

Laws & Regulations concerning Base-Stations for Next-generation Mobile Communication Networks

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Abstract—With the commercialization of CDMA 2000-1x late in 2000, a high-speed wireless Internet, based on a mobile communication networks, appeared in Korea. This will develop into the next-generation of mobile communications(4G) in the future and the new cell layout will be required the cellular configuration of 4G. We would need the legislation with respect to base-stations and to building the mobile communication networks, as well as the optimization of mobile communication systems. In this study, in order to provide 4G, I examined and analyzed that the current laws & regulations related to licensing and operating a mobile communication base-stations in KOREA.

Index Terms—Next-generation of mobile communications (4G), Cell layout, Base- stations, Laws & regulations.

I. INTRODUCTION

ITU-R contains proposals for the next generation of mobile communications (4G), which necessitate speedier data transmission and greater transmission volumes than IMT-2000 (3G). Korea is also developing a 4G system to provide services in 2010.[1] Furthermore, the usable frequency band of the future 4G is 2 GHz, 3~5 GHz, which is higher than the 800 MHz, 1.8 GHz of usable frequency available for present mobile communications. The cellular configuration required for 4G necessitates a new cell layout, as well as an improved propagation environment and enhanced communication quality, taking into consideration the properties of electromagnetic waves, which directly affect the field optimum for mobile communications, the wireless network, and base stations, as has been suggested elsewhere.[2-6]

When the 4G services are common used, to more offer a universal service of mobile communication[7,8] and to more reduce a digital divide[9], we would need the legislation with respect to base station and to building the mobile communication network, as well as the optimization of mobile communication systems.

In this study, in order to provide the 4G services that have to offer a universal service of mobile communication and to reduce a digital divide in KOREA, I examine and analyze the regulations pertaining to base station of mobile communication systems.

II. NEXT-GENERATION MOBILE COMMUNICATIONS (4G)

ITU-R has indicated the direction of the development of future mobile communication systems by dividing it into the Future Development of IMT-2000 (FDIMT, *i.e.*, 3.5G), which is an extension of the present IMT-2000 (3G), and the System Beyond IMT-2000 (SBIMT, *i.e.*, 4G). FDIMT aims at providing service with a maximum transmission rate of 30 Mbps by 2005, with a focus on synchronous 1×evolution-data and voice (1×EV-DV) and asynchronous high speed downlink packet access (HSDPA), by continuously adapting the present IMT-2000 service. SBIMT should be developed by 2010. SBIMT calls for a system that enables high-speed mobile users to transmit a maximum of 100 Mbps per cell and for low-speed mobile users to transmit a maximum of 1 Gbps by 2010.[10] Figure 1 shows the block diagram of the system used for 4G wireless transmission of ETRI (Electronics and Telecommunications Research Institute), which has a mobile communications environment of micro/macro cells and a hot spot area. This provides very-high-speed mobile multimedia service due to the configuration of the integrated network, which connects the existing wireless mobile communication system, ADSL, W-LAN, Ad-hock, and satellites.[11]

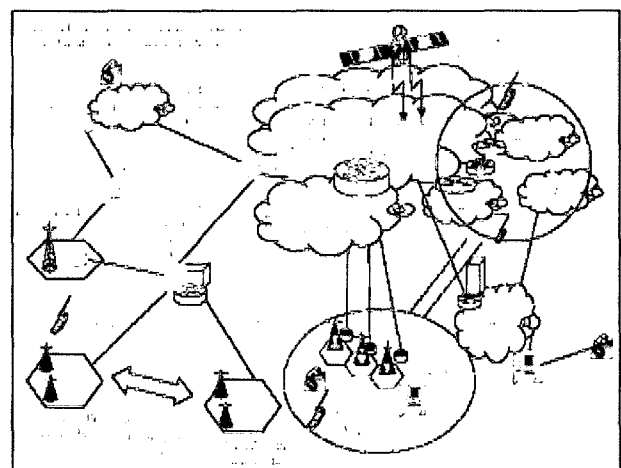


Fig. 1 The system block diagram for 4G wireless transmission of ETRI

Table 1 lists the ETRI standards for the 4G wireless transmission system. It has a 2 GHz, 3~5 GHz of usable frequency band, which exceeds the 800 MHz, 1.8 GHz of usable frequency of present mobile communications. There is therefore a need to configure 4G cellular for the new cell layout.

