# *IEICE Communications Society* GLOBAL NEWSLETTER *Vol. 36, No.2*
# Contents

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# IEICE is not a Japanese Institute but an International Institute

Yoshiaki Tanaka
President, IEICE Communications Society

IEICE was established in 1917. Now, we are preparing to celebrate its 100th anniversary. Formerly, IEICE had "of Japan" in its name. In 1987, we deleted "of Japan" from its name. Now, IEICE is an international academic institute. The mission and the vision of IEICE are as follows:

Mission: The institute is an international organization concerned with electronics, information, communications and related fields with the aim of promotion of scholarly growth, industrial advancement, and cultivation of human resources.

Vision: The institute will contribute to achieving a healthy society supported by rich communications, and to maintaining and improving the global environment.

"International" and "Global" are described in the mission and the vision. Now, IEICE has 35,000 members, and around 15% of which is non-Japanese members. IEICE has 4 societies and 1 group.

Communications Society is the biggest and the core society of IEICE. It has 13,000 members. It is the most global society. IEICE Transactions on Communications was indexed by SCI firstly among 4 transactions. Communications Society holds English sessions at every General Conference and every Society Conference. Around 50 papers are submitted to English sessions, and non-Japanese speaking people can attend the conference for 4 days without Japanese language. Of course, Communications Society and its technical committees hold many international conferences.

At present, electronic journals and navigation systems are the most important in global academic institutes. About 15 years ago, some academic journals became electronic journals, and now most academic journals are published in electronic form. This fact is not only for the journals published by academic institutes, but also for the journals published by commercial publishers. It requires much investment to make an electronic journal publishing system. Therefore, small publishers were merged with big publishers. At present, 10 big publishers publish 90% of electronic journals. IEEE is one of 10 big publishers. IEEE Xplore is the strongest tool in electrical and electronics engineering fields.

IEICE Transactions are published in electronic form, and other journals such as NOLTA, ComEX, ELEX are also published in electronic form. Moreover, the members of Communications Society can read IEICE Technical Reports and the Proceedings of General Conference and Society Conference online. However, each journal has each navigation system, and they have not been unified yet.

In this year, Communications Society started a project to make a new document archiving and navigation system. It is named "IEICE Knowledge Discovery". It is a sophisticated system, and it has many convenient functions, such as linked data. If we look for some papers on a specific topic, we will be able to get various kinds of information related to the topic such as the relation of the papers, recent news on the topic, etc. They are different functions from that of IEEE Xplore. We are aiming for a more convenient system. Communications Society will spend the largest amount of money to develop this system in IEICE history. The system in this year is the first step. We hope that other societies will participate in this project in the next year, and that we will continue this development for several years.

Ethics is another important issue which is related to publishing. Many members do not understand the copyright law well. Many members submit the same content as in IEICE Technical Report to an international conference. Many members submit the same content as in an international conference to IEICE Transactions. As for IEICE Technical Report, the authors must transfer the copyright to IEICE. As for an international conference, the authors must transfer the copyright to the sponsor of the conference. As for IEICE Transactions, the authors must transfer the copyright to IEICE.

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In the world, researchers are becoming stricter in ethics. On the other hand, some researchers in IEICE Communications Society are still lax in ethics. All members of IEICE Communications Society should become strict in ethics.

# Wired Digital Transmission and Related Network Synchronization Technologies in the Core network - Experience and View -

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## 1. Introduction

This letter presents the technical review on the establishment of wired digital transmission and network synchronization technologies, in which I had been engaged at NTT Laboratories. Also the view based upon the experiences is presented.

Digital transmission systems had been primarily developed as stand- alone systems, and then developed together with digital exchange systems. Direct connection of digital transmission and digital exchange systems forms an integrated digital network, which requires a network synchronization system.

Also, establishment of the network synchronization technologies is presented.

## 2. Wired digital transmission technologies

Transmission media for wired transmission systems were firstly metallic cables like twisted-pair cables and coaxial cables, and secondly optical fibers.

### 2.1 Metallic digital transmission

The world first wired digital transmission system was T1 System over twisted pair cables with the bit rate of 1.544Mbps, which had been developed by Bell Laboratories in USA in 1962.

NTT has also developed the similar transmission system with the bit rate of 1.544Mbps, which was applied over short haul trunk cables in 1965, and the bit rate corresponds to the first level of digital hierarchy.

Then the PCM-16M System had been developed, which conveyed 240 telephone channels using two toll cables, where the main interference is FEXT (far-end cross-talk) noise. Then at the introduction stage, its system conditions were reconsidered, and changed to use one cable. Therefore, the main interference was NEXT (near-end cross-talk) noise, and its channel capacity was reduced to be 120 channels. The system was called as PCM-120 System. However, crosstalk performances under the real plant conditions made it difficult to be finally commercialized.

Higher-bit-rate wired digital transmission systems for medium- and long-haul trunk lines utilized coaxial cables as the transmission media. 100Mbps and 400Mbps digital transmission systems over coaxial cables had been developed.

In development of the digital transmission systems over coaxial cables, their system architecture was studied on zero bases from the following viewpoints.

For high capacity long-haul wired transmission systems with many repeaters, their key issues are high speed transmission over coaxial cables and high reliability. The cross-talk in coaxial cables can be neglected, and the power budget design was executed on thermal noise base.

The first key point is to handle the characteristics of trans-mission media, which was a coaxial cable in this case. The transmission media were 2.6/9.5 mm disk-insulated coaxial cables, which were recommended by ITU (International Telecommunication Union) as the global standard. Measurement of the standard coaxial cables was conducted in the frequency range between 1MHz and 1GHz, and their possibility in realizing transmission systems was assured.

Firstly, transport characteristics of attenuation and phase performance were measured. At that time, two types of coaxial cables were utilized, which were S-type and W-type cables. Two types of coaxial cables had a little different transmission characteristic, which had an effect on an equalized pulse shape with typically 5% increase of inter-symbol interference. This impairment resulted in the decision to adopt unification of applied cable to the S-type cables.

Cross-talk performances were also measured. As a result, we assured the cross-talk attenuation target of above 160 dB. In the very low frequency range below 100 kHz, cross-talk appears due to the low frequency unbalance mode transmission. However, balanced transmission code suppresses the low frequency spectrum part of the transmission signals, and therefore, the cross-talk in the low frequency range brings about no problem for digital baseband transmission.

In the frequency range of 100~200MHz, multiple reflections happen in a coaxial cable, and they are caused due to the periodic mechanical irregularity in manufacturing. This phenomenon brings loss increase of 0.2 dB/km, and makes it difficult in realizing higher capacity analog transmission systems. However, in realizing digital transmission systems based on the TDM technology, this interference can be considered as a noise, which corresponds to the S/N above 60dB, and can be neglected.

So far, the digital transmission code was a kind of the pseudo ternary code called as AMI (Alternative Mark Inversion) and its modification since T1 System. However, in case of thermal noise limit systems over coaxial cables, multi-level codes could be promising alternatives from the viewpoint of S/N. In developing the digital transmission system of the fifth digital hierarchy, 5-level quaternary balanced transmission code was considered to realize 800 Mbps transmission

systems for the purpose of competing against the existing analog transmission system from the viewpoint of cost. After the intensive study including transmission experiments, multi-level transmission more than three-level was found to be the severe challenge due to inter-symbol interference, especially under high speed conditions. These studies drove the direction that 3-level multi-level transmission like 4B-3T code, where 4 binary codes are converted to 3 ternary codes, was put in the spotlight. However, unfortunately 800Mbps transmission system using 4B-3T code was not developed due to lack of developing time. The transmission technology using 4B-3T code was established in developing revised 100Mbps transmission system called as DC-100MR System.

So far, regenerative digital transmission was adopted. In the development, "hybrid transmission" with the combination of regenerative repeaters and analog amplifier repeaters was studied as a challenge theme. Finally the challenge did not result in success. It was because accumulation of low frequency cutoff and high frequency thermal noise in the baseband digital transmission over coaxial cables prevented the system commercialization. On the contrary, in case of optical transmission systems, there are no factors to prevent commercialization. In fact, afterwards, transoceanic submarine optical transmission systems using the hybrid transmission technology were developed and installed.

In the long-haul digital transmission systems, jitter accumulation was the critical issue. Scrambling of a code signal was the solution to solve it. It has the features of no additional signals and no additional hardware in repeaters. It has an additional merit of suppressing the dynamic range of timing signal in each repeater substantively, and at 400Mbps, timing signal loss happens once in 100years. These excellent characteristics of scrambling assure BSI (bit sequence independency) for transmitting signals.

When the digital transmission systems over coaxial cables were introduced, the analog transmission systems over coaxial cables were already installed in operation.

Therefore, the compatibility with the analog transmission systems should be considered in various viewpoints, such as cables, repeater spacing and repeater housing.

Concerning the transmission medium, the same kind of standard coaxial cables were utilized both analog and digital transmission.

The most important compatibility issue was repeater spacing. The repeater spacing of C-12M analog transmission system with the channel capacity of 2700 channels was 4.5km. The 100Mbps transmission system with AMI code called as DC-100M had the repeater spacing of 3km, which had not compatibility of repeater spacing with C-12M System. This incompatibility brought about the change of transmission code from AMI to 4B3T to achieve the repeater spacing of 4.5km, and resulted in success of commercialization of advanced DC-100MR System.

The repeater spacing of 400Mbps transmission system called as DC-400M using AMI code had the repeater spacing of 1.5km, which has the compatibility with that of C-60M analog transmission system with the channel capacity of 10,800 channels.

The other compatibility issue was the colocation of digital and analog repeaters in the same repeater housing. To resolve the issue, thermal equivalent digital repeaters were fabricated for evaluating thermal performances.

Based on the technologies described above, the 100Mbps and 400Mbps digital transmission systems had been developed, which corresponded to the fourth and fifth Japanese digital hierarchy, respectively.

The DC-100M System had been developed and installed in 1972, and the DC-100MR System had been developed and installed in 1980.

The DC-400M had been developed and installed in 1973.

All the systems employed scrambling technology and did not employ hybrid transmission technology.

**2.2 Submarine optical fiber transmission**

Submarine transmission systems are important telecommunication infrastructures for both domestic and transoceanic applications. So far, various submarine transmission systems over coaxial cables were developed and installed. However, at that time, it reached a deadlock to develop higher capacity submarine coaxial cable transmission systems. It was due to the fact that even though larger coaxial cables were employed, repeater spacing became shorter and there happened various problems such as more accumulated noise, lower reliability, higher power supplying voltage and difficulties in installing systems.

These difficulties could be resolved using the optical transmission technology. However, even though terrestrial optical transmission technology had been developed at that time, various new technologies should be developed to realize submarine optical transmission systems.

The biggest developing issues were to assure high reliability of the system, especially submerged repeaters and submarine cables.

Submerged regenerative repeaters contain many active components, and circuits were to be integrated into the IC. Various ICs had been developed, corresponding to each R function in repeaters and reduced the number of components by 1/10.

The biggest reliability issue of components was that of LD (laser diode). It was due to the fact that LD's degradation mechanism and reliability were not yet clarified. In the development of LDs applied to submerged repeaters, intensive study was conducted. Based upon the high reliability potential of InGaAsP LD, high reliability mounting structure was established. Acceleration life test was conducted, and using assumed acceleration rate, its failure rate less than 60 FIT, the required value was assured. Also, cold standby LD was mounted in submerged repeaters. These studies assured the failure rate of a repeater less than 80 FIT.

Concerning submarine optical fiber cables, mechanical reliability should be assured. To assure the

required strength, the proof test was conducted for both fibers and fiber splicing points with the proof test strain of 2% and 2.5%, respectively.

Under the system development, the evolving splicing technology for single-mode fibers has been developed. So far, there were several technologies that using the technologies, where splicing could not be executed locally. We discovered the possibility that a fiber core could be observed locally by a microscope. Using the fact, the direct monitoring splicing machine was developed, and became the world de-fact standard.

These technologies tuned for submarine optical transmission systems resulted in wide penetration also in terrestrial systems.

Based on the technologies established so far, submarine optical cable transmission systems using the wavelength of1.3μm had been developed and installed. The first repeatered system was installed on Miyazaki-Okinawa Route with the length of 790 km in 1986. It was the first long-haul submarine transmission system in the world.

Thereafter, various new submarine transmission systems had been developed thanks to the newly developed optical technologies, which were the 1.5μm transmission technology using DFB-LD, the SDH system architecture and the hybrid optical transmission technology.

1979. This year, 0.2dB/km single-mode fiber and room temperature continuous operation of a InGaAsP LD were realized for the first in the world in the wavelength of 1.5μm. Then the submarine optical transmission systems were installed in service in 1986. It means that the first system using new technologies took less than the system life of 25 years. It did not coincide with the traditional principle of submarine transmission systems that the new submarine transmission systems using new technologies is firstly installed after the system life since the new components were first utilized. This challenge was done globally. It can be thought that the final success was achieved thanks to the excellence of the long wavelength fiber transmission technology with respect to transmission performances and reliability, which depends upon both using single-mode fibers and InGaAsP LDs.

### 2.3 Coherent optical transmission

So far, optical transmission had employed IM (Intensity Modulation) method. However, an optical signal is inherently an electromagnetic wave. Therefore, an advanced modulation method as for wireless transmission can be considered, and that is a coherent optical transmission technology. The study on the coherent optical transmission technology started in 1983. As the result, a long span transmission experiment at 400 Mbps using FSK modulation achieved 270km non–repeatered transmission in 1985, which marked the world record.

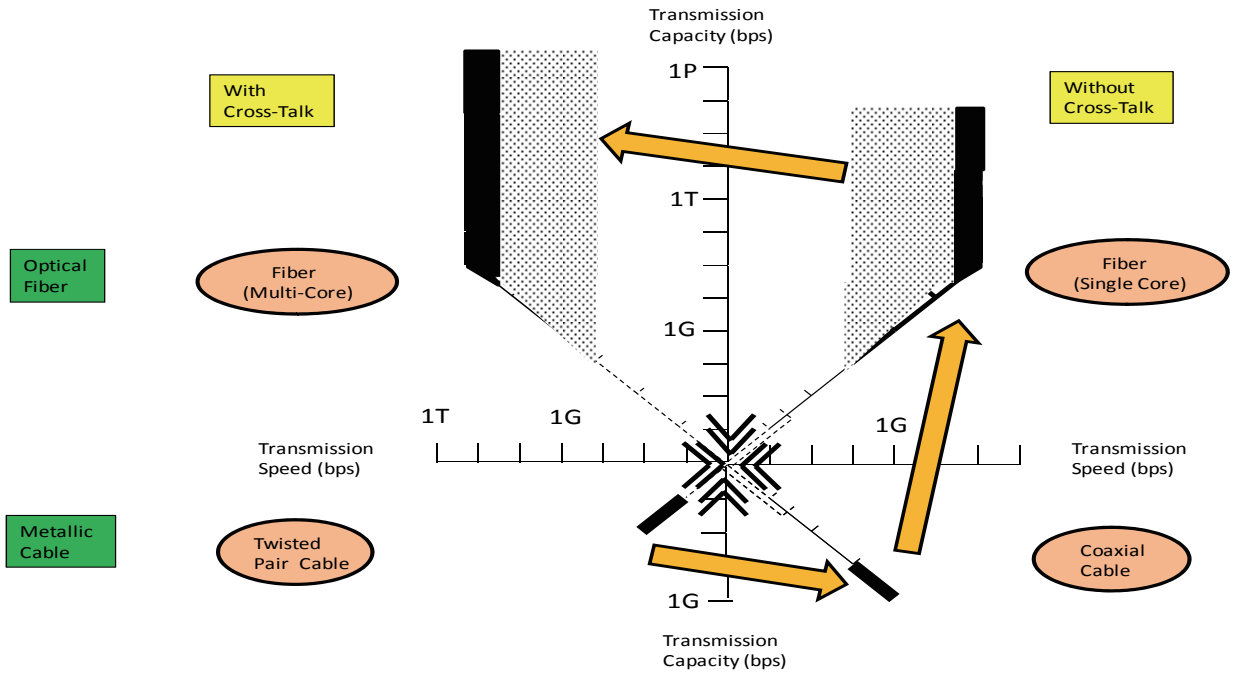



Fig. 1 Evolving wired digital transmission systems

From the historical point of view, the development of submarine optical transmission systems was a very interesting story. The long wavelength optical transmission technologies were firstly demonstrated in

Its key elements were narrowing spectrum width of light emitted from LD, controlling the polarization of the transmitted optical signal, stabilizing the optical frequency, compensation of the inhomogeneous

frequency characteristic and so on. The S/N gain of 8dB was obtained the coherent optical transmission. This kind of the technology would advance the optical transmission technologies afterwards.

### 2.4 Trend of wired digital transmission technologies

The wired digital transmission systems are always evolving toward higher transmission capacity corresponding to the big demand of telecommunication. Figure 1 shows the evolving wired digital transmission systems. X axes indicate transmission speed and y axes indicate transmission capacity. The upper plane indicates optical fiber transmission systems, and the lower plane indicates metallic transmission systems. The left plane indicates systems with cross-talk, and the right plane indicates systems without cross-talk.

The wired digital transmission systems evolve from metallic (twisted pair cable) systems to metallic (coaxial cable) to optical fiber systems (single core) and to optical fiber systems (multi-core).

Optical transmission systems increase their capacity by other multiplex than TDM (time division multiplex), that is, WDM (wavelength division multiplex), PDM (polarization division multiplex) by two, MDM (mode division multiplex), SDM (space division multiplex) by a multi-core fiber and FDM (frequency division multiplex) by multi-carrier. These multiplex technologies give the variety of the relations between the transmission speed and the transmission capacity.

## 3. Network synchronization technologies

The integrated digital network to combine digital transmission systems with digital exchanges requires network synchronization. Network synchronization has two viewpoints: “frequency synchronization” of a network and “phase alignment” at each node.

### 3.1 Frequency synchronization

In the development of network synchronization systems, choice of synchronization method was the biggest issue. There are three synchronization methods, that is, plesiochronous, master-slave and mutual synchronization methods.

