1 Research Activities on EMC in NICT

SUZUKI Yoshiaki

In the ubiquitous network age when a lot of equipment equip wireless function, interference between a certain wireless system and other communication systems, performance degradation of a telecommunications system or malfunction of an electronic equipment may occur. Uneasiness concerning adverse effect that electromagnetic wave possibly causes for human body may also increase more than before. Therefore, establishing EMC (Electromagnetic Compatibility) of various equipment and systems becomes very important. Furthermore, it is feared that the problem of the information leakage by the reception of the very low electromagnetic wave radiated from the telecommunication equipment occurs. To secure "Safety and well-being" of the ICT society, which is one of the NICT missions, and to promote the harmonized use of the radio frequency spectrum, EMC unit are providing various academic activity and services. In this text, the outline is introduced.

Keywords
Electromagnetic Compatibility, EMC, Tempest

1 Introduction

Various technologies are currently under development in view of the creation and advancement of a ubiquitous network society. Since many electronic devices are expected to feature wireless terminal functions in the ubiquitous network age, it is essential that we devise solutions to, and establish countermeasures against, the following problems: (1) interference between wireless and other communications systems (e.g., wired systems), (2) malfunctioning of electronic devices caused by radio waves, and (3) the biological effects of radio waves. Also essential are measures against (4) problems with wireless systems caused by interference-inducing emissions from electric/electronic devices (Fig. 1).

With the development of various technologies aiming at the realization of a ubiquitous network society, communications and broadcasting systems are becoming increasingly digitized. As a result, it is becoming more difficult to determine clearly the effects of interference emissions, particularly when viewed against similar efforts in the era of analog technology. Nevertheless, we can assume that the electromagnetic environment in general is becoming more problematic each year. The reason: most digitized devices contain a CPU

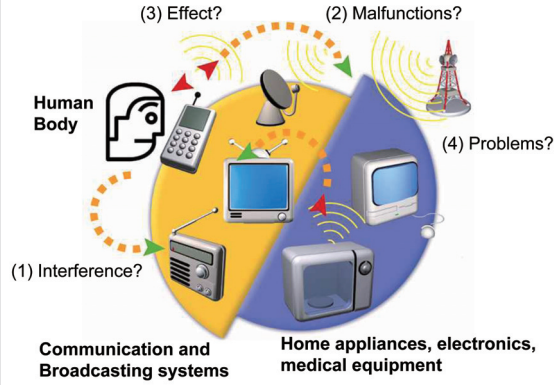

Fig. 1 *EMC among devices, communications and broadcasting systems, and the human body*

that generates and emits radio-frequency signals; these devices are thus all potential sources of interference emissions.

NICT's EMC Unit was set up in December 2004 to conduct comprehensive studies on interference and other system problems caused by the use of radio waves.

EMC generally refers to the reduction of unwanted emissions from equipment (especially electric/electronic devices other than communications systems) and the enhancement of device immunity to external electromagnetic waves.

Our EMC research also covers the biological effects of radio waves emitted (as communication signals) from wireless systems. Interference between wireless communications systems has conventionally been considered a problem related to radio wave administration (i.e., a question of frequency allocation), not EMC. However, it is possible to apply the existing concept of interference emission control (permissible levels, measurement methods, etc.) to new communications systems in which frequency bands are shared, such as UWB (Ultra Wide Band) and PLC (Power Line Communications) systems. Additionally, our EMC research covers the measurement of spurious emissions from wireless devices, as there are numerous points in common between spurious and interference emissions measurements.

Concerns have recently arisen with respect to information leakage caused by electronic eavesdropping of weak electromagnetic waves emitted from information and communications equipment. This problem differs from those related to EMC essentially because, in this case, weak radio waves are intercepted intentionally (and with malicious intent). However, the EMC Unit also addresses this problem due to the similarities between measurement of "leaked" electromagnetic waves and the measurement of EMI, or ordinary emissions.

2 Background to establishment of EMC Unit and its organization

In March 2, 2004, the CRL (Communications Research Laboratory) set up an EMC Center in its Wireless Communications Department through the integration and reorganization of two EMC-related groups (studying the electromagnetic environment and measurement technologies, respectively) that had both been organized under another department. The EMC Center consists of one project office and three groups assigned to develop EMC-related technologies and provide comprehensive testing and calibration services[1].

In April 1, 2004, NICT was founded as a result of the consolidation between the CRL and the TAO. In December of the same year, NICT set up an EMC Unit to promote coordination between the EMC Center and the Sendai EMC Research Center, which had previously been part of the TAO (the Sendai facility had been engaged in R&D of technology for three-dimensional visualization of radio waves leaked from electronic devices).

