RADIO COMMUNICATION RESEARCH ACTIVITIES IN KOREA

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1. Introduction

This paper presents an overview of radio communication research activities in Korea. Particular emphasis is placed on recent activities in industries, research institutes, and universities. In Korea the digital mobile communication system technology has been growing since 1989 as the strategic technology development by government policy. The mobile communication system adopting the CDMA technology had been developed by means of the joint development between Qualcomn and ETRI(Electronics and Telecommunications Research Institute), a government-invested institute, for 5 years from 1991. In 1995 the CDMA technology was also adopted as standardization of Korean PCS system.

At present there are many wireline and wireless operators in Korea. The wireline operators are KT(Korea Telecom), DACOM, Hanaro and Onse Telecom. The wireless operators are SK Telecom for cellular and pager, Shinsegi Telecom for cellular, KT Freetel, Hansol M. com, and LG Telecom for PCS, and 11 regional pager operators. The cellular and PCS subscribers in Korea are increasing rapidly since the digital mobile service began in 1996. Presently, the subscribers are 53 % of total Korean population of 46 millions.

The technology development for satellite communication system began in the middle of 1980. Although Korea has a short 15-year history for satellite communication technology development, it is operating the commercial communication and broadcasting satellites, Koreasat 1, Koreasat 2, and Koreasat 3 launched in 1995, 1996 and 1998, respectively. Also the remote sensing satellite, KOMPSAT 1(Korea Multi-Purpose Satellite 1), launched in 1999 is operating in low earth orbit of 685 km altitude.

In this paper, Engineering Research Center(ERC) program for universities and activities of Korea Electromagnetic Engineering Society(KEES) are also introduced.

2. Research and Development Activities in Industries and Research Institutes

2.1 Mobile Communication

The mobile communications service in Korea began with analog cellular service(AMPS) by Korea Mobile Telecom(former name of SK Telecom) in 1984. The service was not popular at that time because of high service cost, limited service area, and small capacity. So, ETRI initiated the project for the development of digital cellular system in 1989 and CDMA was determined as a multiple access type of the development system in 1991. With the successful results of the joint development with ETRI, Qualcomm, and manufacturers such as Samsung, LGIC, Hyundai and so on, SK Telecom and Shinsegi Telecom have started CDMA digital cellular service (IS-95, down-link 824~849 MHz, up-link 869~894 MHz) in 1996. As you might know, this was the world's first commercial CDMA cellular service.

In addition, PCS service (down-link 1840~1870 MHz, up-link 1750~1780 MHz) based on Upbanded IS-95 using 13 kbps QCELP vocoder has been offered by KT Freetel, LG Telecom, and Hansol M. com from 1997. Furthermore, KT and DACOM are preparing the service of WLL system (down-link 2.37~2.40 GHz, up-link 2.30~2.33 GHz) using 32 kbps ADPCM vocoder, which has already been developed.

At present, IMT-2000 system of '3rd Generation' is under development with the request of 2 Mbps multimedia service and global roaming. ETRI and several manufacturers have been working actively

in 3GPP and 3GPP2, the associations for the development of IMT-2000 synchronous system and non-synchronous system, respectively. As a result, the Korea-proposed OCQPSK (Orthogonal Complex QPSK) Modem method and AISMA(Acquisition Indication Sense Multiple Access) method were accepted as a core technology in IMT-2000 system. In Korea, IMT-2000 commercial service is supposed to start in 2002 and ETRI, SK Telecom, Samsung and LGIC are now developing the system.

2.2 Satellite Communication

Korea is operating Koreasat 1 to Koreasat 3 and KOMPSAT 1, a remote sensing satellite. The development of the satellite technology in Korea has been conducted by KT, ETRI, KARI(Korea Aerospace Research Institute), and several industries and is classified as the development of communication payload, TT&C technology, earth station technology, and satellite system engineering technology.

The communication payload technology has been developed since the development of the test facility for satellite transponder started in 1990. In 1995, the laboratory transponder model had been developed in Ka-band, which has the same physical layout, functions, and performance with actual satellite transponder. Based on the development technology of the transponder models, the Ka-band transponder with high performance and reliability has been developed. The Ka-band transponder adopted dual configuration of TWTA channel and SSPA channel to evaluate the performance of self-fabricated SSPA. The development of core elements for satellite payload has been actively progressed in the field of Ka-band satellite transponder, such as MMIC SSPA, LNA, frequency selective surface antennas, and multi-mode filters.

The TT&C technology development began in 1990 with the satellite transponder model. Though the development of laboratory TT&C model was started for Koreasat, the TT&C technology development for a remote sensing satellite had been conducted for 4 years from 1995. The KOMPSAT mission control system, which consists of mission control subsystem, satellite operation subsystem, mission analysis and planning subsystem, and TT&C, was installed in KARI in 1999. At present TT&C mission control system in the remote sensing satellite is performing very well.

VSAT and DAMA-SCPC earth station technology had been developed in 1993 and 1995, respectively. To progress the earth station technology, industries are interested in the multimedia service via satellite, such as satellite internet access earth station technology and 155 Mbps satellite ATM transmission technology. The satellite internet access station adopts IP over MPEG-2 technology for forward link and DS-CDMA technology for return link. The system may provide various data broadcasting, multicast service, and two-way data communication service. As the HDR(High Data Rate) satellite ATM transmission technology, the 155 Mbps HDR MODEM chip was developed for burst mode in 1999. The Ka-band ATM satellite transmission service which uses the developed MODEM chip will be examined in early 2002, especially to provide the service for the 2002 world cup game.