The plesiochronous method is simple one, where a high precision oscillator (atomic oscillator) is installed at each node. However, it has disadvantages that multi-link connection causes degradation of quality or increase of slips, that is insertion or omission of data on frame base.

Concerning the master-slave synchronization method, master-slave relation is established by fixed or adaptive control. By adaptive control method, master-slave relation is always established, but its control is very complicated on network level. On the other hand, fixed control is simple, but in some cases, plesiochronous mode should be tolerated.

Mutual synchronization method has inherently the fatal characteristics that behavior of an oscillator at a node, such as the free-run of PLO brings about the effect on the whole network. Its behavior cannot be detected locally because of the multi-loop architecture in the whole network.

Figure 2 summarizes features and evaluation of the three methods. In the figure, the evaluation lists up the issues to be solved, and only the master-slave technology can resolve it. The studies led to the conclusion that the best method is the master-slave method with fixed control and countermeasures against line outages. This solution can remove the system complexity, system unstableness, quality degradation and system cost up.

The final system decision was that the domestic network synchronization system is composed by the master-slave system, and its master clock realizes the international plesiochronous operation. The master clock is realized by Cs atomic oscillator with the frequency accuracy of $10^{-11}$, and the slave clocks use Rb or crystal oscillator oscillators.

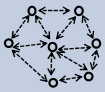
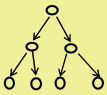
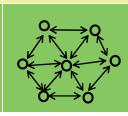
| Technology alternatives | Network configuration | System features | Issues to be solved |
|---|---|---|---|
| Plesiochronous |  | multiple non-synchronous links | Quality degradation |
| Master-slave synchronization |  | unidirectional tree structure | Line outage recovery |
| Mutual synchronization |  | multiple loops In a network | network level instability |

Fig. 2 Network synchronization technology alternatives

It is interesting that the architecture of the developed network synchronization system is just analogous to that of the global political system.

The master-slave network synchronization technologies had been established in two stages.

The firstly developed technology is called as “tightly-coupled master-slave system”, and maintains the network clock by tree-structure clock distribution with clock path switch as the countermeasure against line outages. In this case, each node has its own priority in the network, and at each node, a timing circuit is composed of a priority switch plus a back-up fixed high precision crystal oscillator. Even in the case that the network clock cannot be obtained due to line outages, the back-up fixed crystal oscillator maintains high precision clock with the frequency accuracy of $10^{-8}$ during few hours or few days. Therefore, the network can maintain high quality of synchronization.

The secondly developed network synchronization technology is called as “loosely-coupled master-slave synchronization”, and employed the advanced PLL using a digitally processing called as DP-PLL. The advantages of DP-PLL are to be able to set optimum parameters in each mode, such as pull-in mode and locked mode, and to maintain nearly the synchronized frequency in free-run state thanks to its inherent memory feature of digital processing. For example, free running during several days can be tolerable. By this

technology, priority switching of clock distribution path is not critical, and its maintenance can be eased.

The network synchronization systems had been developed corresponding to each digital network.

The first digital network was the digital data network called as DDX. The network synchronization systems for DDX employed the tightly-coupled master-slave technology based on 1.5Mbps clock distribution.

As the second step, the advanced network synchronization system has been developed for the digital telephone network or the digital communication network, which was the dominant network. The network synchronization system employed the loosely-coupled master-slave synchronization technology.

### 3.2 Phase alignment

The other aspect of network synchronization is "phase alignment" at each node, which is indispensable in pre-processing function for synchronous multiplexing and digital exchange. A frame aligner is to absorb the delay variation and to align an input signal as a frame phase. Delay variation is mainly induced by thermal variation of transmission media, and happens very slowly by the time constant of day or year. This kind of delay variation is called as "wander".

To design a frame aligner, the wander values were to be surveyed. The delay variation survey for various kinds of cables was conducted.

Figure 3 shows the delay variation due to temperature as well as transmission delay of various transmission media, including wireless transmission medium. As shown in the Figure, standard coaxial cables and space media for wireless transmission have low delay performances in both transmission delay and delay variation. Pair cables have high delay variation performance compared with other transmission media. Their delay variation performances differ according to their insulating materials of paper and polyethylene by ten times.

Delay variation or wander to absorb at a frame aligner is the product of delay variation performance due to temperature, transmission length and temperature variation. The worst case is transmission systems over paper-shielded pair cable installed in aerial environment. It closes to 10μsec, and is about one-tenth of the frame length 125μsec.

In Japan, the network synchronization systems have been installed nation-wide.

Next technology issue may be time synchronization for end-to-end applications.

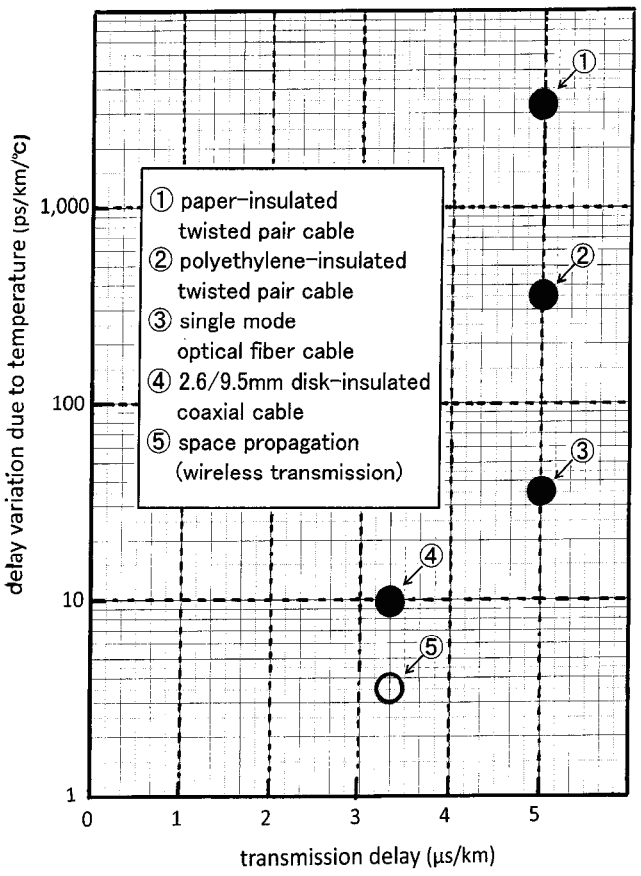



Fig. 3 Delay performances of transmission media

### 4. Views on wired digital transmission technologies as the conclusion

So far, the wired digital transmission technologies established by NTT were described. They were the history of transition from analog to digital transmission, from asynchronous to synchronous and from low speed to high speed.

Digital transmission technology is established by digital architecture based upon analog technologies. Analog technologies correspond to physics, and always seek for higher speed until their limit, and seek for new physics beyond the present limit. Digital architecture is established to realize the fundamental functions such as transmission, multiplexing and synchronization, and now seeks for their enhancement for the new service demands.

**Acknowledgement**

I would like to thank the members in NTT and in the related manufacturing companies for their guidance, cooperation and collaboration during my life study in NTT Laboratories.

# Review of Evolution of Wireless Transmission Technologies

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## 1. Introduction

More than 30 years have passed since cellular telephone systems were first developed, and we are now in an era where many persons own one or more cellular phones, and are able to remain connected wherever they are. Fig. 1 illustrates the changes in the statistical number of cellular phone subscribers for the past 25 years [1], highlighting some landmark events. In the mid-90s, the 1st generation mobile network based on analog technology was replaced by the 2nd generation digital mobile network, or PDC (Personal Digital Cellular) system, which led to accelerated growth in the number of subscribers. Furthermore, at the beginning of this century, the 3rd generation mobile telecommunication systems (IMT-2000) based on CDMA (Code Division Multiple Access) technology were introduced, and largely enhanced features such as the maximum user throughput, mobile multimedia capabilities, and globalization, allowing cellular phones to be utilized worldwide. In 2011, LTE (Long Term Evolution) was introduced, and can be considered to be a forerunner of the 4th generation. With LTE, the bit rate has been increased by about 100 times when compared to that of the 3rd generation, and by 5,000 times compared to the 2nd generation. This builds on the significant progress of wireless transmission technologies achieved so far, and this letter reviews their evolution and gives an overall prospective of wireless technology trends.

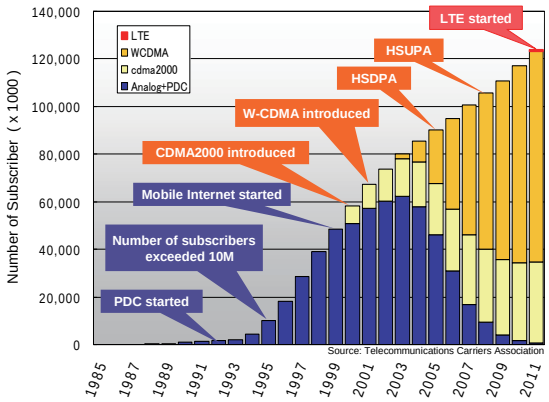


Fig. 1 Statistical transition of subscribers

## 2. Progress of Spectrum Efficiency

An electromagnetic wave (radio wave) that is used as a medium for wireless communications radiates in multiple directions. Therefore, a separate frequency needs to be allocated for each wireless communication system in order to avoid mutual interference. On the other hand, since the upper frequency limit suitable for wireless communication is about 10 GHz due to increasing path loss, it has been an ongoing challenge to provide solutions for the efficient usage of such a finite resource.

A scale that is used to measure the efficiency of frequency utilization, sometimes referred as "*spectrum efficiency*," is defined as the channel capacity per unit frequency bandwidth of 1 [Hz], C/B [bit/s/Hz], where B [Hz] is the frequency bandwidth of a wireless transmission channel and C [bit/s] is the channel capacity provided by the wireless system. From Shannon's theorem, the relationship between the spectrum efficiency C/B and $E_b/N_0$ can be easily derived as in Eq. 1, where $E_b$ [J/bit] is the signal energy required to convey information of 1 bit through a given wireless channel, and $N_0$ [W/Hz] is the noise

$$\frac{C}{B} = \log_2\left(1 + \frac{E_b}{N_0} \cdot \frac{C}{B}\right) \qquad (1)$$

power density of the wireless channel.

The C/B given by Eq. (1) indicates the upper bound of spectrum efficiency that can be provided by a wireless system for a given $E_b/N_0$. Various wireless transmission technologies have been investigated and developed with a special focus on the upper limit of the frequency band.

It is important to convey as many information bits as possible in a given time in order to improve the spectrum efficiency. In other words, the goal is to pack symbols conveying information onto the communication medium. Three typical methods have been developed to maximize the number of symbols into such orthogonal domains. Some of these are

(1) Phase domain of modulated carrier,
(2) Frequency domain for multiplexing,
(3) Physical space for MIMO transmission.

First of all, QAM (Quadrature Amplitude Modulation) was developed to allocate a large number of symbols onto the phase space of a carrier vector. Table 1 summarizes the symbol allocation (referred to as a "*constellation*"), a power that is increased to the average QPSK (denoted as $\Delta P_{av}$), and C/B and $E_b/N_0$ for the case where the roll-off factor of the baseband filter is 0.3 and where the bit error rate (BER) is equal to $1 \times 10^{-4}$, as is the case for QPSK, 16QAM, 64QAM,

| Modulation | | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| Constellation | | Symbol distance = 2 | | | |
| Number of symbols | $2^k$ | 4 | 16 | 64 | 256 |
| Bit per symbol [bit] | k | 2 | 4 | 6 | 8 |
| Number of levels | n | 2 | 4 | 8 | 16 |
| Average power | Pav | 2 | 10 | 42 | 170 |
| Extra Pav increase to QPSK [dB] | Δ Pav | 0 | 7.0 | 13.2 | 19.3 |
| Signal-to-noise ratio [dB] | $E_b/N_0$ | 8.4 | 12.4 | 16.9 | 21.7 |
| Spectrum efficiency [b/s/Hz] | C/B | 1.5 | 3.0 | 4.4 | 5.9 |

Table 1 Comparison of multi-level QAM

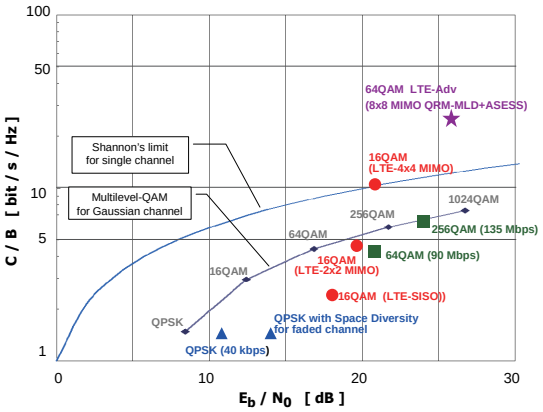


Fig. 3 Spectrum efficiency

and 256QAM. Comparing 256QAM to QPSK, although the average power and $E_b/N_0$ of 256QAM are increased by 19.3 dB and 13.3 dB, respectively, the spectrum efficiency can be further improved by a factor of 3.9 (as is 5.9 divided by 1.5.) Fig. 2 shows the eye aperture waveform of the 256QAM demodulator. The symbol distance of 256QAM is one sixteenth that of QPSK, therefore the design of the modem requires high precision [2] [3]. In particular, allowable upper limits such as the phase error of the orthogonal modulator, frequency characteristics of the circuitry, SNR of the recovered carrier, and the timing error of the clock signal were precisely estimated, and their validities have been confirmed experimentally. This led to the commercialization of 256QAM for digital terrestrial microwave radio system in the 1980s as a first worldwide.

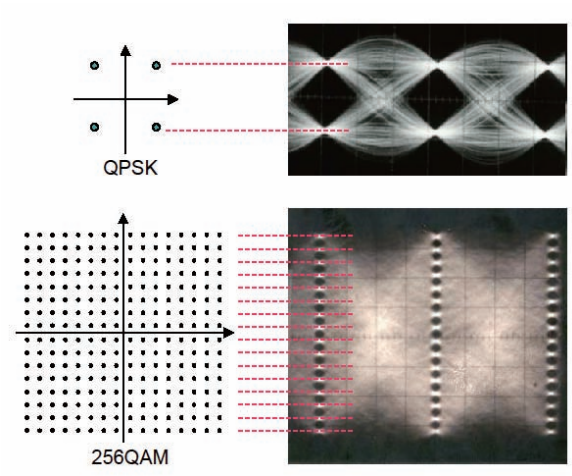


Fig. 2 Eye apertures of 256QAM

From the perspective of the spectrum efficiency, Fig. 3 shows the spectrum efficiency of QPSK for mobile environments and that of 64QAM and 256QAM for Gaussian channels. In the early 1990s, QPSK was mainly used for mobile communications [4] since it was difficult to counter Rayleigh fading at that time. However, as digital signal processing techniques were further developed, such as pilot-symbol-aided channel estimation, coherent carrier recovery, and forward error correction, it later became possible to adopt multi-level QAM even in mobile environments.

The second solution is OFDM (Orthogonal Frequency Division Multiplexing), where symbols are packed in the frequency domain. Historically, FDM (Frequency Division Multiplexing) has been used, where modulated carrier spectrums are aligned on the frequency domain, which requires some guard bands not conveying any information, and leads to inefficient spectrum usage. On the other hand, OFDM multiplexes multiple narrow-band modulated sub-carriers that have the function form of *sin(x)/x*, so that each sub-carrier can be placed at a null point of adjacent sub-carrier spectrum, which causes no mutual interference. Therefore, no guard bands are necessary, and this significantly improves the spectrum efficiency. In addition, since the symbol rate of each sub-carrier is normally chosen so that the symbol duration does not exceed the maximum delay profile of a wireless channel, OFDM also improves the tolerance against frequency-selective fading. However, one drawback is an increase of the peak-to-average power ratio, which has a negative impact on the power efficiency of the transmit power amplifier. However, this was solved using a smart amplification technology, where an amplifier module operates closer to the saturation point and maintained a relatively high power-efficiency, while the non-linear distortion that was incurred can be compensated by using digital pre-distortion (DPD) circuitry [5]. Fig. 4 shows the effectiveness of the DPD

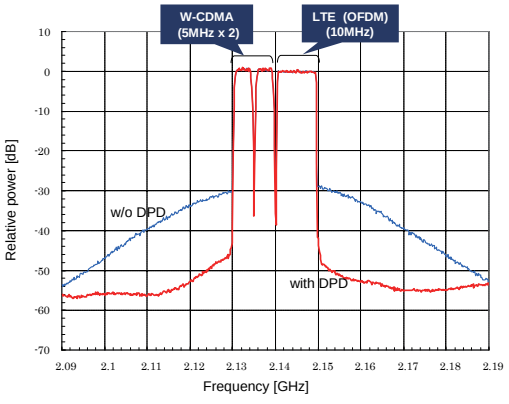


Fig. 4 Effect of digital pre-distortion

which improves the ACLR (Adjacent Channel Leakage power Ratio) by approximately 20 dB.

The third technology is MIMO (Multiple Input and Multiple Output antenna), where multiple streams of data are at the same time transmitted in the same frequency band using multiple antennas both at the transmitting and receiving ends. Each receiver antenna experiences a combination of signals from different transmit antennas, but a demodulator estimates the channel matrix using a pre-defined data sequence as a pilot, and regenerates each stream of data. Although this demodulation requires a significant amount of digital processing power, recent advances in DSP's (Digital Signal Processors) and the miniaturization technology of CMOS devices have contributed to the realization of terminals having reasonable power consumption. This improves spectrum efficiency according to the proportion of the number of antennas being used, as shown in Fig. 5, where the enhancement of the channel throughput for three types of antenna configuration (1 × 1, 2 × 2, and 4 × 4) is given, as in the case for 16QAM using a 5 MHz bandwidth. (In the expression $N$ x $M$, $N$ denotes the number of the transmitter antennas while $M$ denotes the number of receiver antennas.) This confirms that MIMO improves the spectrum efficiency in real environments, in accordance with the number of antennas [6][7].