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Table 1 The ETRI standards for the 4G wireless transmission system

Classification	ETRI 4G Wireless Transmission Standard
Frequency Bandwidth	2 GHz, 3~5 GHz Asymmetric Band/Carrier 5~20 MHz (DL), 5 MHz (UL)
Multiplexing	FDD (macro/micro cell), TDD (hot spot cell)
Multiple Access	Distributed Frequency-Hopping OFDMA
Transmission rate	100 Mbps/20 MHz at 60 Km/h
Frequency efficiency	5 bps/Hz (100 Mbps/20 MHz)
Service platform	Packet
Modulation	AMC (QPSK/16-QAM/64QAM/256QAM)
Multiple antenna	MIMO STC
Channel coding	Turbo Code, LDPC
ARQ	H-ARQ

A. Definition and objectives of the optimum system

The optimum system for mobile communications is a wireless communication network optimum in the broad sense, and a base station or wireless communication environment optimum in the narrow sense. It should maintain good speech quality (coverage, call drop, FER, etc.) by coordinating all the factors and antenna at a base station in order to provide mobile communication subscribers with the best mobile phone speech quality. This should allow subscribers to make good-quality calls without interruption, anywhere, at any time, and ensure optimum coverage by the base station, through the efficient operation of the base station resources and the maintenance of optimum traffic.

B. Factors determining the optimum system

The factors determining the optimum system include the location of base stations, the location of optical repeaters, the areas needing call distribution from a base station or sector, and areas where speech quality is substandard (*i.e.*, where calls are dropped frequently or fail, and tone quality is poor).

C. Optimizing the system

(1) Sequence used for optimization

The sequence used to optimize the system is shown in Fig. 2.

(2) Establish optimum standards

To establish optimum standards, the factors that must be considered include economic efficiency, subscribers' needs, and elements giving competitive superiority. Standards to be considered include signal intensity (based on coverage), call drop/setup rate, and traffic per base station.

(3) Collecting field survey data

A field survey should collect data on signal intensity (coverage), call failure, and call dropping using EmDm/MCS4 and MOBILE DM equipment.

(4) Data analysis

The analysis includes coverage data, FER, and the reasons for call failure/ dropping. The analysis should determine the reason for a lack of signal according to coverage data and standard excess area based on FER and CAI MSG analysis using call failure/dropping.

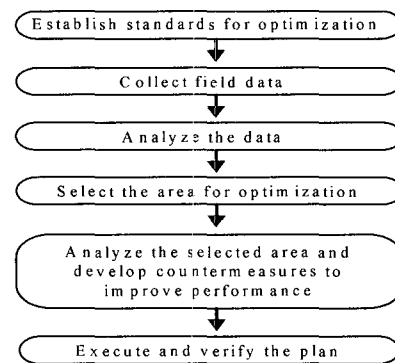


Fig. 2 The sequence used to optimize the system

(5) Selecting the optimum and measures for improvement

- 1) For an area with no signal, consider coordinating the transmission output and the antenna direction of the base station, changing the antenna, or moving or building a new base station.
- 2) For an area with call failure/dropping, eliminate the causes.
- 3) For call distribution, coordinate traffic by changing coverage.
- 4) Use the optimum algorithm for a base station.

(6) Execution and verification

After taking the measures in parts 1 to 3 in the previous section, confirm the results with an actual survey.

III. OPTIMUM SYSTEM

Wireless mobile communication stations are classified as base stations, repeaters, and handsets. The first two are fixed stations, while handsets are mobile. We examined the laws that pertain to establishing base stations and repeaters in now.

