Standardization

Standardization Trends in LTE Enhancement

Efforts toward the commercial introduction of LTE are now being made in many countries around the world, and in Japan, NTT DOCOMO plans to launch LTE commercial service based on the 3GPP LTE Release 8 at the end of 2010. At 3GPP, standardization toward the further enhancement of LTE is already underway. Specifically, Release 9 specifications for achieving an enhanced LTE system are scheduled to be completed by the spring of 2010 and standardization of LTE-Advanced for increasing throughput and capacity beyond that of LTE Release 8 has already begun.

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1. Introduction

The international deployment of the W-CDMA/UMTS system is progressing steadily and at present, more than 180 mobile network operators throughout the European region, North America and Asia are providing 3G services using W-CDMA. The current maximum transmission data rate (throughput) provided by NTT DOCOMO in its packet services in the downlink via High Speed Downlink Packet Access (HSDPA)[*1] is 7.2 Mbit/s and in the uplink via High Speed Uplink Packet Access (HSUPA)[*2] is 5.7 Mbit/s, but the technical specifications of HSDPA in Release 6 support maximum transmission data rates between a radio base station and mobile terminal of about 14 Mbit/s in the downlink. The use of HSDPA and HSUPA can improve not only transmission data rate but also spectrum efficiency[*3] thereby reducing transmission cost per bit. At the same time, the trends toward greater data traffic and high-capacity content are accelerating making the further reduction of bit cost a critical issue.

To provide for long-term development of 3G, NTT DOCOMO proposed the "Super 3G" concept in 2004 [1][2][3]. Super 3G is a standard that expands upon the HSDPA/HSUPA extension technologies of the W-CDMA system, and it is called LTE within the 3GPP. Release 8 specifications of LTE were frozen in March 2009 [4]. The introduction of LTE can provide the following benefits:

- Higher throughput (maximum 300 Mbit/s in the downlink and 75 Mbit/s in the uplink)
- Shorter delays (connection setup delays and one-way transmission delays within the Radio Access Network (RAN) shortened to 100 ms and 5 ms, respectively)
- Significantly greater spectrum efficiency

The commercial introduction of LTE is now being planned in various

*1 **HSDPA**: A high-speed downlink packet transmission system based on W-CDMA. Maximum downlink transmission speed under the 3GPP standard is approximately 14 Mbit/s. Optimizes the modulation method and coding rate according to the radio reception condition of the mobile terminal.

*2 **HSUPA**: A high-speed uplink packet transmission system based on W-CDMA. Maximum uplink transmission speed under the 3GPP standard is approximately 5.7 Mbit/s. Optimizes the coding rate, spread factor and transmission power according to the radio reception condition at the base station.

countries around the world. In fact, commercial services in LTE single mode have begun in northern Europe, and at NTT DOCOMO, commercial LTE services are scheduled to be launched at the end of 2010.

The LTE system is far superior to existing systems in many aspects including throughput, delay and spectrum efficiency as described above. Nevertheless, 3GPP is now working on the standardization of LTE Release 9 specifications to achieve an enhanced LTE system and LTE-Advanced (LTE Release 10 and beyond) specifications to achieve even greater throughput and capacity. NTT DOCOMO has been making significant contributions to the creation of these specifications by submitting technical proposals for standard specifications, by having personnel serve as LTE/LTE-Advanced rapporteurs and chairpersons of standardization groups, etc.

This article describes current trends in the further enhancement of LTE.

2. Standardization Schedule

The standardization schedule at 3GPP toward the enhancement of LTE is shown in **Figure 1**. After the freezing of LTE Release 8 specifications in March 2009, standardization work on Release 9 specifications began with the aim of achieving an enhanced LTE system. Meanwhile, feasibility studies on LTE-Advanced toward the IMT-Advanced system commenced in March 2008 under Study Item (SI), and an agreement on LTE-Advanced requirements was reached in June of the same year. The results of the SI work were submitted to the Working Party 5D (WP5D) meeting of the International Telecommunication Union Radiocommunication Sector (ITU-R) in June and October 2009. NTT DOCOMO's interaction with ITU-R in regard to these standardiza-