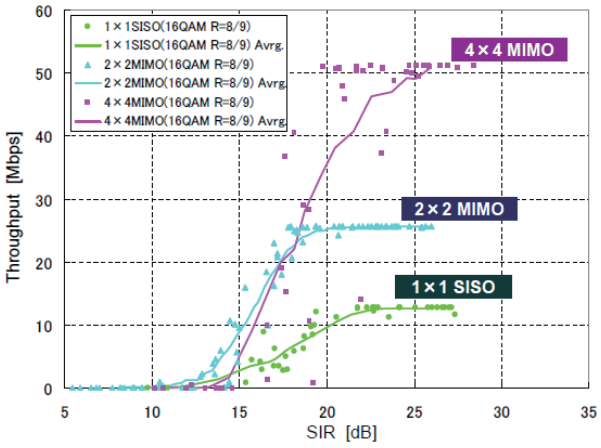


Fig. 5 Performance of MIMO

## 3. Future of Wireless Access

LTE introduced in 2011, has adopted multilevel QAM, OFDM, and MIMO [8][9][10], and has improved the spectrum efficiency by up to 10 bit/s/Hz. However, some reports predict that global mobile data traffic will increase at a CAGR (Compound Average Growth Rate) of 80-90%, and that in 2020 it will exponentially increase to 500-1000 times that of current mobile traffic. In addition, they also predict that the total global mobile traffic will reach more than 127 EB (= 127 × $10^{18}$ bytes) in 2020 [11]. To accommodate such a large amount of traffic, further enhancements of radio access systems are being pursued by the 3GPP (the 3rd Generation Partnership Project) and the ITU-R (International Telecommunication Union Radio-communications Sector), and requirements for LTE-Adv (LTE-Advanced) and IEEE 802.16m have been defined, as shown in Table 2 [12]. For instance, the peak spectral efficiency of LTE-Adv using an 8 × 8 MIMO is set to 30 bit/s/Hz, which is 3 times higher than that of LTE. The corresponding simulation confirms a throughput of 250 Mbps for the case where 64QAM with a 10 MHz bandwidth is assumed, along with 8 × 8 MIMO and QRM-MLD (Maximum Likelihood Detection with QR decomposition and M-algorithm) plus ASESS (Adaptive Selection of Surviving Symbol replica candidates)[13] for MIMO detection algorithm. This implies that a spectrum efficiency of 25 bit/s/Hz is feasible as is also shown in Fig. 3.

| Parameter | | IMT-Advanced ITU-R M.2134 | | LTE-Advanced 3GPP TR36.913 V8.0 | | IEEE 802.16m-07/002r7 | |
|---|---|---|---|---|---|---|---|
| | | DL | UL | DL | UL | DL | UL |
| Peak spectral efficiency [bit/s/Hz] | | 15 | 6.75 | 30 (8x8) | 15 (4x4) | 15 (4x4) | 6.75 |
| Cell spectral efficiency [bit/s/Hz/cell] | Indoor | 3.0 | 2.25 | - | - | 3(4x4) | 2.25 |
| | Microcellular | 2.6 | 1.8 | - | - | 2.6(4x4) | 1.8 |
| | Base coverage urban | 2.2 | 1.4 | 2.4(2x2)<br>2.6(4x2)<br>3.7 (4x4) | 1.2(1x2)<br>2.0(2x4) | 2.2(4x4) | 1.4 |
| | High speed | 1.1 | 0.7 | - | - | 1.1(4x4) | 0.7 |
| Cell edge user spectral efficiency [bit/s/Hz] | Indoor | 0.1 | 0.07 | - | - | 0.1 | 0.07 |
| | Microcellular | 0.075 | 0.05 | - | - | 0.075 | 0.05 |
| | Base coverage urban | 0.06 | 0.03 | 0.07(2x2)<br>0.09(4x2)<br>0.12(4x4) | 0.04(1x2)<br>0.07 (2x4) | 0.06 | 0.03 |
| | High speed | 0.04 | 0.015 | - | - | 0.04 | 0.015 |
| Bandwidth [MHz] | | 40 | | 100 | | Scalable 5 to 40 | |

Table 2 Requirement for LTE-A and 802.16m

In 2010, the 3GPP released several LTE-Adv specifications [14][15][16][17], where for evolution, new wireless transmission technologies include

(1) Carrier aggregation,
(2) Advanced MIMO of 8 × 8,
(3) CoMP (Coordinated multipoint transmission and reception), and
(4) Relaying.

The evaluation results carried out in the 3GPP show that LTE-Adv satisfies the minimum requirements of all of the following test environments: (1) Indoor environment, (2) Microcellular environment, (3) Base coverage urban environment, and (4) High Speed Environment. By considering these outcomes and the achievements made so far, it appears quite promising that people will be provided with the stress-free access to IT resources that are beyond the "*mobile cloud*" in any mobile environments.

To the contrary, wireless transmission technologies have also pervaded various communication fields. Some of them are heading to new applications such as PAN (Personal Area Network) or BAN (Body Area Network), where data communication of comparatively low bit rate within a short distance is expected. The related specifications have extensively been studied and standardized in Task Group 4 of IEEE 802.15 committee. Unlike cellular systems, the specifications cover;

(1) Radio coverage less than 100 m,
(2) Bit rate of a few 100 kbps,

(3) Transmit power range of 0.1 to 10 mW, and
(4) Variety of frequency band depending on regional regulation including ISM (Industry-Science-Medical) band of 2.4 GHz.

| Frequency (MHz) | Region | Modulation | Data Rate (FSK) | Data Rate (OFDM) | Data Rate (OQPSK) |
|---|---|---|---|---|---|
| 169.400–169.475 | EU | Filtered 2FSK / 4FSK | 2.4 / 4.8 / 9.6 | — | — |
| 450–470 | US | Filtered 2FSK / 4FSK | 4.8 / 9.6 | — | — |
| 470–510 | China | Filtered 2FSK / 4FSK OFDM, OQPSK | 50 / 100 / 200 | BPSK: 50 / 100 / 200<br>QPSK: 50 / 100 / 200 / 400 150 / 300 / 600<br>16QAM:200 / 400 /800 300 / 600 | 6.25 / 12.5 / 25 / 50 |
| 779–787 | | | | | 31.25 / 125 / 250 /500 |
| 863–870 | EU | Filtered 2FSK / 4FSK, OFDM | 50 / 100 / 200 | — | — |
| 968-870 | EU | OQPSK | — | — | 6.25 / 12.5 / 25 / 50 |
| 896–901 | US | Filtered 2FSK | 10 / 20 / 40 | — | — |
| 901–902 | | | | | |
| 902–928 | US | Filtered 2FSK, OFDM, OQPSK | 50 / 150 / 200 | as above | 31.25 / 125 / 250 /500 |
| 917–923.5 | Korea | | | | |
| 928–960 | US | Filtered 2FSK | 10 / 20 / 40 | — | — |
| 920–928 | JP | Filtered 2FSK / 4FSK OFDM, OQPSK | 50 / 100 / 200 / 400 | as above | 6.25 / 12.5 / 25 / 50 |
| 950–958 | JP | | | | |
| 1427–1518 | US | Filtered 2FSK | 10 / 20 / 40 | — | — |
| 2400–2483.5 | World wide | Filtered 2FSK, OFDM, OQPSK | 50 / 150 / 200 | as above | 31.25 / 125 / 250 /500 |

Table 3 Physical interface of IEEE 802.15.4g

As an example, the specification defined in IEEE 802.15.4g [18] is shown in Table 3, where MR-FSK (Multi-Rate and multi-regional Frequency Shift Keying,) MR-OFDM (Multi-Rate and multi-regional OFDM,) and MR-O-QPSK (Multi-Rate and multi-regional Offset-QPSK) have been standardized for a variety of frequency bands so as to be deployed in many countries.

## 4. Conclusion

The author has reviewed the evolution and trends concerning wireless transmission technologies over the last three decades. The continuing evolution of frequency efficiency will have to consider the expected rapid increase in mobile traffic, which is predicted to occur within the next decades. The frequency efficiency exceeding 30 bit/s/Hz is expected to be realized through further research and development. Furthermore, wireless transmission technologies will also pervade various application fields for low bit rate communication within a short distance.

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# 15 Years of Living and Exploring in Japan

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## 1. Introduction

At first, I would like to express my gratitude to IEICE (Institute of Electronic, Information and Communication Engineers) for giving me the opportunity to share some of my 15-year experiences, nearly half of my life, in Japan. I was born in a small city called 'Suratthani' in Thailand. Since I have come to Japan in 1997, I have had many opportunities to experience a lot of things in various places around Japan. Some of them were pleasant but some came with sufferings. All of them are precious memories for me. I would like to take this chance to talk about my long journey in Japan and give some advice to foreign students in Japan.

## 2. 1 Year in Tokyo, Metropolitan City

After graduated from high school in Thailand in 1997, I had an opportunity to be a technical college student under the "Monbukagakusho" scholarship program. I took this chance without hesitation because it was my dream to come to study new technologies in Japan. Before I came to Japan in the same year of high-school graduation, I had very little knowledge about Japanese. However, I had enrolled in 1-year Japanese language program in Tokyo as a part of my 4-year scholarship program. There were 4 Thai students came to Japan together. We lived in the same dormitory with many foreign students near to Shibuya, Tokyo.

First problem for every student who comes to Japan is Japanese. Not only the grammar, (for example verb comes last in sentence) but also the Kanji letters are hard barriers for every Japanese learner. I think the best way to learn Japanese is to use it as much as possible. However, I found myself using Thai with my friends and speaking English with other foreign students in the dormitory. It was difficult to improve my Japanese in environment without Japanese around. Meanwhile, I had much fun in the dormitory life. We made Thai foods and eat them together. Going to Shibuya to buy materials and going to Shinjuku and Akihabara to find new electronic devices are my hobby in that time. Every thing is fresh and new for me in the metropolitan city, Tokyo. Another impression is crowded people in a train in rushing hour, and also, subway system spreading around Tokyo.

## 3. 3 Years in Nara, Historical City

After finished my Japanese studies in Tokyo, I went to Nara prefecture to enter Nara College of Technology. I lived in the same dormitory with Japanese students nearby the college. Therefore, I had more chances to practice and improve Japanese with my friends. We played together and they taught me Kansai Ben (dialect of people living in Kansai region). Although Kansai Ben is not standard Japanese, it sounds friendly to me as people in Kansai are. Also there are many historical places worth going to see in Kansai. During my 3-year studies in Nara, I had travelled to many world heritages with my friends in and around Nara. I do recommend you to visit these beautiful places, for example, Kinkaku Temple in Kyoto, Himeji Castle in Himeji, and Todai-Ji in Nara. Besides, what I studied in the class, I have learned much about Japanese histories and cultures during that time. I really like Maiko (Japanese girls in Kimono in Kyoto), going to 'Hatsumode' to make a wish (going to shrine on the New Year), having tea in Japanese Tea Ceremony, etc. They were so interesting and attractive for me.

Fig. 1 Kinkaku Temple in Kyoto

## 4. 2 Years in Akita, City of Snow

I moved to Akita prefecture and enrolled in Electrical and Electronic Engineering Department of Akita University as a third-year student. It was April when I went to Akita and I still remember that there were still snows on the ground. I love to watch snow scene in countryside, exceptionally scene from windows of the 'Shinkansen' (bullet train of Japan) from Akita to Sendai. I would never experience that in Thailand.

The first thing I did when I arrived at Akita was finding a part-time job to earn for my livings because my 4-year scholarship program was ended in March, and I had no financial support from my family. I had to live with my own hands. I had been a waiter in an Asian food restaurant for one and a half year. It was my hard time that I must study and do a part-time job in the same time. However, there were many things that I could never have experienced if I were not in Akita.

People in Akita were so kind for me and I liked to have a talk with customers at the restaurant. I have learned that Japanese are all working hard, keeping everything in punctuality, honest to each other. I think they always speak indirectly because of their kindness that they do not want to hurt each other's feelings. I have learned a lot by meeting many Japanese during this time.

After one year of study, I had joined Inoue laboratory and started my own research. My research interest goes to computational electromagnetics because it looks mysterious for me. I did a research about how to model ferrite in the Finite-difference Time-domain method and I felt a desire to study further in this field. Then, I decided to continue my study in Tohoku University. I got a chance to enter Tohoku University with recommendation because my qualification was fulfilled and I took an interview. Finally, I did it! I received a notification of enrollment. My heart was overwhelmed with rejoice at that time.

**5. 8 Years and a Half in Sendai, Study Capital**

After 2 years in Akita, I moved to Sendai to enroll in Electrical and Communication Engineering Department of Tohoku University. I had started my research life in Sawaya-Chen laboratory since 2003. At the same period, I continued finding a financial support from institutes and companies in Japan. Eventually, I got 'NTT DOCOMO' scholarship for 2 years of my master degree. I got relief so much because I could concentrate more on my research without worrying about economic deprivation. My research theme was titled 'non-invasive measurement system using modulated scattering element'. Contrary to my interest in computational electromagnetics, I had to do experimental measurements instead. At first, I thought that the experiment was boring because I must keep doing same procedures repeatedly. But I found that the best way to gain intuition about some natural phenomena is to experience them from the reality, likewise learning a new language. In this way, I can understand differences between the real world and numerical simulations using computer programming. Every simulation comes up with assumptions or postulates, whereas in the reality, our assumptions may be not satisfied enough. So experimental results are not always what I want them to be, but I continued doing them without giving up. Then, after some progress, I am required to write conference papers for domestic conferences during my 2-year study.

After graduated from the master degree, I decided to continue my research with a new theme about numerical method in computational electromagnetics as I wanted. However, electromagnetic theory was too deep and difficult to understand for me and it took me too much time to study it from the beginnings. With support from my supervisors, Prof. Sawaya and Prof. Chen, I eventually received Ph. D. in Engineering from Tohoku University in 2010. Difficulties in finding financial support and my own expertness in the field of computational electromagnetics give me mentality strength. I still remember the words of Prof. Sawaya saying 'You must open up your way by yourself' (自分の道を切り開かなければならない). Up until now I am still seeking the way and asking myself what I am, what I can do, where I should go. To answer these questions is not easy but I will keep on searching the answers.

Besides the life in the laboratory, I was one of Sendai International Committees. I had many chances to go to primary schools to introduce about my home country, Thailand. In addition, I enjoyed myself in the Sendai-Thai group. There were almost 40 Thai students in the Sendai-Thai. We had much fun together and got familiar with each other. I think that Thai people have more tolerances in accepting weak points of each other. We had so many good memories together.

Fig. 2 Farewell party of Sawaya-Chen laboratory

**6. Conclusion**

I have gained many experiences from living in many places for 15 years in Japan. I learned Japanese in Tokyo, Japanese history and culture in Nara (most by travelling), worked for a part-time job in Akita, studied and researched in Sendai. I could not had reached to this point without many supports from my family, my friends, my teachers, the restaurant owner, the customers, the professors, and vice-versa. I would like to take this place for expressing my sincere gratitude to all of them for everything they have done for me. Now I am working in Nagoya. It has already been half a year since I came to Nagoya, but I still do not have much time to explore around Nagoya. However, if I have a time, I do not hesitate to go around and explore the city as much as I can. I do also recommend all of you to explore around the city you live as much as you can. There are so many interesting places that would open your vision of Japan! You will find a part of Japan that you never experience before.

Finally, I would like to thank again the IEICE for giving me this chance and for continuing publishing English versions of global newsletter. I believe this will bring Japan and the world getting close together.

# Working in Japan as a Network Research Engineer

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## 1. Introduction

First, I would like to thank the editors of IEICE Global Newsletter for giving me this opportunity to share my personal experience with all their readers. I joined Ritsumeikan University, Japan in September 2001 after I received my B.E. in Computer Science from NanKai University [1] which is located in Tianjin, China. I attended a special program which started in that year. All of my classmates were foreign students, and our courses were taught in English. We learned technology management together. At the same time, I chose communication networks as my major. After I received my M.E. in information networking from the university, I joined the research center of Japan Telecom in April, 2004 and started my career as a research engineer. (Japan Telecom was taken over by Softbank Group in 2004.) I am currently engaged in R&D on QoS (Quality of Service) control and mobility management for mobile network systems.

This article will give a brief outline of my life in Japan in the last 10 years. I hope that it will be useful to those who may be planning to develop their career path in Japan.

## 2. Campus life

Thanks to the scholarship of Japanese government, I was able to study in Japan. Ritsumeikan is one of the most famous private universities in Japan and has always been very active in promoting global education. For example, more than 50% of the student body in Ritsumeikan Asia Pacific University (APU) [2] come from overseas, and all lectures are given in English. Biwako Campus of Ritsumeikan (BKC) is very beautiful and has good facilities. The environment is very suitable for advanced research. During my campus life, I made several presentations in domestic and international academic conferences. The pleasure of researching advanced technologies in Ritsumeikan led me to join the laboratory of a telecommunication operator.

I also had lots of very valuable experiences at that time including home stays in summer vacation, factory tours, international exchange activities, one-month internship, a part-time job at an IT venture company, and so on. As a part of the program, we had a valuable chance to enter the factories of several famous Japanese makers. My eyes were opened wide when I saw a well-managed and efficient automatic manufacturing line. The home stay was really important for studying both Japanese culture and language. After my home stay for three days, I was able to speak full sentences for the first time rather than single phrases. Living in a non-English speaking environment will encourage you to speak the local language and it was a very useful experience for me. In addition, the internship and the part-time job experience helped me to understand the operation of Japanese companies. Their atmosphere of good team work and kind leaning guidance suited me very well. They were the main reasons why I decided to stay and work in Japan after graduation.

## 3. Working experience

In Softbank Mobile Corp., I belong to the research arm, which is in charge of both academic research and practical product development including field tests. The mobile network is now regarded as a fundamental infrastructure and indispensable to daily life. Therefore, it must be as reliable as water and electricity. In addition, the mobile network, whose capacity is limited due to the scarcity of radio resources, has to accommodate the heavy data traffic generated by smart phones. I am engaged in the R&D of QoS control and mobility management to build a robust mobile network for our subscribers.