A. Laws governing the licensing of a wireless station

Obtaining a license for a wireless station involves a consideration of all the administrative steps necessary to open a wireless station, including licensing, reporting use approval, and inspection of the station. The licensing process is outlined in Fig. 3.[12-14]

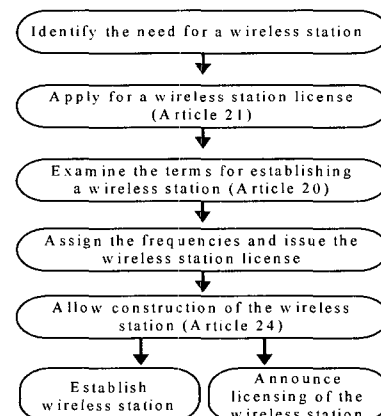


Fig. 3 Processes involved in granting a license for a wireless station

(1) License-related laws

1) License standards

The Radio Wave Law and its Enforcement Ordinance cover the licensing of wireless stations. The standards required for obtaining a license, including the forms, conditions, terms of validity, etc., and the provisions of the relevant law are shown in Table 2.

Table 2 The regulations governing the standards for a wireless station

Division	Details
Initial Concept	* Article 2-5~10, The Radio Regulation Law (Definitions) * Article 10, Enforcement Ordinance of The Radio Regulation Law (Classification of wireless stations)
Form for granting a license	* Article 19, The Radio Regulation Law (Establishing a wireless station) Articles 1, 2, 4, 5
Terms covering granting of license (Establishment)	* Article 21, The Radio Regulation Law (Granting a license to establish a wireless station) Article 2 * Article 16, Enforcement Ordinance (Terms governing the establishment of a wireless station) * Article 15, Enforcement Ordinance (Items mentioned in the license)
Effective terms of the license	* Article 22, The Radio Regulation Law (Effective term of the license) * Article 21, Enforcement Ordinance (Effective terms of a license for establishing a wireless station)
Transferring the license	* Article 14, The Radio Regulation Law (Frequency use right) * Article 23, The Radio Regulation Law (Transferring the license)
Approving changes and other considerations	* Article 26, Radio Regulation Law (Approval of any change and other considerations) * Article 24, Enforcement Ordinance (Approval of any change and other considerations)

2) Steps involved in acquiring a license

The provisions of the relevant laws governing the establishment of a wireless station are shown in Table 3, and include the administrative steps involved in applying for a license, the license conditions, issuing the license, and renewing the license.

Table 3 The standards governing the granting of a license for a wireless station

Division	Details
Granting a license for a wireless station	* Article 19, The Radio Regulation Law (Establishing a wireless station) Articles 1, 3 * Article 13, Enforcement Ordinance (Unit of application for Granting of License) * Article 14, Enforcement Ordinance (Application for a license) * Article 22, Enforcement Ordinance (Renewing a license) Article 1, 2 * Article 24, Enforcement Ordinance (Approving any changes) Article 1
Transferring a License	* Article 14, The Radio Regulation Law (Frequency use right) Article 3 * Article 23, The Radio Regulation Law (Transferring a license) Article 2, 3 * Article 23, Enforcement Ordinance (Reporting license transfer)

(2) Licensing a wireless station

In general, the license for a wireless station includes the license/license treatment/reporting/non-reporting/approval of frequency use. A mobile communications wireless station must obtain a license.

1) Conditions of the license (establishment)

The conditions for obtaining a license for establishing a wireless station include the basic requirements and technical details related to licensing a wireless station, as well as various other conditions that have to be considered. The following must be included.

- * The frequency must be specified.
- * The radio equipment to be installed and operated must meet technological standards.
- * The employees must be qualified.
- * The following conditions must be met:
 - Communication facts must fit the objectives of the establishment
 - The radio equipment must not be given to others.
 - The facility must meet the standards laid out in law.
 - The minimum frequency and antenna power must be used.
 - The installation site should not pose a risk to human life, property, or air safety.
 - The station must not hinder the operation of other wireless stations.

2) The term and renewal of the license

The law provides that a wireless station shall be licensed for a certain period after being established. The period of validity differs for different types of wireless station. For a mobile communication wireless station, the term is 5 years.