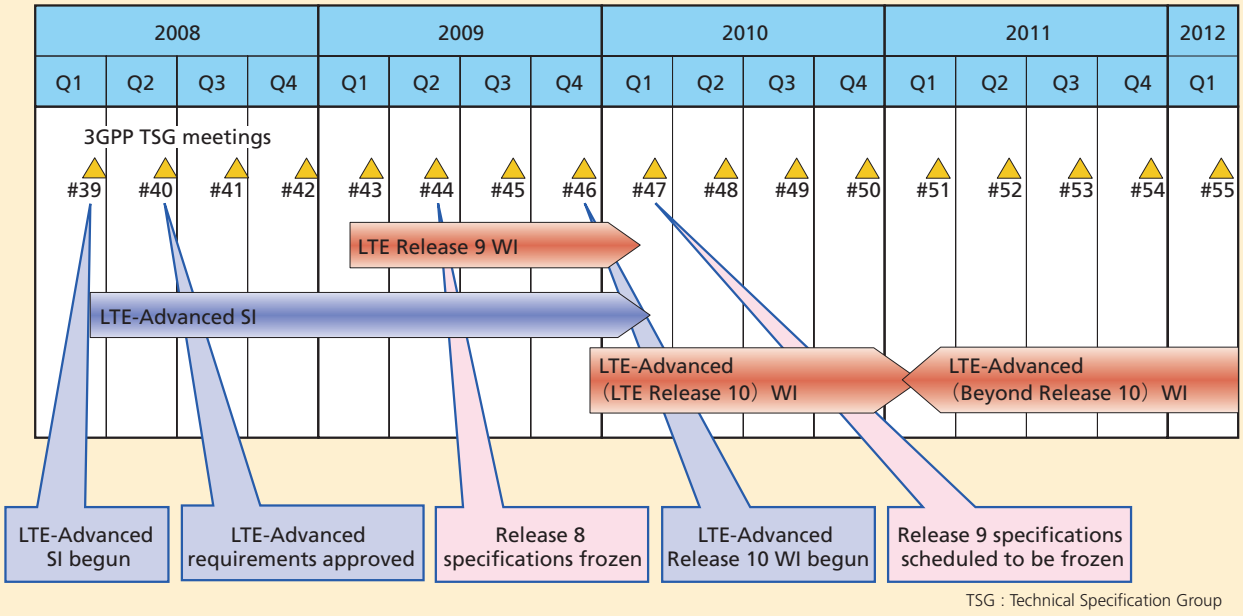

Figure 1 3GPP standardization schedule

*3 **Spectrum efficiency**: The number of data bits that can be transmitted per unit time and unit frequency band.

tion activities will be described in detail in the next issue of this publication. Then, in December 2009, it was agreed that Work Items (WI) would be established for standardizing several elemental LTE-Advanced technologies studied during the SI period.

2.1 LTE Release 9

In addition to improving spectrum efficiency and throughput, LTE Release 9 will introduce technologies for achieving an enhanced LTE system capable of diverse services and operation methods. These include radio resource control of Home eNB (HeNB), also called femtocell Base Transceiver Stasions (femto BTSs)[*4], which are effective for hotspots[*5] and coverage extension, Self Organizing Networks (SON) for automatically organizing and/or optimizing base-station parameters, Location Service (LCS) for providing location-based information services, and Multimedia Broadcast Multicast Service (MBMS) for providing broadcast-based communications. Please see the article "Further Enhancements of LTE - LTE Release 9 -" [5] for more details on the above technologies.

2.2 LTE-Advanced (Release 10 and beyond)

LTE-Advanced (Release 10 and beyond) is an expanded form of LTE achieving even higher throughputs and capacities. It is a candidate for the radio interface of IMT-Advanced, which is now being standardized at ITU-R. Submission of proposals on radio interface technologies for IMT-Advanced was closed in October 2009, and these proposals are now being evaluated by an external evaluation group. Detailed specifications on the radio interface are scheduled to be finalized by the beginning of 2011. Main technologies being studied in LTE-Advanced include Carrier Aggregation[*6] for increasing throughput by expanding bandwidth, Coordinated Multiple Point transmission/reception (CoMP) for sending and receiving signals through the cooperation of multiple base stations, enhancement of Multiple Input Multiple Output (MIMO)[*7] technology for single or multiple users, relay[*8] technology for relaying radio signals, and technology for further reducing delays. Details on LTE-Advanced standardization activities and technologies will be described in the next issue of this publication.

3. Conclusion

This article described standardization trends at 3GPP toward further enhancement of LTE. We will continue to contribute actively to the stabilization of LTE Release 9 specifications and the standardization of LTE-Advanced specifications with the aim of creating a smooth introductory path to 4G.

REFERENCES

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*4 **Femto BTS**: Ultra-small cellular base station that covers a small area with a radius of several tens of meters, i.e., a femtocell.

*5 **Hotspot**: An area with a high concentration of traffic.

*6 **Carrier Aggregation**: Technology for achieving high-speed communications through bandwidth expansion while maintaining backward compatibility with existing LTE by performing simultaneous transmission and reception using multiple component carriers.

*7 **MIMO**: A wireless communication technique that utilizes multiple paths between multiple antennas at the transmitting and receiving ends to exploit spatial propagation properties, causing the capacity of wireless links to increase in proportion with the number of antennas.

*8 **Relay**: Technology for repeating radio signals at a relay node to expand coverage area.