I attend several domestic and international conferences every year to present our research outcomes and keep in touch with the latest technology trends. Fig.1 is a picture taken in TriSAI2009 (Triangle Symposium on Advanced ICT) held in Chofu, Japan. Attending a conference is a good chance to exchange ideas, hold discussions with other researchers, and develop your own human network. Excellent feedback and advice inevitably helped me a lot. We also disseminate our R&D results in the exhibitions.


Fig. 1 Talk in an international symposium

We are carrying out indoor and outdoor experiments to evaluate a next-generation mobile network in which our unique technologies are implemented. Field trials are the most interesting but the hardest part of my work. They pose a lot more challenges than indoor experiments or simulations. However, I can discover so many things through troubleshooting and network operation and field trials make me more confident as a qualified network research engineer. Also, establishing cooperation with different groups is important in field trials because their expertise ensures that I can learn lots of new technologies. For example, I became familiar with wireless protocols like MAC (Medium Access Control) and PHY (Physical layer) in a field trial [3]. These practical experiences helped me to obtain the license of "Grade One Technical Radio Operator for On-The-Ground Services" [4] from the ministry of Internal Affairs and Communications Japan. I believe that this is a small step to becoming a telecommunications specialist, which is my long-term goal.

My efforts have been highly regarded both inside and outside my company. Internally, my research center has won the Softbank Award [5] for the last three years straight. This award is a very highly-regarded acknowledgement and competition is fierce. Personally, I have won awards within the research center several times for my on-the-job performance. Externally, I was the winner of 72nd IEICE Young Researcher Award in 2009 and it was a real honor to receive the prize. Fig. 2 was taken in the commendation ceremony. The person on the right is Prof. Aoyama who is the former chairman of IEICE, and the left side is the author.

## 4. Some advice

I would like to give some advice to those who may be planning to develop their career path in Japan based on my personal experience.

Fig. 2 Commemorative photo with Prof. Aoyama who is the former chairman of IEICE

- Keep your promises

  Both within the company and society, strictly keep you promises and you will be trusted and respected. Do not overstate your ability and always be modest.
- Be active and open-minded

  Be active to build your personal network. Take advantage of every opportunity such as conferences, exhibitions, meetings and so on. For me, drinking with colleagues and friends after work in Izakaya (Japanese style pub) is helpful to maintaining good human relationships. If you are living in Tokyo, there are lots of events, exhibitions, shows at which you can gather information and broaden your knowledge. Whatever your major is, knowledge in other fields may help boost your innovation.

## 5. Closing remarks

Writing this article has been a good opportunity for me to look back my life in Japan. I try, and will continue to try, to do my best to be a bridge between Japan and China. I believe that we all can benefit from cultural exchange. I hope that my personal experience and advice will give you confidence to really challenge your future. Please do not forget to enjoy the delicious foods and beautiful nature of Japan. (Forget the hard work!) I finish this article with my desk motto, "Stay hungry. Stay foolish." [6]

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# Life is Colorful, and Research is Cheerful

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## 1. Introduction

Never have I thought that I could have the opportunity to share some of my experiences on the "GLOBAL NEWSLETTER", please let me express my heartfelt gratitude.

First of all, I would like to briefly introduce myself. I was born in a beautiful town in JiangXi province, China. I obtained my Bachelor Degree in Computer Science and Technology at Tianjin University in 2004, and acquired my Master Degree at Peking University in 2007. After graduation, I came to Japan as a research engineer at Sony Digital Network Applications. Inc., and then I started to pursue my PhD degree at Waseda University in 2009. Have coming to Japan is my first time to be abroad, and the wonderful stay in Japan has broadened my horizon and influenced my way of thinking a lot. I would like to share my experiences in life, industry and research aspects.

## 2. Life in Japan

After graduation, I obtained a 3-month Japanese language training held by Sony, together with other Chinese freshman employees before coming to Japan. A strong fraternal bond has been created among us during this period. The company has also allocated us to the same company dormitory after setting foot on Japan, so we can always have parties celebrating festivals or birthdays, it has further strengthened our friendship.

Fig. 1 Autumn trip to Nikko, 2008

Together with these friends, I have enjoyed excellent sceneries in Japan a lot. In Springs, we are surrounded by the tender white or pink cherry blossoms far and near; in Summers, we are impressed by the wide blue seas, the romantic purple lavenders and the energetic yellow sunflowers; in Autumns, we are astonished by the amazingly beautiful red leaves in Kyoto; and in Winters, we are entertained by the excitement of skiing and the comfort of hot springs in the snow nation of Hokkaido. Under the help of these friends, I quickly overcame the solitary and oscillation probably caused by the first journey abroad, and adapted myself to enjoy the colorful life in Japan.

Fig. 2 Shariden at Kinkaku-ji, Kyoto

Fig. 3 Cherry blossoms at Chidorigafuchi Park, Tokyo

## 3. Industry in Japan

Japan is famous for cutting edge technologies, good quality consumer products and super advanced robots. I have been proud of getting a chance to work in one of its top manufacturers of consumer electronics. Only when you are involved in a real project could you understand that all the successes come from the traits of creativity, preciseness and diligence.

I was impressed a lot during embarking on my projects, the Japanese have tremendous amount of creativity, which allows them to think out of the box, and new technology can be created all the while. It is

said that Japanese pay attention to subtle details, which makes them produce many user-friendly products and designs. The Japanese are also kind and open-minded, as a foreigner, I am always touched by their kindness and the way of thinking. It is known to all that Japanese are hard workers, by investing lots of efforts and disciplines into the project, they can produce high quality products to the world.

**4. Research in Japan**

During my daily work, I gradually recognized my own deficiency, and I would like to learn more knowledge to improve myself. So I applied for the doctoral course in Computer Systems and Network Engineering at Waseda University.

In 2009, I started to study towards my Ph.D. degree. My research focuses on learning the economic behavior of the AP and users in wireless local area networks, and using a game theoretic approach for radio resource management. The objective is to improve overall network utilization by making more efficient uses of deployed resources [1].

The doctoral research is totally different from those in college life, because it requires the students to independently find out the problems in the existing system, think out solutions and solve the problems at last. Therefore, to develop an open-minded and independent way of thinking is quite essential to the doctoral research.


Fig. 4 ICACT2012 at Phoenix Park, PyeongChang, Korea

At first, I was studying as an on-job doctorate student; it has been a tough period to undertake both work and study at the same time, but it helps to shape me into a better person with well-trained mind and virtues like patience and consideration. Under the guidance of my advisors, I can schedule my doctoral research, to some extent, freely. As this is a totally new topic for me, I was engaged in collecting and reading theoretical books and papers, the novel ideas and excellent papers lead me into a new world of knowledge. I have been trying to find out the shortcomings of the current system, make brain-storming for ideas, model the problem mathematically, and make simulations to verify the proposed ideas.

Through attending both Domestic and international conferences, I can communicate with the experts in the realm, and also sharpen up my representation skills. The various seminars held in my lab also provide me with chances to discuss about the research progress with professors and classmates. These activities help to widen my views, improve the communication skills, and make me feel substantial and cheerful every day.

Fig. 5 Joint Summer seminar at Minami-Aizu, 2011

In 2011, I received the IEICE Young Researcher's Award for my two papers published in 2010 IEICE General Conference and in 2010 IEICE Communication Society Conference [2][3]. Winning this award really encourages me in my future research and I hope that the attention will also encourage other researchers with similar research interests. I am immensely grateful to my supervisor Prof. Yoshiaki Tanaka, my advisor Prof. Kyoko Yamori, and Dr. Sugang Xu. Without their support, collaboration and guidance, my doctoral research would not have been the same.

**5. Conclusion**

The experiences in both the colorful life and cheerful work and research will be always cherished by me, and I believe that they will benefit me in all my life. Moreover, I would like to continue obtaining more excellent experiences during my future stay in Japan.

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# Experiencing Campus Life in Japan

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## 1. Introduction

First of all, I would like to thank the editor of IEICE-CS Global Newsletter to give me the opportunity for writing this article.

When I was 23 years old, I left China to pursue my master education and professional career in France. In 2009, I was fortunately adopted as one of the Ph.D candidates of "The Future Leaders Program in the Fields of Global Information and Telecommunication Studies, Info-communication Industry and Info-communication Policy" in WASEDA University. From then on, I started a novel journey of study and life in Japan.

## 2. Eventful Campus Life

I am settled at the WASEDA Honjo campus, which locates near to the Honjo-Waseda station (Joetsu-Nagano-Shinkansen Line) [1]. In this campus, we have two nice buildings for laboratories, lecture rooms, and offices in Fig. 1. This campus is surrounded by the trees and hills. Sometimes, we even can see the monkeys, weasels, etc. Therefore, local people tell us that we are like in a natural zoo.

Unlike in Tokyo, the life in Honjo city is quiet, but there are various activities. The parties are favoured by all the students from different countries. At the end of year, the Christmas party is the biggest one, and many Honjo people will join us to celebrate together. During this time, we also can offer various specialties of national and international cuisine made by the foreign students, e.g., spring rolls of Vietnamese style, couscous, etc. that I have never known. So, the Chinese students also have a nickname for it that is Honjo gourmet festival. And, it is the most joyful and busiest day for all the residents in Honjo campus.

In season of Japanese cherry blossoms, we are always luckily invited by the Honjo international friendship association to attend the cherry blossom viewing (hanami) and rice cake making (mochitsuki) in Fig. 2. This is a good chance to taste and learn doing some traditional Japanese dishes. At the same time, there will be a small concert with playing Japanese instruments, e.g., shamisen. With the Japanese music and delicious food, we really enjoy ourselves on the whole day.

The near elementary and junior high schools often invite international students to make an introduction on their countries to the Japanese students. In return, they will play an impressive show. For example, we took the exchange event with Yotsuba Junior-High School (in Isesaki, Gunma) in Fig. 3. In this event, we learned

Fig. 1 WASEDA Honjo campus.

Fig. 2 Honjo hanami and rice cake making event in April 2010.

Fig. 3 Yotsuba junior high school visit event in August 2010.

from each other. They sang the "alma mater" (school song) and demonstrated the kendo (way of the sword) for us. Finally, we played the "trip to Jerusalem" (chair-occupying game) with the Japanese students, which seemed to transport me back to my childhood.

### 3. Research Life in Laboratory

Besides the enjoyment of these rich and colourful activities, we spend most of our time on the research work. In our laboratory (Tanaka laboratory), we are divided into four groups:

- Marat group: network measurement, monitoring, management, etc.;
- Yamori group: telecommunication pricing, teletraffic theory, QoS (Quality of Service), QoE (Quality of Experience), etc.;
- Xu group: optical wavelength switched network design, control, etc.;
- Yamamoto group: wireless, ad hoc communication networks, etc.

The team work is a key characteristic of our laboratory, which helps to efficiently organize and advance research work, because we can share the documents, discuss the ideas, and cooperate in simulation programs. Although, my researches are difficult, but each time I encounter problems, I always can get help from Professor Tanaka, Dr. Xu, and my teammates, and finally solve them quickly.

On every Tuesday, the laboratory seminar is held in Kikuicho campus. A quarter of members would report their research progress, and meanwhile professors will discuss with us and give some comments and advices. This also provides a good platform of interaction among the groups, which may results in producing good ideas.

The end of each semester is the harvest time. We are encouraged to publish papers in IEICE general or society conference where we can show our achievement to the academic community and industry. On the other hand, it is a good opportunity of studying the cutting-edge technologies and the tendency of latest researches. After one day of conference with high pressure and busy, we have a jolly time. The local famous restaurant is the most attractive. Here, we chat about our past, current, and future. There always will be lots of funny and amazing stories.

A joint summer seminar is scheduled at the end of every spring semester. We need ascend a mountain in Aizu plateau in Fukushima-ken (e.g., Fig 4). This seminar is also joined by other laboratories and professors. At the first night, if the weather is fine, there is a night market and a big fireworks show. If we feel tired, the hot spring is perfect for us to relax and recharge ourselves. The most exciting time is at the second evening when we have a drinking party. I think it is not only for toasting the end of the seminar, but also for celebrating the past academic year.

### 4. Conclusion

Two and a half years have passed since I started my study in Japan. The life in Japan feels like a mixture of bitterness and sweetness. The bitterness is due to the unfamiliar environment and difficulties in the research. However, the sweetness comes from the fruit of research work and having more and more friends. With the help of professors and friends, we become unafraid and determined in front of whatever difficulties life has given us.

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Fig. 4 Joint summer seminar in Minami-Aizu, Fukushima-ken in July 2011 [2].

# Motivation Vector and A Water-Flowing Rule

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**Abstract**

This article presents author's experience in research and daily life with a key point of motivation. A rule called "Water-flowing" applying for foreigners traveling in Japan with limited Japanese language is also introduced. Experiential tests show that the rule would be much correct in tourism places.

## 1. Introduction

Studying oversea, in developed countries with high quality education systems, would be an intense dream of many students, especially those who are from developing countries. This is because going aboard is an opportunity not only for mastering knowledge but also to open mind toward a bright future. By studying under supervision of leading professors with advanced facilities and techniques, a student would reach to a great success. However, in new environments, foreign students might also face to a number of challenging and difficulties such as language, culture, or pressure on work. These would, sometimes or somehow, affect seriously on students' education and daily life. In such case, one's motivation is a tremendously important factor that directs them toward the successful way.

In this article, I will share my experience in studying and daily life during a PhD program Japan with limited Japanese ability. During the whole journey, the motivation that I owned is a key point of success. Furthermore, a rule called “water-flowing”, found when I traveled in Japan, would be an interest point to share with foreign students.

My name is Dinh Thanh Le, a Vietnamese student studying in Japan. I had completed undergraduate and master courses in an university in Vietnam in 2006 and 2008 respectively. Soon after, I won a scholarship, and came to Japan in March 2009 for a doctoral course in The University of Electro-Communications, Tokyo. Recently, I have finished the PhD program and is just offered a research position in National Institution of Information and Communication Technology (NICT), Japan.

## 2. Motivation Vector

As normal as a life, one’s motivation also has up and down times. When it is up, people have a confident feeling and happiness in working or studying. However, when it is down, they may easily get stuck, and lose the confidence. Because of the changeable feature of motivation, I always consider it as a vector, naturedly called as "motivation vector". The important point in our work or studying is to maintain motivation vector toward the positive direction.

### 2.1. Starting point

Depending on each person, their motivation may come from different aspects. In my case, a spirit of getting out of poverty, and a dream of being a scientist would be the two main factors building up my motivation on work and study.

I was born and brought up in a poor village, where, two decades ago, even a black and white TV was such a luxurious thing and almost out of dream for us. In fact, this condition had a great effect on me, creating a strong motivation and urging me to study harder and harder. I believe that being a well-educated and skillful person would be a right way to get out of poverty.

Moreover, coming to Japan for a doctoral course, I am realizing my dream of being a scientist for not only discovering new knowledge but also transferring that knowledge to students. With an unyielding hope of success, I am enjoying doing research, and would try to do as much as I can.

### 2.2. Up and Down

For a long time, it is really hard to keep motivation always positive. Even for the most motivated persons, there are always times that the motivation vector goes up and down. Therefore, it is very important to maintain motivation vector toward a positive direction.

**The up time**

For PhD students, the time motivation vector goes up is obviously when we get good research results, going for conferences, receiving notification of accepted papers, passing PhD defense, or if lucky, receiving awards. These times are all very special because we can reach to ever a little success which makes our dreams come true.

I have many things to share for the up time of motivation of mine, but the most things I would like to share with PhD students, as I was being, is the time we go for conferences. No matter how big or small, local or international conferences, that would be the perfect chance to learn something new from other presentations, to discuss with leading professors in our major, and to make new connections with people in our fields. Being shy or hesitated to question in a conference would not be the right way of a motivated person. When I attended the IEICE society conference in 2009 in Osaka, Prof. Yoshio Karasawa - my supervisor - told me one thing that I still remember clearly. It is that if you want people giving comments

Fig. 1 Meeting Prof. Christos Christodoulou (center) in 2011 IEEE APS symposium

on your research, a good way is to discuss with them about their research first. That would be a very interesting way to exchange research ideas, and to make new connections.

I would love to mention here the time I went to the 2011 IEEE International Symposium on Antennas and Propagation and USNC/URSI National Radio Science Meeting, held in July, 2011, Spokane, Washington. Coming to the conference, and attending the welcome drink, I tried to make new friends, and introduced my research to them. At that time, I met Prof. Christos Christodoulou who currently is a professor in University of New Mexico, USA. We had some interesting discussions about cognitive radio antennas while drinking beers. Since then, I still keep in touch with him. We just met each other recently in the EuCAP 2012 conference, having some technical discussions and enjoying a view of Prague's most famous landmark together. That would be a great opportunity to make a new connection motivating the dream of being a scientist.

**The down time**

The down time occurs when we face to big difficulties. Motivation vector might be changed to the negative direction. People would be worried or sometimes lose confidence and get stressful. At that time, optimistic would be an important characteristic. We should keep our motivation strong and positive, and step by step trying to overcome the difficulties.

During my PhD program, there are also many times motivations getting down such as when I received notification of a rejected paper or homesick. However, the most serious time is the days after 11th Mar. 2011 when a huge earthquake happened, following by tsunami and nuclear plant disasters in Fukushima. At that time, many friends went back home, and I received calls after calls from parents. My motivation on work and study came to floor, replaced by a warried and uncertained feeling.

