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New Year Messages

From the Minister of MIC, President of ITU-AJ

Special Feature

Beyond 4K: Providing a High-definition Immersive Video Experience/ Achieving Both High Resolution and High Sensitivity: A 4K-Enabled Network Camera That is Ideal for Wide Area Surveillance/ Proposed New Applications for 4K Tablets/ An RGB Laser-backlit Liquid Crystal Display

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About the ITU-AJ

The ITU Association of Japan (ITU-AJ) was founded on September 1, 1971, to coordinate Japanese activities in the telecommunication and broadcasting sectors with international activities. Today, the principle activities of the ITU-AJ are to cooperate in various activities of international organizations such as the ITU and to disseminate information about them. The Association also aims to help developing countries by supporting technical assistance, as well as by taking part in general international cooperation, mainly through the Asia-Pacific Telecommunity (APT), so as to contribute to the advance of the telecommunications and broadcasting throughout the world.

2016 New Year Greeting from the Minister of Internal Affairs and Communications

Sanae Takaichi
Minister of Internal Affairs and Communications

Happy New Year!

I would like to thank you for your kind cooperation and assistance as always on behalf of all the staff at the Ministry of Internal Affairs and Communications.

This year we will redouble the efforts of the Ministry of Internal Affairs and Communications to formulate and implement effective measures that allow all citizens to move one step ahead and contribute dynamically. We will do this by working in partnership with related ministries in recognition of the fact that we need to do whatever we can to continue pursuing the economic recovery and regional stimulation initiatives arising from the broad agreements reached by the TPP last year.

ICT is a crucial field that not only provides an indispensible platform for all forms of socioeconomic activity and everyday living, but is also the key to generating growth and employment by accelerating investment in Japan's future and promoting creativity and innovation in provincial areas.

With the arrival of the IoT/Big Data era when new value will be created by exploiting all kinds of data, the government will also have to support Japan's further growth. The Ministry of Internal Affairs and Communications is making rapid progress in service development support, budgetary provision and the like based on an IoT testbed, and in the preparation of systems that can cope with the expanded deployment of practical security training based on last December's interim report of the Information and Communications Council in order to devise new ICT strategies for the IoT/Big Data era and promote the development and practical use of cutting-edge technology.

The 2020 Tokyo Olympic and Paralympic Games will give Japan an ideal opportunity to demonstrate its high standard of ICT to the rest of the world. In anticipation of Japan's sustained growth following the Olympics, we will work towards the creation of the world's highest standard of ICT environments through advanced research and development and promoting the spread of ultra-high definition immersive 4K and 8K video technology. To make our foreign visitors feel welcome, we will make further advances in the implementation of "whole-society" ICT. For example, by organically combining multi-language voice translation systems with digital signage that enables the simultaneous transmission of disaster information and the like, we can configure a cloud environment where it is possible to supply information that is tailored to the attributes of individuals, including their mother tongue.

From the viewpoint of increasing the disposable income of households, revitalizing the economy and improving the life of citizens, we are firmly resolved to establish smartphones as an infrastructure supporting people's everyday lives. Specifically, in line with the policy we established in December last year, we aim to establish a competitive environment for fixed-line and mobile phones, such as reducing smartphone fees and optimizing retail via smart terminals to promote the diversification of MVNO services, and we will then promote the spread of ultra-fast broadband and the like.

To capture the expanding international market, we will continue working in partnership with the Fund Corporation for the Overseas Development of Japan's ICT and Postal Services Inc. (JICT) to promote high-quality infrastructure investment that draws on the strengths and features of Japan's ICT. In addition, by promoting international expansion of broadcast content that contributes to the stimulation of regional economies and enhancing and strengthening international television broadcasting at the World Telecommunication/ICT Indicators Symposium (WTIS-15) in Hiroshima back in November, we are taking the initiative to promote the use of development assistance and other forms of ICT in solving regional issues expressed by relevant government officials of developing countries regarding ICT development.

In conjunction with the G7 Ise–Shima Summit, which will be hosted by Japan in May this year, a G7 ICT Ministers' Meeting will also be held on April 29 and 30 in Takamatsu city, Kagawa prefecture. On themes such as IoT and security measures that are of interest to countries around the world, we will engage in deep discussions with ministers from other G7 nations, and we will demonstrate Japan's leadership in the ICT field by contributing to ministerial discussions.

Although the issues to be tackled by the Ministry of Internal Affairs and Communications are diverse and multi-faceted, we will once again mobilize our policy resources this year in order to concentrate our utmost efforts into solving them.