As satellite system engineering technology, the adaptive rain attenuation compensation technology and the utilization technology of satellite orbit and frequency resources have been researched. To compensate for the rain attenuation in satellite link, the adaptive MODEM, CODEC and TDMA topology are considered, especially, in Ka-band satellite link.

In satellite communication, the Korea model for a commercial communication and broadcasting satellite will be started in the middle of 2000. The project will be progressed by the joint development between ETRI and KARI

2.3 Radio Spectrum Engineering

Recent projects in industries and research institutes are research and development of radio spectrum resource utilization technology, radio monitoring system, and EMC technology. The contents of the radio spectrum resource utilization technology are the development of a narrow band(5kHz) walky-talky and an automatic spectrum management system for improvement of the available spectrum resource, and measurement and analysis of radio propagation characteristics at 26 GHz band for the new wireless services such as indoor LAN and BWLL. The contents of the radio-monitoring project are the system integration of radio monitoring equipment for a computerized monitoring environment

and development of radio monitoring facilities and an integrated radio-monitoring network. The contents of EMC technology are the study on electromagnetic interference and susceptibility, and biological effects of electromagnetic fields.

2.4 Antenna Technology

Active antenna system for mobile DBS and satellite multimedia reception had been developed by ETRI for 3 years from 1996. The system adopted an active phased array antenna to track a satellite while in motion at every place within satellite beam coverage area. It has very wide range of beam scan angles(Elevation:+/-12° Azimuth: 360°) without any manual adjustment and has two dimensional electronic scan to adapt the fast movement of vehicles and high speed initial and repeat search by the unique adaptive tracking algorithm. The system is installed on the roof of vehicles and can be installed on any visible place to the satellite. Also, researches on the adaptive(smart) antennas are carried out at ETRI, Hanyang Univ., and several companies.

3. Research Activities in Universities

Researches on radio communication area in universities are usually more active than those of other engineering areas. In this paper research activities on microwave and millimeter-wave engineering will mainly be discussed. Research funds of universities come from the governmental foundations, the research institutes, and the industries. KOSEF(Korea Science and Engineering Foundation) under Ministry of Science and Technology and KRF(Korea Research Foundation) under Ministry of Education are two major foundations. Above all, Engineering Research Center(ERC) program launched by KOSEF was initiated in 1990 for the purpose of fostering centers of excellence able to meet the rapid changes in the world of engineering. KOSEF provides nine-year stable support to each center with approximately 1 million U.S. dollars a year, but the support may be terminated by mid-term evaluations every 3 years. The competition to host an ERC to the university is so high that the selection ratio of application is around 7 %.

Last July Millimeter-wave INnovation Technology Research Center(MINT) applied by Dongkuk University in Seoul was selected as an ERC. There are two research groups in MINT. One is the group for research on the active devices and modules, and the other is on the passive components and system. MINT is composed of research teams from 18 professors and 1 company(for foundary service). 6 professors from Dongkuk Univ., 2 from KAIST, Chungnam National Univ., and Sogang Univ., respectively, and 1 from Kukmin Univ., Kwangwoon Univ., Hanyang Univ., Seoul National Univ., Ajou Univ., and Inchon Univ., respectively.

4. Korea Electromagnetic Engineering Society(KEES)

KEES is the professional society for Korea's prominent technological specialists in the field of electromagnetic engineering. It was established about 10 years ago and currently has 1,700 members. Only 2 years ago there were 1,000 members in the society. Therefore, the remarkable expansion of KEES can be easily understood. KEES co-organized 1995 Asia Pacific Microwave Conference(APMC) and KJJC-AP/EMC/EMT(Korea Japan Joint Conference-Antenna and Propagation/Electromagnetic Compatibility/Electromagnetic Theory). Domestically, every year KEES holds symposiums, workshops, and tutorials, such as antenna workshop, microwave and millimeter-wave workshop, EMC workshop, bioelectromagnetics workshop, and RF circuit design tutorial. Besides the above mentioned topics, this year KEES plans to hold workshops on SDR(Software Defined Radio), Electronic Packaging, ITS(Intelligent Transportation System), and Spectrum Engineering. Furthermore, Korea-Japan Joint Conference on MTT(Microwave Theory and Techniques) is now under formulation, expecting to be held in Korea in September this year.

5. Towards Advanced Radio Communication

Future trends of radio communication in Korea are to progress toward multimedia communication

and utilization of the higher frequency bands. The multimedia communication will advance from voice to high definition video and low data rate to high data rate, having wide frequency bandwidth. From the development of millimeter-wave technologies, millimeter-wave bands will be mainly used in MMAC(Multimedia Media Access Communication System), ITS, and satellite communication.

The mobile communication will be progressed as the mobile broadband multimedia system that provides the high mobility, high definition, high data rate and multimedia, In satellite communication, the high-speed satellite internet and Giga bit ATM transmission technology will be researched. Also, more researches on frequency resource management, human hazard of EMF, and EMI/EMC control technology will be progressed in radio application technology.

6. Conclusion

Current government policy is to support the research and development of science and technology and to assist in the establishment of venture firms. Government is seeking to inject vitality into the economy and create more job opportunity through the support of the venture firms. Radio communication area is one of the most emphasized areas supported by the government. Korean industries, research institutes, and universities concentrate on research in various fields for next-generation multimedia radio technology development.

References

[1] SK Telecom, "Telecommunications Review," Dec. 1999.

[2] ETRI, "1st ETRI-CRL Joint Conference," Radio & Broadcasting Technology Laboratory, Oct. 1999.

[3] KICS, "99 Satellite Expo for the New Millennium," Seminar proceeding, Sept. 1999.

[4] RRL, "Seminar for Radio Wave Technology," Seminar proceeding, Radio Research Laboratory, May 1999.