Fortunately, I had been learned a big lesson from my professor at that time. Three days after the earthquake, I came to university and saw that my supervisor, a typical Japanese, stills worked in his laboratory, even harder and harder despite of earthquake, tsunami,

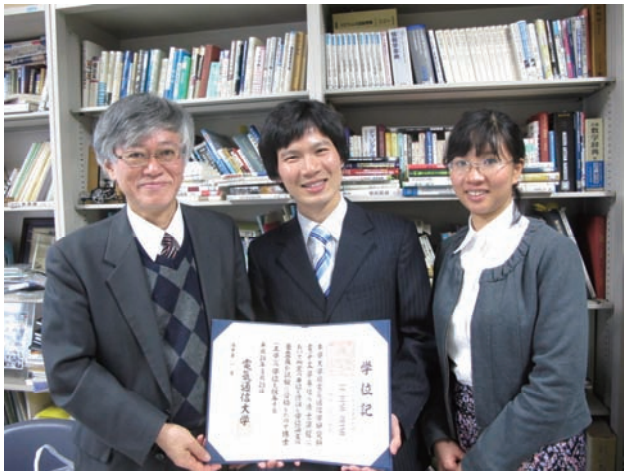

Fig. 2 Graduation day with Prof. Karasawa and my wife

nuclear meltdown, electric power cut off or so on. His image had a great effect on me, dispelling fears and worries, changing my motivation vector up and strong. I soon realized that a motivated scientist needs not only hard-working but also the brave characteristics.

After three years studying, I have successfully completed a PhD program. The knowledge, experience, and skills that I have gained during my doctoral course under Prof. Karasawa's guidance are invaluable in my professional work. On this occasion, I would like to express my sincerest respect and deepest gratitude to him for his continuous guidance and encouragement. They have been critical factors for me to open the door into the real science garden of the world. Indeed, it would be my greatest honor and privilege working under supervision of such a prominent scientist.

**3. Water-flowing Rule**

Living in Japan during a PhD course, I have found some interesting things, not only in research but also in daily life. In this part, I will share a funny rule named "water-flowing", applicable for people with limited Japanese language traveling in Japan.

**3.1. Basic idea**

The "water-flowing" rule suggests a simple way to find a famous place without asking local people or reading difficult kanji letters. The basic idea comes from the fact that water starts at high points and begins to flow down to lower points. As the water flows down, it may pick up more water from other small streams. These streams may slowly join together to form a larger stream or river. Small rivers and streams may join together to become larger rivers. Eventually all this water from rivers and streams will run into the ocean or an inland body of water like a lake [1]. Figure 3 shows the water streams with numbers indicating how small or large each stream is [2]. Let consider the destination (a famous place) as the ocean or a lake, the majority of people coming to the place as a river, and an individual as a small water stream, the simple way for a tourist to find the famous place is to follow the majority.

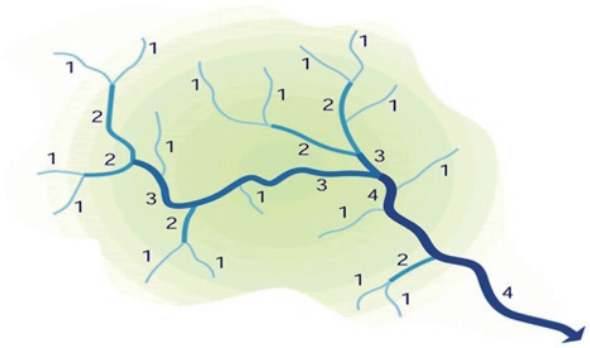

Fig. 3 Water stream [2]

### 3.2. Rule and Condition

In the first year in Japan, when traveling to some famous places such as Osaka Castle, Kyoto Kinkakuji Temple, I had a difficulty to communicate with local people to ask for help, or to read direction boards with full Kanji letters due to my limited Japanese ability. I had to help myself, and that was the time I found this interesting rule.

The water-flowing rule to find a famous place can be explanted as

*Nearby a famous place, one does not have to ask local people for direction to get there, but just to follow the majority*.

The condition to apply this rule is there must be a majority stream, and the destination should be a famous place or at least the place where a number of people are heading for, such as fireworks (hanabi), parks with special events likes flower viewing (hanami), or so on.

In general, people need to go there by bus or trains. Therefore, a good point to find the majority is to start from stations. A crowded train heading for the place should be a reliable signal to find the majority. There are also some other signals to recognize a stream depending on specified destinations. For example, if one is going to a place where fireworks are conducted, they should see Japanese people dressing kimono or yukata clothes as shown in Fig. 4. These people may have not formed a large stream but would be an expected signal to a main stream.

### 3.3. Experiential Tests

The rule has been found from the realty, and tested in several times. The tests have been carried in various places, including Tokyo Tower, Osaka Castle, Kinkakuji and Ginkakuji Temples in Kyoto, Eastern Great Temple (Tōdai-ji) in Nara prefecture, and some fireworks places in Tokyo and Osaka. Most of the tests show the correctness of the rule if the condition is fulfilled. However, there are also times I got lost when the main streams were not big enough. In these cases, the better way is try to speak Japanese as much as we can, or another way, we can use an iPhone with the maps application for sure.

## 4. Conclusion

Experience in research and daily life during a three-year PhD course in Japan of mine are presented in this article. For research, maintaining motivation vector up and strong would be a key point of success. For daily life, a “water-flowing” rule, applicable for foreign students with limited Japanese ability traveling in Japan has been introduced. The rule is experimentally tested in several famous places to verify the correctness.

Fig. 4 A stream heading for hanabi

Personally, I believe that the achievements of mine are very much humble, and the way of advancing my professional is still long and steep. But I will try my best for every step of the journey. To conclude this article, I would like to quote a sentence of Douglas Adams (1952-2001), a famous British comic writer: “I may not have gone where I intended to go, but I think I have ended up where I intended to be.”[3].

## 5. Acknowledgement

I would like to express my sincerest gratitude to IEICE Communication Society Global Newsletter for offering me a great opportunity to share my experience in research and daily life during a PhD course.

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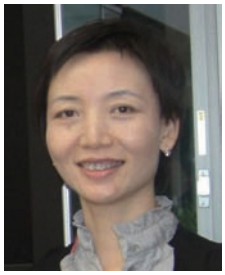
# Dream Building Labs

# - Center of Excellence with Delight and Passion -

Chen Lan
Director of AWS Lab, DOCOMO Beijing Communications Labs



## 1. DBL is a DBL

DBL is not just the acronym for DOCOMO Beijing Labs, it's for Dream Building Labs! Here in DBL, everybody has his dreams, and we are responsible for realizing those dreams into the reality.

## 2. Three Labs in DBL

Talents, rapidly developing technology on mobile communication, and huge and expanding market, are the major factors boosting the voice of China in the world. With this background, NTT DOCOMO established Beijing Labs in 2003 in order to fully collaborate with China, and reinforce its R&D.

DBL consists of three labs(Ref.[1])—Innovative Radio Transmissions Lab(IRT), Advanced Wireless System Lab(AWS), and Mobile Ubiquitous Communications Lab(MUC). IRT is focusing on multi-dimensional wireless access technologies, MUC is developing new and innovative technologies and pioneering new services and business models, while AWS aims to realize the 1000 times capacity enhancement from three dimensional approaches. Cooperative communication/enhanced MIMO improve the capacity from the spatial domain, heterogeneous network with interference coordination enables the feasibility from network density, while carrier aggregation realize the expansion from frequency domain, as shown in Fig.1.

There are 10 colleagues in AWS graduated from Tsinghua University, Beijing University of Post and Telecommunications, Xidian University and Harbin Institute of Technology. Among them, 50% are woman researchers, and 30% are Ph.D holders.

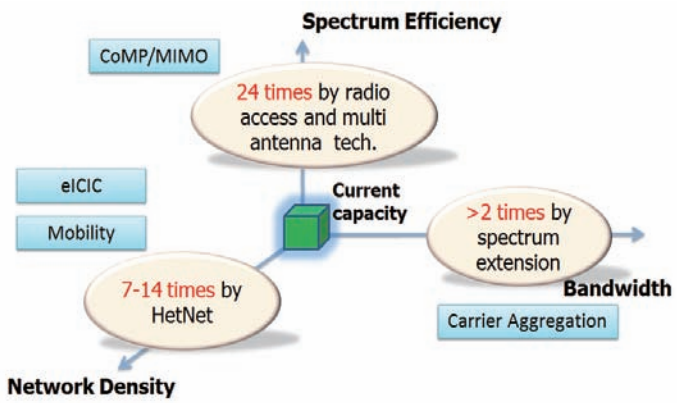



Fig. 1 AWS's focus on three dimensional approaches for capacity enhancement

## 3. Research Activities in AWS

Among the above three dimensions, Cooperative Multi-Point/MIMO technologies contribute greatly to spectrum efficiency enhancement.

AWS focus on CoMP feedback, interference measurement. Three main CoMP schemes are shown in Fig.2, including Coordinated scheduling/coordinated beamforming(CS/CB), Dynamic Point Selection(DPS), and Joint Transmission(JT). Common feedback framework to support all CoMP schemes, tolerable feedback overhead, and sufficient accuracy are required to be considered. On the other hand, in order to support CoMP transmission, interference outside of the CoMP measurement set is necessary to be measured. Currently we are now studying CQI feedback for CoMP considering the above requirement, and reference signal design for interference measurement.

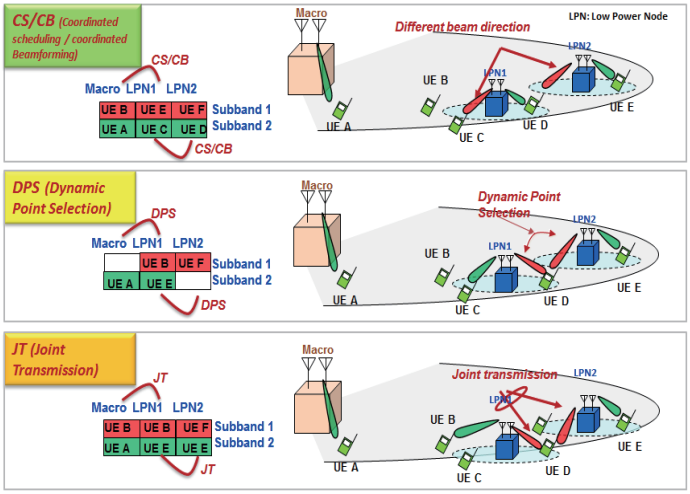



Fig. 2 CoMP schemes

Not only data channel, control channel is also necessary to be enhanced to support the capacity increase and considering new scenario like heterogeneous network. Unlike conventional control channel, ePDCCH (enhanced Physical Downlink Control Channel) is designed to use part of the resource blocks and occupy the remaining symbols of downlink shared channel (data channel) in one subframe, as shown in Fig.3. We are now conducting research on search space design among multiple control regions, and reference signal design to support localized and distributed ePDCCH, considering the frequency diversity gain and beamforming gain.

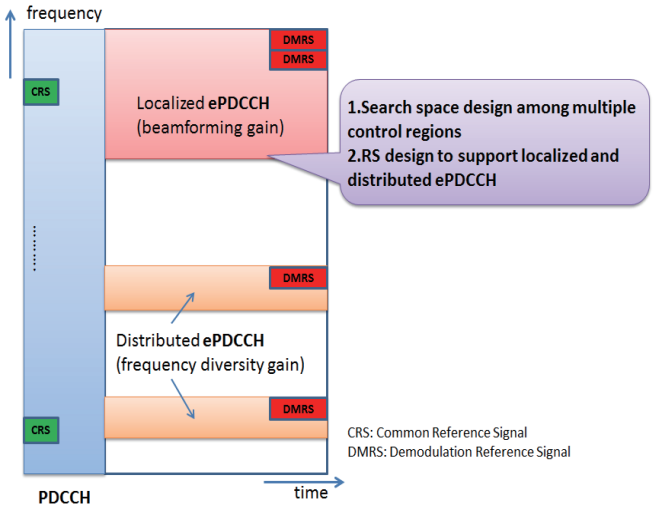



Fig. 3 Enhanced downlink control channel (ePDCCH)

## 4. Standardization Activities in AWS

As a research lab, it is very important to visualize the research achievement. Making proposals to 3GPP standardization is also a very important outlet, in addition to publishing journal papers.

There are three main benefits to do standardization oriented research. The first one is to contribution to the LTE evolution and benefit the commercial network of operators. The second benefit is to improve our technologies through online and offline discussion. Recently, the 3GPP RAN1 contributions include many innovative technologies which have not been shown in journal and international papers. Many companies are proposing their technologies in 3GPP. The number of contributions in recent RAN1 meeting reaches 900, and number of attendees reaches about 300. Fig. 4 shows the topics and distribution of RAN1 contributions of March meeting this year. We can see from this figure that CoMP, Carrier aggregation enhancement, and ePDCCH are hot topics discussed in 3GPP. The third benefit is to maintain high motivation of researchers. If our proposals can be included in 3GPP specification, our technologies will be used by the people in the world. This is really a great motivation to researchers.

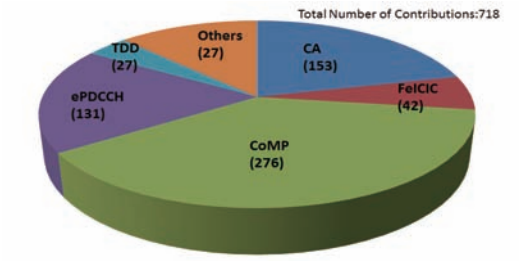



Fig. 4 3GPP RAN1 contributions in #68bis meeting (Jeju, Mar. 2012)

Meanwhile the hurdle of pushing our proposals into 3GPP standard is becoming higher since we have more and more rivals to face. Competitive and challenges polishes good proposals, and we are continuously improving our proposal and collaborating with other companies, trying to handle it in a strategic way. Another challenge lies in the evaluation work. System level simulation is becoming more complex and more time consuming. Needless to mention, the importance of system level simulation is quite clear. It is very essential to show the advantage of our proposed method directly. It also has another two important significances. One is to preclude unnecessary functions and make the system simple and effective. (This will benefit operators very much with low development cost), the other one is to lead the 3GPP trend and help to push new features into the enhanced release.

Understanding the benefits and difficulties of standardization related research, since 2006 we started to conduct the 3GPP R8 (LTE) related research and making proposals to 3GPP, through the tight collaboration with Access Group of Radio Access Network Development Division (RANDD). Discussion with RANDD colleagues usually further motivates us to improve our proposal since they have very rich experience on 3GPP standardization related research and their wide background on system development.

Table 1 shows the main research topics and our proposals being included in 3GPP R8 and R10. In the meantime, we conducted many simulation evaluation work on MIMO dimensioning and transparency, in order to preclude the unnecessary large dimension and non-transparency. In the beginning of R11, we showed the gain of CoMP by average throughput and edge UE throughput under homogenous network and heterogeneous network, which successfully contributed to the setup the CoMP work item in R11.

Table 1 Our research topics towards LTE and LTE-Advanced (Ref. [2-8])

| System | Release | Main field | Proposals included or being discussed |
|---|---|---|---|
| LTE | R8 | DRX CDD | DRX control signaling, CDD for MIMO precoding |
| LTE-Advanced | R10 | MIMO, CA | MIMO Downlink signaling, HO signaling to support CA |
| | R11 | CoMP, ePDCCH TDD CA | CoMP feedback, interference measurement, ePDCCH search space design, TDD CA cross carrier scheduling |

R11 will be finalized in this September, currently we are going all out to further improve our proposals including CoMP feedback, interference measurement, ePDCCH search space design, and TDD CA (as shown in Table 1).

## 5. Collaboration with Local Institutes

In additional to the research work, we are promoting the collaboration with local institutes by joint research with important universities on LTE-Advanced topics,

and exchanging views with operators and vendors. Recently the number of participants in 3GPP from Chinese companies has reached 10%, and number of contributions has reached 20% in total, the voice from China becomes stronger and more powerful. With information exchange and discussion on 3GPP contributions, we successfully co-sourced with Chinese companies, and finally our contributions are agreed at 3GPP.

Furthermore, we also contribute to the technical forums including FuTURE FOROM(Ref.[9]) and UNITed FORUM. We are submitting technical papers, making presentation in seminar/workshop. Meanwhile, as the only one Japanese company in the board members, DOCOMO are continuously supporting the collaboration among Japan and China since 2006 from the first Sino-Japan Future mobile communication workshop, proposed by Prof. Yoshida Susumu of Kyoto University and Prof. You Xiaohu of Southeast University. Our contributions are recognized and awarded. Fig. 5 shows the award of contributions from FuTURE forum, and best paper award from Chinacom 2011.


Fig. 5 FuTURE Forum Contribution Award in 2010 and Best Paper Award in Chinacom 2011

## 6. Dream Building with Delight and Passion

Confucius, the saint of 2000 years ago, pointed out that “He who knows the truth is not equal to him who loves it, and he who loves it is not equal to him who delights in it.” Through this, I understand the close relationship between passion/love and quality of research work. To do good research with persistence and strong determination, we need to be really in love with the research we are focusing, or we could not discover the inherent value and treasure which others otherwise could not find, and continuously build our dreams and overcome obstacles.

In DBL, our dream of making our technologies used by the world is the source of both our passion and love towards research work. The persistence in building this dream will also shape DBL into a center of excellence.

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[4] 3GPP, R1-103257, “Consideration on DCI Design for DL MIMO in Rel-10”, May 2010
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[7] 3GPP, R1-121476, “On the Need of Common Search Space for E-PDCCH”, Mar., 2012
[8] 3GPP, R1-121464, “PDCCH Enhancement for Different TDD UL-DL Configuration on Different Bands”, Mar., 2012
[9] http://www.future-forum.org/en/

# Activity of Fujitsu Research and Development Center in China

Satoshi Naoi
FUJITSU Research & Development CENTER CO., LTD.

## 1. Introduction

Fujitsu Research & Development Center Co., Ltd (FRDC) is a China based research center, wholly owned by Fujitsu Limited , and was established in 1998. There are three laboratories, located in Beijing, Shanghai, and Suzhou, respectively, where the number of members in total is more than 100.

Rapid development of information and communication technologies (ICT) has brought fundamental change to our lives. We are now welcoming a new era of ubiquitous communication, where the existence of computer networks is no longer noticeable. Looking forward to the future, we continue to pursue the development of the most advanced technologies to support our ICT-based society.