3) Permission for change

Permission must be obtained before changing the original license conditions or details specified in the license after establishing a wireless station. The law provides for making changes to the following.

- * Objective of the wireless station
- * Communications counterpart
- * The site where radio equipment is installed
- * The call sign and call instructions
- * Form of propagation, frequency bandwidth occupied, and antenna power
- * The form, configuration, and gain of the antenna
- * Permissible working hours
- * Adding transmission equipment
- * Replacing radio equipment

4) Steps involved in obtaining a license

The following steps must be taken to license a wireless station. The person who wants to establish a wireless station applies for a license using the prescribed form. The government examines the relevant conditions. If they are judged legal, a license is issued and announced. The main points to be considered in the application are listed in Table 4.

Table 4 Provisions that must be considered in granting a license for a wireless station

Division	Target wireless station
Application for a license	* Applying to establish a transmission facility based on the classification of a wireless station * The application should consider the communication network, the location, and frequency, if necessary.
Submission for a temporary application and attached papers	* To renew a license, submit an Application for Renewing a License 2~4 months before the expiration of the current license. * To obtain approval for any changes, submit an Application for the Approval of Any Changes and Other Considerations and the Specifications of the Changes.

B. Laws relevant to the establishment of a wireless station

When a new mobile communications base is established, relevant laws include The Electricity & Communication Law, The Radio Wave Law, The Building Law (urban and rural areas), The National Parks Law, The National Land Use Plan Law (rural areas), and The Town Planning and Zoning Act. For further information on the relevant rules, refer to the following flow chart outlining the process involved in establishing a base station in accordance with these rules, in Fig. 4.

1. Farmland diversion and request to change land use
 - Permission for farmland diversion: Art. 4 of The Farmland Diversion and Utilization Act (except for urban areas)
- (2) Permission to change land use: Clause 1, Art. 4 in The City Planning Act (for urban areas)
- (3) Related regulation: Art. 20 in The Utilization and Administration of The Land Act (request for the location of public facilities)
2. Declaration and building permit
 - (1) Related regulation: Art. 5 in The Building Act, Art. 4 in The City Planning Act
 - Construction of a temporary work structure: Clause 2 Art. 47 in The Building Act
 - Permission to possess and use roads: Art. 40 in The Road Act
 - Permission to hookup to distributed installations: Art. 24 in The Sewage Act
 - Permission for the sewage system: Art. 15 in The Septic Disposal Act
 - Installation of a waste disposal tank: Art. 16 in The Septic Disposal Act
 - (2) Permission conditions
 - Minimum site area: Art. 85 in Enforcement Ordinance of The Building Act
 - Design of the building and work supervision: Clause 1, Art. 6 in The Building Act
 - Relation between site and road: Clause 1, Art. 27 in The Building Act
 - (3) Request for inspection on completion
 - Declaration period: Clause 2, Art. 6 in The Building Act
 - (4) Changing the land use classification
 - Related regulation: Art. 49 in The Land Registration Act
 - (5) Permission standard for a steel tower: (building declaration of structure)
 - Related regulations: Art. 9 in The Building Act (application of a retaining wall and structure, etc.), Art. 18 Enforcement Ordinance of The Building Act