The Sendai EMC Research Center wound up its research activities at the end of March 2005. To assimilate the former Center's research results and to broaden the range of research subjects to include TEMPEST, or electromagnetic security, NICT then established the new Sendai Electromagnetic Field Measurement Technology Research Center on June 1, 2005[2].

Figure 2 shows an organizational chart of the EMC Unit as of the end of March 2006.

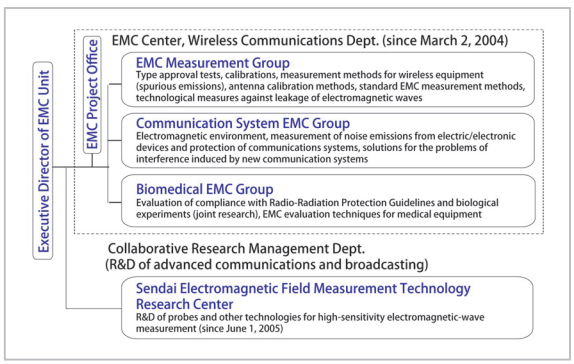

Fig.2 *Organization of EMC Unit and its research subjects*

3 Research subjects at EMC Unit

3.1 EMC Center

As shown in the chart, the EMC Center consists of one project office and three groups whose comprehensive activities include not only EMC research but also testing of wireless equipment and calibration of measuring instruments. An overview of the respective research subjects is given below:

(1) The EMC Project Office is in charge of planning and implementation of all research activities at the center, manages joint research activities with external organizations, and handles public relations. In collaboration with the EMC Measurement Group, this office works on the standardization of EMC-related technologies and conducts research on the electromagnetic environment in the long-wave band for the purpose of protecting the reception environment for radio-controlled clocks.

(2) The EMC Measurement Group performs type approval tests of wireless equipment and calibration of measuring instruments for wireless equipment. In connection with these services, the Group develops methods for the measurement of wireless equipment using a reverberation chamber and measurement of spurious radar emissions and calibration of instruments. In addition, the Group contributes to domestic and international standardization through the development and evaluation of standard EMC measurement methods at frequencies of 1 GHz or higher, and studies TEMPEST measures aimed at countering leakage of electromagnetic waves.

(3) To ensure electromagnetic compatibility in communications systems, the Communication System EMC Group conducts studies on EMC-related problems involving new wireless and wired communications systems for the ubiquitous network era.

(4) To promote the safe and secure use of radio waves in accordance with the Radio-Radiation Protection Guidelines, the Biomedical EMC Group develops methods for testing guideline compliance as well as biological and epidemiological experiments to confirm the adequacy (or aid in the revision) of these guidelines.

3.2 Sendai Electromagnetic Field Measurement Technology Research Center

To devise measures to reduce or prevent the leakage of electromagnetic waves from electronic devices and to verify the effectiveness of such measures, technology must be developed for the precise measurement of weak electromagnetic wave emission across a wide frequency range. Accordingly, the Sendai Research Center has undertaken the following R&D activities:

(1) R&D of high-sensitivity electromagnetic-wave measurement probes

R&D of electric/magneto-optic crystalline materials and devices for the measurement of high-frequency electromagnetic fields; R&D of high-sensitivity photoelectric/magnetic field measurement probes with these materials using micromachining and integration techniques

(2) R&D of high-sensitivity electromagnetic-wave measurement technologies

R&D of a signal processing technology to detect signals from the photoelectric/magnetic field probes; R&D of a high-speed wideband system for the measurement of surrounding electromagnetic fields

With the development of these technologies, we hope that it will become possible to determine the precise electromagnetic leakage characteristics of computers, mobile phones, and other electronic devices at the prototype stage, which will in turn facilitate the implementation of adequate countermeasures.

4 Conclusions

In this article, we briefly described the organization in charge of EMC-related R&D at NICT and the research subjects of the relevant teams. In fiscal 2006, NICT will launch a new medium-term plan. Taking advantage of

NICT's public, objective position, we will continue to promote industry-academia-government collaboration in the field of EMC research and try to return the fruits of this research to society at large. We appreciate the ongoing support and cooperation from all those concerned.

References

1 "CRL Establishes EMC Center", press release dated February 25, 2004.
(http://www2.nict.go.jp/pub/whatsnew/press/040225/040225.html)

2 "R&D of High-Sensitivity Electromagnetic-Wave Measurement Technology for Ensuring Electromagnetic Security—Opening of Sendai Electromagnetic Field Measurement Technology Research Center", press release dated June 1, 2005.
(http://www2.nict.go.jp/pub/whatsnew/press/h17/050601-2/050601-2.html)

SUZUKI Yoshiaki
Executive Director, Wireless Communications Department