Fig. 1 FRDC Beijing


Fig. 2 FRDC's three laboratories

## 2. Research fields

In FRDC, we are engaged in various research and development projects to support and benefit Chinese society. Our main research areas are next generation services and solutions, software technologies, advanced network and device platform technologies.

### 2-1 Next-generation communication systems

To support the realization of ubiquitous society, we are developing large capacity, high speed, flexible next generation wireless and optical communication system. In close cooperation with Fujitsu worldwide and universities in China, we are doing intensive R&D on: international mobile telecommunications-advanced

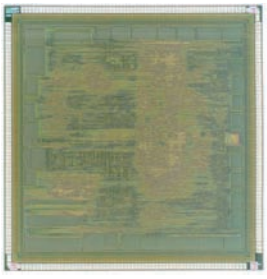
(IMT-Advanced), broadband access, Radio Frequency (RF) transmitter and receiver, near field communication such as Ad-hoc network and body area network and personal area network (PAN/BAN) in wireless field, and high capacity optical communication system.

### 2-2 Information Processing

With the arrival of the information explosion and the age of cloud computing, we are now surrounded by various vehicles for information such as the internet, newspapers, and advertisements, which bring abundant data in diverse formats (text, image, sound, etc.). We are dedicated to developing technologies that are used to efficiently process mass data and extract useful information and knowledge. Meanwhile, we are devoting ourselves to key technologies such as software as a service (SaaS) and cloud computing for innovative information processing platforms, and cooperating with other subsidiary companies to promote our R&D results in the China market. Our research scope covers natural language processing, WEB information processing, cloud computing, multimedia information processing, speech processing and optical character recognition (OCR).


### 2-3 System LSI technology

We are quickly stepping into an intelligent society which brings us a safe and comfortable life. The system requires large scale integration (LSI) to realize a wide variety of intelligent functions with low power feature. We are focusing on R&D of system LSIs for intelligent applications with image, video, audio, and graphics processing capabilities; including video & audio codec, graphics processor, imaging application processor, and sensor signal processor, with the vital feature of high performance, ultra low power, and small size.



### 3. Collaboration in China

FRDC creates cutting-edge technologies for a safer and more comfortable future society. We engage in joint R&D collaborations with highly qualified and top level Chinese research institutes and universities, government, and local companies to develop and promote these technologies.

We have a strong relationship with local institutes and universities, such as the establishment of joint research center with Peking University in 2006, engaged in the research of information science and technology. In addition, we have developed various collaborations with many famous universities (Tsinghua University, Beijing University of Posts and Telecommunications, Shanghai Jiao Tong University, China Academy of Telecommunication Research, Chinese Academy of Sciences, etc), covering such substantial research aspects as wireless and optical communications, cloud computing, and LSI relevant technologies. Meanwhile, we are encouraging good communication with Chinese local government, cultivating our business in China. To beneficially grasp our market opportunities and massively earn our business profit, we are successfully collaborating with local companies (Fengyun, Kingsoft, etc), by jointly establishing the cloud computing and SaaS related projects.


Fig. 3 Peking University - Fujitsu joint research center

As the largest one of Fujitsu's overseas laboratories, we hold a global vision and commit the ideal of “shaping tomorrow with you” to contribute the creation of value to our customers. Connecting to our real-world surroundings, we realize a "human centric" networked society that delivers experience, discovery, reliability and growth.

# Renewal of Sister Society Agreement between IEICE-CS and CIC (China Institute of Communications)

Hidetoshi KAYAMA and Takao NAITO
Director, Planning and Member Activities, IEICE-CS

## 1. Overview

This letter reports the renewal of the sister society agreement between IEICE-CS and CIC (China Institute of Communications). In 2008, the first sister society agreement between them was concluded, and it had been effective since 2009 to the end of 2011. The signing ceremony was held at Shanghai Tong Mao Hotel on February 23, 2012. With this renewal, the second agreement will be effective to the end of 2014.

## 2. Signing ceremony at Shanghai Tong Mao Hotel

From CIC, the Chairman, Prof. Deqiang Zhou , Vice chairman, Prof. Zhen Yang (also the president of Nanjing University of Posts and Telecommunications), Deputy Secretary Generals, Ms. Naiqi Song and Mr. Meizhuang Zhao, and Deputy Director of Academic Department, Ms. Yanxia Li attended the signing ceremony while from IEICE-CS, the President, Dr. Kazuo Hagimoto and Director of Planning and Member activities, Dr. Hidetoshi Kayama were present. Before the ceremony, the chairman Prof. Zhou introduced the current status and activities of CIC. He mentioned that he hopes this opportunity will cement the cooperative relationship between communication societies of our two countries. He also mentioned that the development of communication technology is very fast, so both of the societies are expected to contribute in this field continuously. The president Dr. Hagimoto introduced an overview of IEICE-CS including latest academic activities and international cooperation. He also mentioned that he expects the cooperative relationship between two societies will have more deeply involved with each other by the collaboration on international conferences and so on. Then the signing ceremony of the sister society agreement renewal was conducted in a friendly atmosphere.

## 3. About other sister society agreements

Currently IEICE-CS has five sister societies agreements concluded with IEEE ComSoc, KICS, KIEES, VDE/ITG and CIC (in the order of the initial conclusion date) respectively. Each sister society agreement includes mutual privileges of conference registration and paper submissions fee, promotion of their publications, and further cooperation with each other. In addition to such main agreements, side agreements which introduce the discount rates of membership annual fee are concluded with ComSoc, KICS, and VDE/ITG so far.

As a part of international activities, IEICE-CS will continue to construct a close and mutually beneficial relationship between all sister societies in the future. At the same time, the IEICE-CS hopes that many overseas members of “Sister Societies” will join in the IEICE-CS as a member and also participate in the IEICE-CS related international conferences/meetings.

Figures: Signing ceremony of sister society agreement between IEICE-CS and CIC

From left to the right on the left picture; Prof. Deqiang Zhou (Chairman of CIC), Ms. Naiqi Song (Deputy secretary general of CIC), Prof. Zhen Yang (Vice chairman of CIC and President of Nanjing Post and Telecommunications University), Mr. Meizhuang Zhao (Deputy secretary general of CIC), Dr. Hidetoshi Kayama (Director of planning and member activities of IEICE-CS), and Dr. Kazuo Hagimoto (Prescient of IEICE-CS),

# Report on NS English Session at 2012 IEICE General Conference - BS-3 Management and Control Technologies for Innovative Networks -

Kazuhiko Kinoshita[*], Masaki Bandai[**], Takashi Kurimoto[***], Shigeo Urushidani[+], and George Kimura[++]
[*]Osaka University, [**]Sophia University, [***]NTT, [+]NII, [++]NTT West

## 1. Introduction

IEICE Technical Committee on Network Systems (NS) [1] hosted a complete English Session as one of the Symposium Sessions of Communication Society at the 2012 IEICE General Conference. It was entitled "BS-3 Management and Control Technologies for Innovative Networks".

## 2. Background

The committee has held such English Sessions since 2005, and improved it gradually. The purpose of this Session was to promote the globalization of IEICE by providing the participants staying in Japan or joining from overseas with more opportunities of presentations and discussions in English.

This year, the Session included 14 consecutive subsidiary sessions and lasted for three and a half days during the conference. The number of papers in the Session has increased every year and was 43 this year. Table 1 lists the historical theme and number of presented papers.

Table 1 History of NS English Session

| Year | Theme | # |
|---|---|---|
| 2005 | Network Controls for High-Quality Communications | 11 |
| 2006 | Technologies and Architectures for Ubiquitous Network Systems | 19 |
| 2007 | Traffic Measurement, Analysis and Network Controls for Comfortable Network | 12 |
| 2008 | Network Management Technologies for Next Generation Network | 20 |
| 2009 | System, Control and Design Technologies for Emerging Network | 34 |
| 2010 | Emerging Network Technologies for Ambient Information Society | 34 |
| 2011 | Network Design, Management and Control for Future Networked Systems | 43 |
| 2012 | Management and Control Technologies for Innovative Networks | 43 |

## 3. Topics and Statistics

The Session included many types of technical topics such as mobile and wireless networks, sensor networks, optical networks, traffic analysis, network control and management, content delivery and distribution, P2P, network applications, and network security.

Almost 83% of the speakers (36 out of 43) were international students studying in Japan or non-Japanese researchers working at Japanese companies/universities.

## 4. Conclusion

The NS English Session was very successful due to many excellent papers and active discussions. The organizers believe that this activity is advantageous for all attendees and effective for the globalization of IEICE.

Finally, special thanks go out to Prof. Yoshiaki Tanaka, who contributed greatly in the call for papers by using his nation-wide academic influence and human relations.

## 5. Reference

[1] IEICE Technical Committee on Network Systems web site, http://www.ieice.org/~ns/eng/.

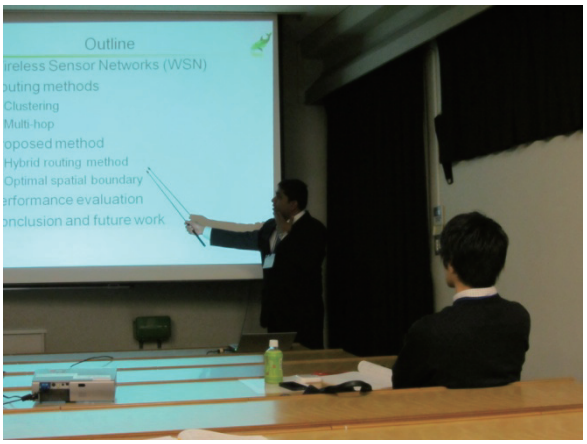



Fig. 1 Presentation

Fig. 2 Discussion

# Report on Photonic Network Symposium 2012

# - 100Gbit/s Fiber Optics and Competitive Power in Global market -

Hisaya Hadama
Executive Manager, NTT Network Innovation Laboratories

## 1. Introduction

Photonic Network Symposium 2012 -100Gbit/s Fiber Optics and Competitive Power in Global market- was successfully held at YRP Hall in Yokosuka Research Park (YRP), Japan on March 15, 2012. The most advanced photonic technologies which will support next generation high-speed and large capacity transmission systems were overviewed by distinguished guest speakers. It was organized as the first joint forum by Ministry of Internal Affairs and Communications (MIC) and IEICE Communications Society in collaboration, and cosponsored by National Institute of Information and Communications Technology (NICT) and YRP R&D Promotion Committee. The number of participants reached 204 and they joined hot discussion with speakers.

Mr. Shigeyuki Kubota, Director General of MIC inaugurated the Symposium and referred to the national policy of photonic technology development and expectations of YRP activities in the field. Prof. Hiroshi Yasuda, President of IEICE gave a guest speech and stated the increasing dependability on networks required through the experience of huge disasters and the expected role of photonic technologies.

Fig. 1 Mr. Shigeyuki Kubota inaugurated the Symposium, and Prof. Hiroshi Yasuda gave a guest speech.

## 2. Keynote and Invited talks

Keynote Speech was given by Prof. Kazuro Kikuchi, University of Tokyo. He overviewed the worldwide R&D activities of fiber optics and introduced the detailed historical R&D background of digital coherent optical communications with the fundamental knowledge and state of art technologies, proposed issues for implementation of higher speed and larger capacity communications.

Special Lecture was given by Dr. Tetsuya Miyazaki, Leader of Photonic Network Group, NICT. He introduced NICT's R&D activities toward the New Generation Network covering its architecture, network virtualization, the next phase Giga-bit network test bed JGN-x and photonics, and referred to new network concepts and updated technologies represented by elastic network, multi-core fiber, optical packet/path integrated node.

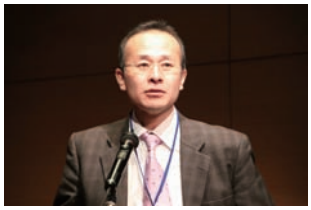
Fig. 2 Prof. Kazuro Kikuchi giving Keynote Speech

Fig. 3 Dr. Tetsuya Miyazaki introduced NICT's R&D activities

## 3. Technical session

Successively, five Technical Lectures on optical transmission technologies were given by distinguished guests. At first, Dr. Masahito Tomizawa, NTT Network Innovation Laboratories introduced concept of DSP (Digital Signal Processors) for the 100Gb/s digital coherent optical transmission. He showed proof that the interoperability of transceivers made by multiple vendors was confirmed. Dr. Kiyoshi Fukuchi, NEC System Platform Research Laboratories referred to the development details of wave length dispersion compensation capabilities effective even at extremely high speed modulation rates. Dr. Hiroshi Onaka, Network Product Business Unit, Fujitsu Limited introduced essential technologies implemented on the DSP covering transparent client signals forwarding, photonic address switching, polarized wave processing and transceiver based on the technologies. Dr. Takashi Mizuochi, Information Technology R&D Center, Mitsubishi Electric Corporation introduced error correction technologies for optical communications,

Forward Error Control capabilities implemented on the DSP with his idea of 'Economic Shannon Limit. Dr. Shinji Nishimura, Telecommunications & Network Systems Division, Hitachi Limited introduced ultra-high speed and low power photonic transmission technologies for 100Gb/s Ethernet as the result of MIC commissioned research project.


Dr. Masahito Tomizawa


Dr. Kiyoshi Fukuchi


Dr. Hiroshi Onaka


Dr. Takashi Mizuochi


Dr. Shinji Nishimura

Fig. 4 Distinguished speakers gave Technical Lectures

## 4. Panel discussion

Panel Discussion on evolving photonic technologies deployed for the future business and industries was held by distinguished guests including Mr. Isao Sugino, Director of R&D Office of MIC, Mr. Shigeru Iwashina, Research Laboratories, NTT DoCoMo and the above mentioned five lecturers with the initiative of Moderator, Mr. Kazuo Hagimoto, Executive Director of NTT Science and Core Technology Laboratory Group, and President of IEICE Communications Society. As a result of discussion on the roles of Government, Academia and Industries, network virtualization, preferable relation between wireless and photonic networks, standardization strategy and the other issues, the expectation of open innovation and the survivability of networks in a disaster were pointed out to be important.

Fig. 5 Mr. Kazuo Hagimoto, chairing the session


Mr. Isao Sugino


Mr. Shigeru Iwashina

Fig. 6 The panel discussion was moderated by Mr. Hagimoto, and many vibrant Q&A are exchanged.

## 5. Exhibition

Seven organizations; NTT, NEL, NEC, Fujitsu, Mitsubishi Electric, Hitachi and NICT exhibit distinguished outcomes of photonic transmission technologies as the result of MIC commissioned research project. Most of those results are detailed explained in the technical session.

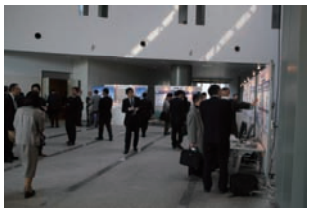


Fig. 7 Participants discussing research outputs at the exhibition sites

## 6. Conclusion

Photonic Network Symposium 2012 was successfully held at YRP. State of the art technologies, which realize 100Gb/s photonic transport systems, are detailed by the distinguished speakers. Business strategies and the other issues are also discussed with eager audience.

Dr. Hiroshi Kumagai, Vice President of NICT gave Closing Remarks of the Symposium.


Fig. 8 Dr. Hiroshi Kumagai giving closing remarks

# Report on 28th IN/NS Research Workshop

Tomonori Takeda[†], Takashi Kurimoto[†], Masaki Bandai[††],
Shigeo Urushidani[†††], George Kimura[††††], Masashi Toyama[†], Junichi Murayama[†],
Kazuyuki Tasaka[†††††], Kenji Hori[†††††], Tohru Asami[††††††],
and Hikaru Suzuki[†††††††]

[†]NTT Corp., [††]Sophia Univ., [†††]NII,
[††††]NTT West Corp., [†††††]KDDI R&D Laboratories Inc., [††††††]The Univ. of Tokyo, and
[†††††††]NTT Communications Corp.

## 1. Introduction

The 28th IN/NS Research Workshop took place in Miyazaki, Japan, on March 7-8, 2012. The workshop was sponsored by the technical committees on Information Networks (IN) and Network Systems (NS) of the IEICE Communication Society. The workshop's aim was to discuss the technical direction and research topics for future networks. It was held after The World Telecommunications Congress (WTC). A record showing of 142 participants underscored the success of the workshop. The overall theme was "Useful ICT technology for emerging countries in the near future - using the experiences of Japan." The workshop featured invited talks, overviews of the talks, and a panel discussion.

Fig. 1 Workshop

## 2. Invited speakers

The general chair of the workshop, Hikaru Suzuki (NTT communication Corp.), invited six distinguished experts involved in ICT technology and globalization of R&D strategy. These speakers addressed new challenges in globalization of R&D strategy from the viewpoint of using Japanese ICT technologies for an emerging country from academic, political, and industrial perspectives. Figure 2 shows photographs of the speakers.


Fig. 2 Invited speakers

- Specially Appointed Prof. Hideyuki Oku (Tohoku Univ.) presented internationalization of a Japanese ground-digital-broadcasting system.
- Prof. Koji Okamura (Kyushu Univ.) presented the effect of a high-speed network for international research/education at Kyushu University Hospital.
- Visiting Prof. Fujio Maruyama (Waseda Univ.) discussed network media and commerce - trends in copyright and privacy problem.
- Associate Prof. Kensuke Nishioka (Miyazaki Univ.) presented future low-cost photovoltaics.
- Dr. Hideyuki Iwata (TTC) addressed a case study of ICT utilization in rural Southeast Asia.
- Dr. Shin Miyakawa (NTT communications Corp.) discussed the status of the drain of IPv4 address and introduction of IPv6.

## 3. Panel discussion

As the chairperson, Mr. Suzuki organized the panel discussion. He and the six speakers took their seats as panelists, and the audience filled the hall.

First, Mr. Suzuki gave the theme of the discussion to the panelists: “Useful ICT technology for emerging countries in the near future - using the experiences of Japan.” The panelists then expressed their opinions from their own perspectives, and actively discussed the issues involved. In addition, they answered various questions from the audience.
The discussion showed that there is increasing interest in the R&D strategy of the manufacturing industry.


