

Overview of 5G Field Trials 2017

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The Fifth Generation Mobile Communications System (5G) will pave the way for many new capabilities and features such as ultra-high speed, massive machine type communications, ultra-reliability, and low latency. 5G is expected to be developed in the years ahead as the essential ICT infrastructure supporting the IoT era and Japan's economic growth.

Japan's "Growth Strategy 2018", approved by the Cabinet on June 15 this year, highlights the importance of "rapid dissemination and development of 5G in rural areas of Japan". 5G is required as a powerful engine for growth nationwide, not only in urban areas but also in rural areas to activate those region and resolve the problems besetting rural areas.

To make Japan as one of the first countries to commercialize 5G in the world, the Ministry of Internal Affairs and Communications (MIC) has strengthened international partnerships with Europe, U.S., and other Asian countries. In October 2016, MIC consulted the Information and Communication Council about "Technical Conditions Concerning New Generation Mobile Communication System" to begin consideration of allocating spectrum bandwidth to 5G, and the Council reported on 5G technical requirements in July 31, 2018. MIC will allocate spectrum to 5G by the end of the fiscal year.

Meanwhile, MIC continues to promote R&D to commercialize 5G and carry out field trials to demonstrate actual 5G applications. The trials began last year, and stakeholders in a number of relevant fields—transportation, tourism, medicine, etc.—took part in six demonstration projects that have already yielded good results.

This special issue provides an overview of the 5G Field Trials (hereafter *Field Trials*) of 2017 sponsored by MIC.

1. Introduction

The capabilities of 5G represents a major advancement over current wireless systems—very high speed of 10 Gbps (100 times faster than LTE), up to a 1,000,000 connected devices /km² (100 times the number of devices supported by LTE), 1 ms delay (one-tenth the delay of LTE)—which promises to open up all kinds of new service offerings and applications across many different industrial sectors.

3GPP (3rd Generation Partnership Project) and ITU-R (ITU Radiocommunication Sector) have stepped up international standardization activities to make 5G a reality by the year 2020. Governments and 5G promotional organizations of countries and regions around the world have been actively discussing international coordination regarding spectrum for 5G, 5G use cases, and migration scenarios from 4G to 5G with some of the industries that have the most to gain from exploiting 5G.

From this background, six projects were carried out as part of the Field Trials to assess the performance of 5G and to clarify the technical conditions in different test environments. These projects assessed radio wave propagation characteristics and specific applications and services when introducing 5G on frequency bands from 3.6 GHz to 4.2 GHz and from 4.4 GHz to 4.9 GHz (referred to as the 4.5 GHz band) and from 27.5 GHz to 29.5 GHz.

This paper provides an overview of the Field Trials and a detailed description of the six projects by the companies and organizations responsible for the projects.

2. Setting Technical Targets

Numerical targets were set to get an estimation of the achievement levels for the specific services and applications under test.

3. Preconditions

Preconditions for the 5G system were clearly specified to define the system and ensure that there were no inconsistencies among the various projects. Here we assume that the mobile communications system is the 5G system now being investigated by the 3GPP, which is expected to be recommended by the ITU-R as the IMT-2020 system.

4. Test Environment

We use the scenarios, technical performance requirements, and required values for the evaluation environment of 5G as defined by the ITU-R.

1) Usage Scenarios

The ITU-R drafted the recommendation “IMT Vision” (M.2083), which summarizes the basic 5G capabilities and concepts.

In this recommendation, three 5G usage scenarios are described:

- (1) eMBB (enhanced Mobile Broadband)
- (2) mMTC (massive Machine Type Communications)
- (3) URLLC (Ultra Reliable Low Latency Communications)

The eMBB scenario supports ultrahigh-speed transmission of high-definition 4K/8K video and other HD applications; the mMTC scenario supports a large number of communication endpoints with infrastructure maintenance, low-power IoT, and so on; and the URLLC scenario supports real-time communication such as autonomous driving, real-time operation of remote robotics, and remote surgery.

5G does not require all of these scenarios in a single network. Rather, 5G will create a communications environment that satisfies a full range of needs by delivering the performance needed to address these various usage scenarios.

2) Performance Requirements to be Achieved by 5G

ITU-R Recommendation M.2412 provides a guideline for evaluating radio interface for IMT-2020 (5G). Within the guideline, test environments are defined for an evaluation that combines a usage scenario and a geographic environment. The evaluation environments are classified as “indoor hot spots”, “dense urban”, “rural”, and “urban wide areas.” The guideline is associated with a list of up to 13 requirements: peak data rate, and so on.

The key technical performance requirements in the guideline are a peak data rate of 20 Gbps, a connection density of 1,000,000 devices/km², and a latency of 1 ms.

The test environment for the Field Trials is fully compliant with these guidelines.

5. Implementation System

The Field Trials were conducted in collaboration with major telecom companies and institutions that were selected to execute the six projects. Applications were provided by trial partners, and the 5G trials were conducted not only in the Tokyo metropolitan area, but in rural parts of Japan as well.

6. Conclusion

There has been a great deal of interest within Japan and overseas in the results of performance assessments of actual applications in the 2017 5G Field Trials. We have shared the results at two conferences, and many inquiries have been received from overseas.

The Field Trials are scheduled to continue for three years and will focus on 5G services that help resolve rural issues in 2019. Through these efforts, Japan will commercialize 5G as the most advanced system in the world, and 5G will provide a trigger for robust economic growth in urban and rural areas throughout Japan.