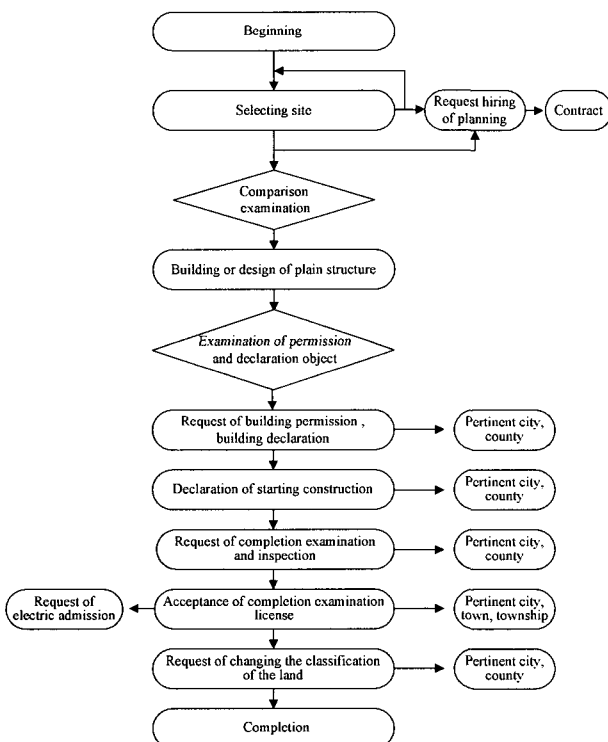


Fig. 4 The regulations involved in obtaining permission to install a base station

IV. LAWS GOVERNING THE ESTABLISHMENT OF A MOBILE COMMUNICATION BASE STATION

A. Regulations for licensing a wireless base station

The provisions relevant to licensing a wireless station are stipulated in Articles 2 and 19, Chapter 4, of The Radio Wave Law, and Articles 10 and 16, of the Enforcement Ordinance of The Radio Wave Law. The steps that must be taken to obtain a license include applying for a license, a consideration of the license conditions, issuing the license, renewing the license, and obtaining a permit to build the wireless station.

To ensure the optimum use of radio waves in a manner that offers greater convenience for communications suppliers and users, the regulations governing the use of radio waves for the next generation of mobile communications need to be drastically relaxed. We need consumer-centered after the fact regulations that emphasize content, including technical standards for removing interference between wireless stations and standards of use.

B. Regulations governing the inspection of wireless base stations

The present system provides for regular inspections of wireless stations, including standards of installation, output, and frequency. A separate before-change inspection is required if the radio equipment is to be changed in whole or part, in accordance with Article 26, Chapter 4 of The Radio Wave Law, and Article 24 of the Enforcement Ordinance of The Radio Wave Law. Since mobile communications suppliers often extend their frequencies as the numbers of subscribers increase, and they frequently change the equipment in the wireless station in order to improve call quality, the expense involved and time required for the inspection process will increase unnecessarily. This is especially true considering the 42,000 existing base stations belonging to the three mobile communication base providers in Korea and the construction of new base stations for the next generation of mobile communications.

C. The effect of relaxation

By relaxing the regulations relevant to licensing and establishing the 4G base stations, as well as the regulations relevant to the licensing and inspection of wireless stations in Korea, I will be able to ensure that the 31 million subscribers are guaranteed quality mobile communication service anywhere, while increasing the reliability of call quality, and decreasing the expense and time involved in licensing and inspection. Moreover, domestic mobile communications providers would be able to use the expertise and technology of mobile communications networks developed overseas.

V. CONCLUSIONS

Mobile communications services, which offer one way to realize the informed society of the 21st Century, have developed rapidly worldwide. With the commercialization of CDMA 2000-1x late in 2000, a high-speed wireless

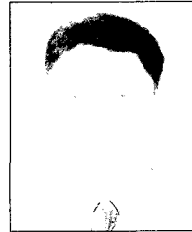
Internet, based on a mobile communication networks, appeared in Korea. This will develop into the 4G with faster transmission of increased volumes of data in the future. The new cell layout requires the cellular configuration of 4G because that the usable frequency band of the future 4G is 2 GHz, 3~5 GHz. And the 4G services have to more offer a universal service of mobile communication and to more reduce a digital divide.

In this study, in order to provide 4G, I examined and analyzed that the current laws related to licensing and operating a mobile communication base station. As a result, by relaxing the regulations relevant to licensing and establishing the 4G base-stations, as well as the regulations relevant to the licensing and inspection of wireless stations in Korea, the 4G will be able to offer a universal service of mobile communication and to reduce a digital divide.

These results will contribute to developing legislation with respect to base-stations and to building the mobile communication networks for the 4G services in Korea.

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Received the B. S, M. S, Ph. D degrees in the Dept. of Electronics Engineering from Chosun University in 1995, 1997 and 2000, respectively. He was a funded professor of Division of Electronics and Information Engineering, Chonbuk National University from 2002, 3 to

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