMF expects that the results of the research reported in this white paper will support ongoing and new research and development, standards activities, and radio frequency allocation coordination, as well as strengthening and extending international partnerships, and will promote to build collaboratative relationship with a variety of industries in order to make the best use of 5G in user scenarios for entertainment, transportation, industry/verticals and emergency and disaster relief.