Fig. 3 Panel Discussion

**4. Conclusion**

This year’s workshop invited key persons to speak on the R&D strategy of the manufacturing industry from the viewpoint of Japanese experiences. We believe that the presentations given by the invited speakers and the panel discussion provided fruitful insight into research and development.

The technical committees on NS and IN plan to hold next year’s workshop in March 2013. Finally, we would like to express our gratitude to the workshop committee members, particularly to, Toshiki Usui (Oki), Naoyuki Saitou (NEC), Hiroshi Kawazoe (Toshiba), Satoshi Imai (Fujitsu) and Ryoichi Tanaka (Hitachi) who made this workshop possible.

Fig. 4 Audience-filled hall

# Annual Report of Technical Committee on Information Networks

Masashi Toyama† and Junichi Murayama†, †NTT Corporation

## 1. Introduction

The technical committee on Information Networks (IN) is one of technical committees of the Communications Society of the IEICE [1]. The IN addresses a broad spectrum of issues associated with information networks and provides a forum for researchers and engineers to discuss various research and development topics. The chairman is Mr. Hikaru Suzuki of NTT Communications Corporation. The vice chairman is Prof. Tohru Asami of the Univ. of Tokyo. The secretaries are Dr. Junichi Murayama of NTT Corporation and Mr. Kenji Hori of KDDI R&D Laboratories Inc. The assistant secretaries are Mr. Masashi Toyama of NTT Corporation and Dr. Kazuyuki Tasaka of KDDI R&D Laboratories Inc. This document presents the IN's annual report for activities from April 2011 to March 2012.

## 2. IN Activities

The IN is one of the most active technical committees of the IEICE Communications Society. The IN held two-days technical meetings 10 times from April 2011 to March 2012. Some meetings are co-organized with other technical committees such as RCS, NV, NS, CS, MoMuC and IA. Irrespective of the influence of the Tohoku earthquake, many researchers participated in the meetings and reported their latest technical research and development results. The venues and the main topics of each meeting are shown in Table 1.

Each technical report is submitted in a paper and published as a Technical Report of the IEICE. Authors of selected papers have received Information Networks Research Awards in which the ceremony is held in March every year.

Fig. 1 Winners of IN Research Award
(from left to right) T. Inoue, N. Kamiyama, Y. Ikeda, H. Suzuki (chairman), E. Adachi, R. Hamamoto, C. Takano, M. Aida, K.Ishida

This year, the following 4 excellent papers were selected from 195 papers.

- Takeru Inoue and Shinichi Minato, "Server load balancing with a URL shortener in Tohoku earthquake."
- Yasuhiro Ikeda, Noriaki Kamiyama, Ryoichi Kawahara, Tatsuaki Kimura and Tatsuya Mori, "Analyzing Correlation among TCP Quality Metrics on Measured Traffic Data"
- Ryo Hamamoto, Chisa Takano, Masaki Aida and Kenji Ishida, "On Guaranteeing Asymptotic Stability of Cluster Structure by Autonomous Decentralized Structure Formation"
- Eriko Adachi and Hitoshi Aida, "An approach for traffic modeling and ensuring connectivity during disasters"

## Reference

[1] Technical Committee on Information Networks http://www.ieice.org/cs/in/eng/

Table 1 Technical meeting schedule

| Date, | Venue, | Main topics, | Num. of reports, | Num. of participants each day, |
|---|---|---|---|---|
| Apr. 21-22 | Kagawa Univ. (Takamatsu) | Mobile network, Home network, Ubiquitous network, etc. | 17 | 23, 28 |
| Mar. 26-27 | Kikai-Shinko-Kaikan Bldg. (Minato) | Wireless Internet, Multi-hop network, Mesh network, Network coding, Cross layer technique, Wireless communication, etc. | 9 | 60, 68 |
| Jun. 16-17 | Aichi Pref. Univ.(Nagakute) | Quality control, Congestion control, Reliability technology, IPTV, Contents network, etc. | 16 | 36,31 |
| Jul. 21-22 | Hokkaido Univ. (Sapporo) | IPv6, Photonic network system, New/Next-generation network, etc. | 19 | 40, 31 |
| Sep. 1-2 | Tohoku Univ. (Sendai) | Post IP networking, Next-generation network, Network model, Internet traffic, TCP/IP, Multimedia communication, Network management, Resource management, Private network, Network security, etc. | 11 | 69, 59 |
| Oct. 20-21 | Osaka Univ. (Suita) | TCP/IP, Protocol, Routing, Network management, Authentication/Identity management, etc. | 15 | 46, 39 |
| Nov. 17-18 | Fukuoka Institute of Technology (Fukuoka) | Home network, Ubiquitous network, Cloud computing, Context awareness, Location information service, E-commerce, etc. | 12 | 53, 31 |
| Dec. 15-16 | Hiroshima City Univ. (Hiroshima) | Internet measurement, Network management, Network security, Traffic theory, etc. | 12 | 52, 52 |
| Jan. 26-27 | Asahikawa Terminal Hotel(Asahikawa) | Overlay network, P2P network, Autonomous distributed network, etc. | 15 | 25, 23 |
| Mar. 8-9 | Miyazaki Seagaia (Miyazaki) | General topics and workshop | 69 | 207, 179 |

# Report on 3rd Workshop of Internet Architecture in Dalian, China

Masahiro HIJI
Hitachi East Japan Solutions, Ltd. / Tohoku University

## 1. Introduction

The Technical Committee on Internet Architecture (TCIA) has held workshops every year since 2009, aiming at further internationalization of IEICE. The workshop has played an important role to promote discussion on Internet and its applications among researchers and practitioners from the academic, industrial, public and governmental sectors in Asian region. TCIA held the 3rd international workshop at Dalian University of Technology in Dalian, China on October 20 and 21, 2011.

## 2. Workshop overview

Prof. Zhongxuan Luo, Dean of the School of Software Technology, Dalian University of Technology, gave the opening address. He introduced the IT industry of Dalian, and IT engineer education. This two-day technical program included two invited talks, English presentations on six technical papers and Japanese presentations on two technical papers. The topics of the invited talks were the following Internet applications.

- "BPO steps over Japan and China" by Mr. Shin Aoki, Genpact
- "Improving Medical Services and Applications A Case Study in Thailand" by Prof. Sinchai Kamolphiwong, Prince of Sonkla University

Mr. Aoki talked about BPO (Business Process Outsourcing) business that occupies an important position in the IT industry in Dalian. Prof. Sinchai presented an on-going project on e-healthcare in Thailand.

There were three English sessions of technical papers: Performance Measurement, Network Protocol, and System Design and Applications. The Japanese session included presentations by Chinese engineers, who talked about offshore development in Chinese companies. This session was based on the experiences and findings of offshore development in Dalian for their Japanese clients. In this presentation, they showed that they found no problem in communication with their Japanese clients throughout the development process.

The student research awards were presented by the chair of program committee, Prof. Yamazaki, at the end of the workshop.

In total, there were about 30 attendees. Attendees had fruitful discussions during the technical program. In addition, on the evening of Oct. 20, a banquet was held at Middle Hailou restaurant, where attendees enjoyed delicious Chinese seafood cuisine.

## 3. Conclusion

We believe that all participants were satisfied with the presentations and discussions. TCIA thanked all the speakers and participants for their efforts. On October 18 and 19, 2012, the 4th workshop of Internet Architecture will be held at Prince of Sonkla University in Phuket, Thailand. Detailed information can be found in http://www.ieice.org/~ia/phuket2012/wiki.cgi.

Fig. 1 Opening address by Prof. Zhongxuan Luo

Fig. 2 Student research award ceremony

Fig. 3 Workshop participants

# Report on World Telecommunications Congress 2012 (WTC 2012)

Noriaki Kamiyama and Kohei Shiomoto
NTT Service Integration Laboratories, NTT Corporation

## 1. Introduction

This article reports on the successful holding of the World Telecommunications Congress 2012 (WTC 2012) in Miyazaki, Japan on Mar. 4 - 7, 2012, technical co-sponsored by VDE and the IEEE Communications Society.

## 2. Concept and Brief History of WTC

This congress started in 2006 in Budapest, Hungary after the International Switching Symposium (ISS)/WTC and the International Symposium on Services and Local Access (ISSLS) merged. WTC builds on the traditions of quality, timeliness, and open interaction from its origins in ISS/WTC and ISSLS. The distinct feature of the congress is that many people, from companies' executives to young researchers, get together to discuss the current situation and future directions of telecommunication network technologies.

## 3. Outline

- Congress title: World Telecommunication Congress 2012 (WTC 2012)
- Organizer: WTC 2012 Local Executive Committee (International steering committee is organized by representatives from USA, Germany, Austria, Italy, UK, Hungary, Australia, Korea, Belgium, Netherlands, Sweden, and Japan)
- Sponsor: the IEICE Communications Society
- Technical co-sponsors: VDE and IEEE Communications Society
- Date: Mar. 4 to Mar. 7, 2012
- Venue: Phoenix Seagaia Resort, Miyazaki, Japan
- Registration: 250 attendees
- Participating countries: Japan, USA, France, Italy, Korea, Sweden, Taiwan, Hungary, Indonesia, Germany, Norway, Austria, Cameroon, China, Finland, Ghana, Thailand, UK, Venezuela
- Program and number of sessions: Opening (1), Keynote (2), Invited (2), Technical (10), Poster (2), and Workshop (6)
- Papers (technical sessions): submitted (70) accepted (40)
- Exhibition: 7 companies
- URL: http://www.ieice.org/~wtc2012/

## 4. Session report

In this congress, a wide range of current technology trends was covered, for example, wireless, M2M, cloud computing, security, network virtualization, optical, and routing. In the poster sessions, 30 poster papers with a variety of topics were presented. Moreover, two workshops with the title "Cloud Computing in the Telecom Environment, Bridging the Gap" and "Software Defined Networks (SDN) and OpenFlow" were also held before and after the main congress. In the workshops, 21 speakers, including major world vendors, made presentations and high-level discussion followed. In the two invited sessions focusing on LTE and disaster recovery, 7 speakers were invited. In the LTE invited session, the status of LTE deployment at NTT DOCOMO and telecom Italia were discussed. In the disaster recovery invited session, the restoration status of damage caused by the Great East Japan Earthquake and trust issues in disaster communications were presented.

The details are described below.

Opening remarks by Dr. Kou Miyake

(1) Keynote session

In the morning of each day, a keynote session was held, and 7 invited speakers gave keynote addresses. The opening session started with opening remarks by Dr. Kou Miyake, General Chair of WTC 2012. Dr. Dave L. Waring gave an overview of the technical program followed by the keynote session.

In the first keynote speech, Dr. Eiji Kuwana, Vice President, General Manager of NTT Information Sharing Platform Laboratories gave a talk on emerging cloud computing technologies such as network virtualization and the open source cloud computing platform. In the second keynote speech, Mr. Toshiyuki Kanoh, Executive Chief Engineer, NEC, introduced a future internet platform technology, "OpenFlow". In the third keynote speech, Dr. Kimiya Yamaashi, Research Director, Hitachi, Ltd., introduced the prospect of public infrastructure evolution in the Big Data era. In the fourth keynote speech, Mr. Luis Jorge Romero, General Director, ETSI, explained the role of standards in telecommunication networks. In the fifth keynote speech, Ms. Allison Cerra, Vice President of Marketing, Communications and Public Affairs,

Alcatel-Lucent in the Americas Region, discussed five key shifts affected by technology. In the sixth keynote speech, Dr. Moriyasu Miyazaki, General Manager, Mitsubishi Electric Corporation, presented the smart community vision of Mitsubishi Electric Corporation. In the seventh keynote speech, Mr. David Mayer, Distinguished Engineer, Cisco Systems, presented a view of Software Defined Networking.

Invited session

(2) Invited sessions

In the two invited sessions, 7 distinguished experts gave talks on the following two topics.

In the session on “Mobile Ultraband for Anyone: The Real Challenge of LTE,” 4 speakers were invited:

- NTT DOCOMO’s LTE/EPC expansion toward shaping a Smart Life (presented by Dr. Hiroshi Nakamura, Vice President & Managing Director of Core Network Development Department of NTT DOCOMO INC.)
- LTE deployment in the Telecom Italia Mobile Broadband Evolution Path enabling new UBB Mobile Services (presented by Mr. Attilio Somma, Telecom Italia)
- 4G Long Term Evolution (LTE) - How long can it be? (presented by Dr. Gunnar Bark, Ericsson)
- Challenges and Opportunities in Deployment of LTE Mobile Broadband (presented by Mr. Naresh Soni, Interdigital)

In the session on “Natural Phenomenon, Disaster Recovery, and the Social Role of Telecommunications,” 3 speakers were invited:

- Restoration Status for Damage Caused by the Great East Japan Earthquake and Future Responses (presented by Mr. Toshiya Masuzawa, Senior Manager, Network Technology Section, Next Generation Network Office, Technology Planning Department, NTT Corporation)
- Trust Issues in Disaster Communications (presented by Prof. Yuko Murayama, Professor, Faculty of Software and Information Science, Iwate Prefectural University)
- Critical IT for Managing Mega Disasters (presented by Dr. Chi-Sheng SHIH, Associate Professor, Department of Computer Science and Information Engineering, National Taiwan University)

(3) Technical sessions

Accepted papers were categorized into the 10 technical sessions listed below, and oral presentations were given. The titles of the technical sessions were Managing Newly Emerging Traffic Classes, Wireless Heterogeneous Networks and Mobile Platforms, High Performance Security and Management, M2M and Ad-hoc Networks, Network Virtualization, Optical networks, Mobile Access and Networks, Networking and Routing, Cloud Computing, and Infocommunications in Markets and Society

(4) Poster sessions

In the two poster sessions, 30 posters were presented on a variety of topics including wireless networks, cloud networks, optical networks, and network architecture.

Poster session

(5) Exhibition

Seven companies, TOYO Corporation, Mitsubishi Electric, NEC, Cisco Systems, NTT, Hitachi, and KDDI R&D Laboratories, demonstrated their recent technologies.

Exhibition

(6) Workshops

Twenty-two speakers (3 were invited) presented their recent studies in the two hot topics, cloud computing and SDN. At the end of the cloud computing workshop, a panel discussion, in which the 3 invited speakers were panelists, was held. Various topics in cloud computing, e.g., how we can form a new business model that enhances the flexibility in deploying new service and in more cost efficient way, were discussed.

**5. Information**

Presentation slides of sections of papers were made publicly available on the congress web site. The next WTC will be held in 2014 in Berlin, Germany.

# Report on the Tenth Jubilee International Symposium on Autonomous Decentralized Systems (ISADS 2011)

Yoshiaki Kakuda
Hiroshima City University

## 1. Introduction

The Tenth International Symposium on Autonomous Decentralized Systems (ISADS 2011) was held in Kobe, Japan on June 29 to July 1, 2011. ISADS 2011 is sponsored by IEEE Computer Society, Information Processing Society of Japan (IPSJ), The Society of Instrument and Control Engineers of Japan (SICE) and The Institute of Electronics, Information and Communication Engineers, Japan (IEICE).

## 2. The 10th Jubilee ISADS

The International Symposium on Autonomous Decentralized Systems (ISADS) has been the premier events in the past twenty years to have successfully addressed these challenges. The ISADS 2011 was the 10th event and we celebrated the event by organizing a special forum, "The 10th ISADS Jubilee Forum" in the morning, in addition to its technical programs consisting of five parallel sessions in the afternoon, which include ten technical sessions, three special sessions, one poster session, one panel session, and two international workshops AHSP 2011 and ADSN 2011. ISADS 2011 was extended about three months due to the Great East Japan Earthquake, nevertheless, it was a big success with participants of about 150 persons from about ten countries. The details of ISADS 2011 can be found at http://www.isads2011.info.hiroshima-cu.ac.jp/ and the Proceedings from IEEE Computer Society.

## 3. The 10th ISADS Jubilee Forum

The topic of the 10th ISADS Jubilee Forum is "Paradigm Shift of Research and Development for Information." The contents of the Forum are as follows.
**Forum 1:** Concept-oriented R&D, Moderator: Kinji Mori (Tokyo Institute of Technology, Japan)
"Software Engineering Approaches to the Challenges in Technology Education and System Development in the Software Ecosystem Environment" by C.V. Ramamoorthy (University of California, Berkeley, USA), "Culture Advancement" by Katsuhiko Shirai (Waseda University, Japan), "Roads to a Smarter City - A Case Study" by Colin Harrison (IBM, USA), "Advance Knowledge, Evolve Society" by Alfonso Fuggetta (Politecnico di Milano, Italy). See Figure 1.
**Forum 2:** Fusion of Technologies, Moderator: I-Ling Yen (University of Texas at Dallas, USA)
"Fusion of Computer and Communication" by Hermann Kopetz (Vienna University of Technology, Austria), "Future of Railway Signaling and Train Control" by Tao Tang (Beijing Jiaotong University, China), "Fusion of Control, Computer and Real World" by Yasushi Fukunaga (Hitachi Automotive Systems, Japan), "Fusion of Computer, Communication and Control Technologies: Needs and Strategies" by Masayoshi Tomizuka (University of California, Berkeley, USA).
**Forum 3:** Glocalization of Business, Moderator: Masaki Ogata (JR East, Japan)
"Globally Integrated Enterprise - Thinking Globally, acting Locally AND Thinking Locally, acting Globally" by Cathy Lasser (IBM, USA), "Standardization: Balancing Continuity & Innovation" by Richard March Soley, (Object Management Group, Inc. (OMG), USA), "Summary of Glocalization of Business "Value Creation"" by Yukio Toyoshima (Hitachi, Japan).

## 4. Summary

This report concisely explains ISADS2011. We are grateful to committee members, speakers, participants and volunteers as well as the ISADS Steering Committee Chair Prof. Kinji Mori, Tokyo Institute of Technology (currently, Waseda University) for his constant advice and support to ISADS 2011. The book on the 10th ISADS Jubilee Forum will be published by Wiley. The Eleventh ISADS will be held in March 2013 in Mexico.


Fig. 1 Forum

# IEICE-CS Conferences Calendar

| Date | Conference Name | Location | Note |
|---|---|---|---|
| 01 Jul. - 05 Jul. 2013 | 18th OptoElectronics and Communications Conference / International Conference on Photonics in Switching 2013 (**OECC/PS2013**) | Kyoto, Japan | Submission deadline: 31 Jan. 2013 |
| 30 Jun. - 05 Jul. 2013 | The Pacific Rim Conference on Lasers and Electro-Optics 2013 (**CLEO Pacific Rim 2013**) | Kyoto, Japan | Submission deadline: 31 Jan. 2013 |
| 20 May - 23 May 2013 | URSI Commission B 2013 International Symposium on Electromagnetic Theory (**EMTS2013**) | Hiroshima, Japan | Submission deadline: 15 Nov. 2012 |
| 05 Nov. - 09 Nov. 2012 | 9th Asia-Pacific Symposium on Information and Telecommunication Technologies (**APSITT2012**) | Santiago and Valparaiso, Chile | Submission deadline: closed |
| 05 Nov. - 08 Nov. 2012 | 12th International Conference on Telecommunications for Intelligent Transport Systems (**ITST2012**) | Taipei, Taiwan | Submission deadline: closed |
| 29 Oct. - 02 Nov. 2012 | 2012 International Symposium on Antennas and Propagation (**ISAP2012**) | Nagoya, Japan | Submission deadline: closed |
| 15 Oct. - 17 Oct..2012 | The 18th Asia-Pacific Conference on Communications (**APCC2012**) | Jeju Island, Korea | Submission deadline: closed |
| 08 Oct. - 11 Oct. 2012 | 16th International Conference on Intelligence in Next Generation Networks (**ICIN2012**) | Berlin, Germany | Submission deadline: closed |
| 09 Sept. 2012 | The 2012 International WDN Workshop on Cooperative and Heterogeneous Cellular Networks (**WDN-CN2012**) | Sydney, Australia | Submission deadline: closed |
| 05 Sept. - 07 Sept. 2012 | 6th Advanced Satellite Multimedia Systems Conference (**ASMS2012**) | Baiona, Spain | Submission deadline: closed |
| 01 Aug. - 03 Aug. 2012 | The 4th International Conference on Communications and Electronics (**ICCE2012**) | Hue, Vietnum | To be held **soon** |
| 18 Jul. - 21 Jul. 2012 | 8th IEEE, IET Int. Symposium on Communication Systems, Networks and Digital Signal Processing (**CSNDSP2012**) | Poznan, Poland | To be held **soon** |
| 18 Jun. - 21 Jun. 2012 | The 11th International Workshop on Assurance in Distributed Systems and Networks (**ADSN2012**) | Macau, China | To be held **soon** |
| 29 May - 31 May 2012 | 10th International Conference on Optical Internet (**COIN2012**) | Yokohama, Japan | Done |
| 24 May - 25 May 2012 | The 4th Sarajevo Technology Forum 2012 (**STF2012**) | Sarajevo, Bosnia and Herzegovina | Done |
| 18 May - 19 May 2012 | 2012 Korea-Japan Electromagnetic Theory, Electromagnetic Compatibility, and Biological Effect Joint Conference (**KJJC-2012**) | Seoul, Korea | Done |
| 06 May – 09 May 2012 | The 2012 IEEE 75th Vehicular Technology Conference (**VTC2012-Spring**) | Yokohama, Japan | Done |
| 05 Mar. - 06 Mar. 2012 | World Telecommunications Congress 2012 (**WTC2012**) | Miyazaki, Japan | **Reported** on this issue |

*: Please confirm with the following IEICE-CS web site for the latest information.
http://www.ieice.org/cs/conf/calendar.html

## *Welcome to the IEICE Overseas Membership Page* URL:http://www.ieice.org/

**Membership for Overseas Candidates:** Overseas Members may opt to join **one IEICE Society of their choice** and may request to **receive the IEICE Transactions of online version** of that Society. Furthermore, Overseas Members may request to receive the IEICE Journal(written in Japanese) and Transactions (published in paper) at an additional cost. Similar services are available to **Overseas Student Members.** Voting privileges in the IEICE election do not apply to Overseas Members. Note that the Overseas Membership applies only to candidates who reside outside of Japan and who have citizenship in countries other than Japan.

**OMDP (Overseas Membership Development Program):** OMDP is provided for candidates **from countries/areas in Asia(except Republic of Korea and Taiwan), Africa, Central America, and South America.** This program is designed so that IEICE can contribute to and support the progress of science and technology throughout the world. Scientists and engineers in these countries/areas are encouraged to apply to the program.

### ● IEICE Societies and Publications

| Society | Transactions | Editorial Subject Indexes |
|---|---|---|
| A (Fundamentals of Electronics, Communications and Computer Sciences) | EA (English) A (Japanese) | Engineering Acoustics, Noise and Vibration, Speech and Hearing, Ultrasonics, Digital Signal Processing, Analog Signal Processing, Systems and Control, Nonlinear Problems, Circuit Theory, VLSI Design Technology and CAD, Numerical Analysis and Optimization, Algorithms and Data Structures, Graphs and Networks, Reliability, Maintainability and Safety Analysis, Cryptography and Information Security, Information Theory, Coding Theory, Communication Theory and Signals, Spread Spectrum Technologies and Applications, Mobile Information Network and Personal Communications, Intelligent Transport System, Image, Vision, Computer Graphics, Language, Thought, Knowledge and Intelligence, Human Communications, Neural Networks and Bioengineering, Multimedia Environment Technology, Communication Environment and Ethics, Concurrent Systems, Measurement Technology, General Fundamentals and Boundaries |
| B (Communications) | EB (English) B (Japanese) | Fundamental Theories for Communications, Devices/Circuits for Communications, Transmission Systems and Transmission Equipment for Communications, Optical Fiber for Communications, Fiber-Optic Transmission for Communications, Switching for Communications, Switching for Mobile Communications, Network, Network Management/Operation, Internet, Wireless Communication Technologies, Terrestrial Radio Communications, Satellite Communications, Optical Wireless Communications, Antennas and Propagation, Electromagnetic Compatibility (EMC), Sensing, Navigation, Guidance and Control Systems, Energy in Electronics Communications, Terminals for Communications, Multimedia Systems for Communications, Broadcast Systems, Integrated Systems for Communications, Space Utilization Systems for Communications |
| C (Electronics) | EC (English) C (Japanese) | Electromagnetic Theory, Lasers, Quantum Electronics, Optoelectronics, Microwaves, Millimeter-Waves, Ultrasonic Electronics, Electronic Circuits, Electronic Materials, Organic Molecular Electronics, Electronic Components, Electromechanical Devices and Components, Semiconductor Materials and Devices, Integrated Electronics, Electron Tubes, Vacuum and Beam Technology, Electronic Displays, Superconducting Electronics, Storage Technology, Electronic Instrumentation and Control |
| D (Information and Systems) | ED (English) D (Japanese) | Computation and Computational Models, Automata and Formal Language Theory, Algorithm Theory, Complexity Theory, Computer Components, VLSI Systems, Computer Systems, Fundamentals of Software and Theory of Programs, System Programs, Software Engineering, Database, Contents Technology and Web Information Systems, Data Mining, Networks, Dependable Computing, Application Information Security, Distributed Cooperation and Agents, Artificial Intelligence and Cognitive Science, Human-computer Interaction, Office Information Systems, e-Business Modeling, Educational Technology, Rehabilitation Engineering and Assistive Technology, Pattern Recognition, Speech and Hearing, Image Processing and Video Processing, Image Recognition, Computer Vision, Computer Graphics, Multimedia Pattern Processing, Natural Language Processing, Biocybernetics, Neurocomputing, Biological Engineering, Music Information Processing, Kansei Information Processing, Affective Information Processing |
| **Journal of IEICE (written in Japanese only)** | | |

### ● Membership Charges (http://www.ieice.org/eng/member/OM-appli.html#c)

Basic Membership Charge is as follows. It will change the term when you join IEICE. Please refer to the above website.

**Basic Membership Charge (UNIT : Japanese YEN)**

| | | Online Version | | Paper Version (optional) | | |
|---|---|---|---|---|---|---|
| Service coverage for overseas members | Admission charge | Registration of the first society (includes its online version transactions) | Registration of additional societies (includes its online version transactions) | Journal (written in Japanese) | Transactions (written in Japanese or in English) (In one society) | |
| | | | | | One title | Two titles |
| Member (overseas) | 1,400 | 7,000 | 3,500 / 1society | 6,000 | 4,000 | 10,000 |
| Member (overseas) with OMDP* | 1,000 | 5,000 | 3,000 / 1society | 5,000 | | |
| Student member (overseas) | – | 2,000 | 2,000 / 1society | 6,000 | | |
| Student member (overseas) with OMDP* | – | 1,000 | 1,500 / 1society | 5,000 | | |

**NOTE**

**1. You need to choose one Society, and you can subscribe Transactions online of your registered society.**
*Example: If you want to subscribe to Transaction of EA, please check **Society Registration** as "A", and your membership fee amounts to 7,000 yen / 5,000 yen.*

**2. If you want to register other Societies and Transaction of web version, please check "Additional Society registration".**
*Example: If you want to subscribe to Transaction of EA and EB, please check **Society Registration** as "A", **Additional Society registration (optional)** as "B". Your membership fee amounts to 7,000+3,500 yen / 5,000+3,000 yen.*

**3. If you want to subscribe to one Transaction of paper version,, please check "Additional Transaction subscription (published in paper)".**
*Example: If you want to subscribe to Transaction of EC in paper version additionally, please check **Society Registration** as "A", and **Additional Transaction subscription (in paper version)** as "C" or as "EC". Your membership fee amounts to 7,000+4,000 yen / 5,000+4,500 yen.*

**4. If you want to change membership from Member (In Japan) to Overseas Member, you don't need to pay an Entrance charge.**

### ● Optional Rapid Mailing Service

Surface mail charge is included in the membership charge. Optional rapid mailing service is available by air mail or surface air lifted (SAL) mail. The additional charge per year periodical depends on the mailing address, as shown in the right table.

| Areas | Air mail | SAL mail |
|---|---|---|
| Asia; Guam; Midway islands | 5,600 yen | 3,200 yen |
| Oceania; Near & Middle East; North & Central America; Europe | 7,800 yen | 4,400 yen |
| Africa; South America | 11,000 yen | 5,600 yen |

**Please contact the IEICE Membership Section:** E-mail:member@ieice.org FAX: +81 3 3433 6659 ***Please fill out the application form printed on the reverse side of this paper.***

# IEICE Overseas Membership Application Form

**URL** http://www.ieice.org/eng/member/OM-appli.html **E-mail** member@ieice.org **FAX** +81-3-3433-6659

◆ **Please type or print in English. The deadline for submitting application form is the 1st day of every month.**

## Personal Information

***Full name:*** _____ ***Nationality:*** _____ ☐Male ☐Female
First name Middle name Last name

☐Prof. ☐Dr. ☐Mr. ☐Ms. ***Place of birth:*** _____ ***Date of birth:*** _____
Day Month Year

## Mailing Address ☐Home ☐Office

Name of Company/School/College Department/Section

Street City State/Province

Postal code Country

TEL FAX E-mail

## Academic Background The highest academic degree: ☐Ph.D. ☐Masters ☐Bachelors ☐Others: _____

University/college/school of the highest academic degree Month & year of graduation

**(For Student Member)** Academic degree which will be conferred on you Month & year when the degree will be conferred on you

## Application Information

***Membership:*** I want to apply for the following membership (check one item!)

☐Member (Overseas) ☐Student Member (Overseas)

◆If you want to apply for OMDP, please check; ☐OMDP (Overseas Membership Development Program)

***Society registration (Membership fee includes one Society of Transaction of Online version.):***

☐A: Engineering Sciences ☐B: Communications ☐C: Electronics ☐D: Information and Systems

**Additional Society (optional):** ☐A: Engineering Sciences ☐B: Communications ☐C: Electronics ☐D: Information and Systems

**Additional Transactions of paper version (optional):**

☐EA: Fundamentals ☐EB: Communications ☐EC: Electronics ☐ED: Information and Systems

☐A: Fundamentals (Japanese) ☐B: Communications (Japanese) ☐C: Electronics (Japanese) ☐D: Information and Systems (Japanese)

**Journal subscription (optional):** ☐(Japanese)

## Remittance Remittance is available only in *Japanese yen* by a *credit card*.

Admission charge……¥_____ Journal subscription (optional)……..¥_____

Annual charge……¥_____ Mailing option: ☐Air mail……..……¥_____

Additional Society (optional) …… ¥_____ ☐SAL mail……¥_____

Additional Transactions (optional)……..…¥_____ **Total……..……¥_____**

Credit Card: ☐UC ☐Master Card ☐VISA ☐JCB ☐American Express

Card number: | | | | | | | | | | | | | | | | |

Expiry date: ____/____ Credit Card Holder: _____ Signature: _____
Year Month

## Endorsement

*Endorsements by one IEICE Member application is required. If it is difficult to find endorsers, please contact the IEICE Membership Activities Section by sending this sheet, and we will help you.*

I recommend this applicant for IEICE membership.

Endorser's name Membership number Endorser's signature Date

# IEICE-CS Overseas Membership with Special Annual Fees for Sister Society Members

To foster the cooperation between the Sister Society and the IEICE Communications Society (IEICE-CS), the Sister Society agreement enables members of each institution to become members of both societies by granting special annual fees.

A 10% - 20% discount* of the annual fees will be granted to the sister society members to become the IEICE-CS overseas members. The discounted fees will be applied for the individual members when the new membership is starting or the current membership is renewing. The details of this discount can be found in the following IEICE-CS Web page:

URL http://www.ieice.org/cs/member/sister_society.html

* The discount does not apply to the optional items and services i.e. “Additional Society”, “Additional Transactions of paper version” and “Rapid Mailing Service”.

------ *Please send the following Sister Society membership information, together with membership application form in the next page.* ------

**Sister Society membership information**

***To apply discount rates for this IEICE-CS Sister Society member’s application, please indicate your Sister Society Membership number below, and attach a copy of your Sister Society Membership certificate or card to this form.***

Sister Society: ☐IEEE ComSoc ☐KICS ☐VDE-ITG

Membership number (Member):_____

Copy of Membership certificate or Membership card:

(Attached here)

# IEICE Overseas Membership Application Form for IEICE-CS Sister Society Members

**URL** http://www.ieice.org/eng/member/OM-appli.html **E-mail** member@ieice.org **FAX** +81-3-3433-6659

◆ **Please type or print in English. The deadline for submitting application form is the 1st day of every month.**

## Personal Information

☐Male ☐Female

***Full name:*** _____ ***Nationality:*** _____
First name Middle name Last name

☐Prof. ☐Dr. ☐Mr. ☐Ms. ***Place of birth:*** _____ ***Date of birth:*** _____
Day Month Year

## Mailing Address ☐Home ☐Office

_____
Name of Company/School/College Department/Section

_____
Street City State/Province

_____
Postal code Country

_____
TEL FAX E-mail

## Academic Background The highest academic degree: ☐Ph.D. ☐Masters ☐Bachelors ☐Others: _____

_____
University/college/school of the highest academic degree Month & year of graduation

## Application Information

***Membership:*** I want to apply for the following membership*:

☐Member ☐Member (including Japanese Journal subscription)
☐Student Member ☐Student Member (including Japanese Journal subscription)

**Membership applies only to applicant who reside outside of Japan and who have non-Japanese citizenship.*

◆If you want to apply for OMDP (Overseas Membership Development Program), please check; ☐OMDP

***Society registration (Membership fee** includes one Society of Transaction of Online version.):***

☑B: Communications

***Discount rate (see the URL below) is applied to this IEICE-CS Sister Society Member's application.*

URL http://www.ieice.org/cs/member/sister_society.html

---------- *Discount rate is not applied for the following optional items.* ----------

**Additional Society (optional):** ☐A: Engineering Sciences ☐C: Electronics ☐D: Information and Systems

**Additional Transactions of paper version (optional):**

☐EA: Fundamentals ☐EB: Communications ☐EC: Electronics ☐ED: Information and Systems
☐A: Fundamentals (Japanese) ☐B: Communications (Japanese) ☐C: Electronics (Japanese) ☐D: Information and Systems (Japanese)

## Remittance Remittance is available only in *Japanese yen* by a *credit card*.

Admission charge……..¥_____ Journal subscription (optional)……..¥ _____
Annual charge…….. ¥_____ Mailing option: ☐Air mail……..……¥_____
Additional Society (optional) …… ¥_____ ☐SAL mail……¥_____
Additional Transactions (optional)……..…¥_____ **Total……..……¥** _____

Credit Card: ☐UC ☐Master Card ☐VISA ☐JCB ☐American Express

Card number: | | | | | | | | | | | | | | | | |

Expiry date: ____/____ Credit Card Holder: _____ Signature: _____
Year Month

## Endorsement *The following endorsement for this Sister Society member's application will be given by an IEICE-CS director (any related action of endorsement by applicant is not necessary if a copy of your Sister Society Membership certificate or card is indicated).*

I recommend this applicant for IEICE membership.

(Director of Planning and Member Activities, IEICE-CS)

_____ _____ _____ _____
Endorser's name Membership number Endorser's signature Date

# From Editor's Desk

## ● Academic Year in Japan

This fiscal year began in April and I restarted my activity with a refreshed mind. In Japan, the academic year also began in April and I see fresh first-year students every morning. Recently, some universities consider switching the season of enrollment from spring to autumn, which is led by the University of Tokyo. The autumn enrollment can afford more opportunities for foreign students to study in Japan and opportunities for Japanese students to study abroad. I think that Japanese students tend to hesitate to study abroad. If the change of enrollment is adopted, I hope that more Japanese students will enjoy their activities in foreign countries.

IEICE GLOBAL NEWSLETTER Editorial Staff

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