I'm looking forward to taking on these challenges with you over the coming year, and I hope that by next January we will be able to say that 2016 was a "leap year" in more ways than one.

A Message for the New Year

Michiaki Ogasawara
President
The ITU Association of Japan

Happy New Year!

Last year was the 150th anniversary of the signing of the International Telegraph Convention that laid the foundations of the International Telecommunication Union (ITU). It was also a very fruitful year for the ITU Association of Japan (ITU-AJ).

The ITU's 150th anniversary was celebrated at a variety of commemorative events in Japan and in other countries. These included the ITU-AJ's World Telecommunication and Information Society Day gathering on 15th May, at which the Minister of Internal Affairs and Communications presented Professor Toshio Obi of Waseda University with the MIC Minister's Award in recognition of his contributions to ITU activities for over 30 years, and we also received a video message of congratulations from ITU Secretary-General Houlin Zhao.

At an anniversary ceremony held at the ITU headquarters in Geneva, Professor Ken Sakamura of Tokyo University was among the recipients of the ITU150 Award. Other recipients included Bill Gates.

Last year, the ITU-AJ was also able to participate in the administration of important international meetings related to wireless communications and the like.

The first of these was the AWG (APT Wireless Group) international conference, which was held in Kyoto in March.

This event was attended by approximately 220 people from organizations related to radio communication in 25 countries and regions in the Asia-Pacific Telecommunity (APT), who participated enthusiastically in the discussions. We also held a Workshop on Next-Generation Mobile Communication Systems in order to cultivate a common understanding in the Asia-Pacific region regarding the introduction of fifth-generation mobile communication systems.

The second event was the World Radiocommunication Conference (WRC-15) held in Geneva in November.

The purpose of this conference was to revise the Radio Regulations governing the usage of the radio-frequency spectrum internationally, the operation procedures for radio stations, technical standards and so on. Additional spectrum allocations to fourth-generation mobile communication were also discussed, and as a new agenda item for the forthcoming WRC-19, it was resolved that frequency-related matters would be studied with a view to using them in fifth-generation mobile communication systems.

At the end of November Hiroshima hosted the third event which was the World Telecommunication/ICT Indicators Symposium (WTIS). WTIS is a meeting to discuss information and communications technology (ICT) statistics and indicators, and last year was the first time in Japan for it to be held as one of the events to commemorate the ITU's 150th anniversary.

Being able to contribute to these important meetings as part of the secretariat has been a truly gratifying experience for me.

Furthermore, ITU Telecom World has been held somewhere other than Geneva since 2012, and each time ITU-AJ has supported the local secretariat and published preliminary reports. Last year's event, in Budapest, also featured a Japan Pavilion, where we held presentations and other events that attracted a great deal of attention from leading figures of all nationalities.

This year's Telecom World is due to be held in Bangkok, and I have already heard from Japanese corporations and other organizations that plan to exhibit there. The ASTAP (Asia-Pacific Telecommunity Standardization Program) conference and WTSA (World Telecommunication Standardization Assembly) will also take place this year.

This year, the ITU-AJ will continue to contribute to the elevation of Japan's profile by playing an active role in ITU and APT activities and conferences, and will continue to perform work in the public interest such as the commendation program and the publication of research. I would therefore like to ask once again for the continued guidance and cooperation of everyone in the member companies.

I hope that 2016 turns out to be a successful and prosperous year for you all.

WRC-15 Viewed from the Front Row

Yasuhiko Ito
KDDI Corporation Executive Adviser
RRB Chairman

Radio Regulations Board (RRB) members are customarily seated in the front row at the World Radiocommunication Conference (WRC), and I was seated in the very center of the front row, where tension in the room can be instantly sensed. For me personally, WRC-15 was very special and memorable for a number of reasons.

Everybody would probably agree that the agenda items generating the most heated discussion were the additional frequency allocation for IMT and the frequency allocation for unmanned aerial vehicles. Japan had emphasized its interest in the additional allocation for IMT. North and South America and Europe have identified 400 MHz of bandwidth in the 3 GHz band while the Asian Region only agreed to 200 MHz in the same band, with the remaining 200 MHz to be allocated domestically by Japan and Korea. Although this was a disappointing outcome for Japan, I still believe that Japan should pioneer and show the usefulness of wireless broadband to the world and endeavor to further prepare for expansion of the available spectrum at WRC-19. While the details of the frequency allocation for unmanned aerial vehicles will be redetermined at WRC-23, the identification of candidate frequencies was a noteworthy achievement coming at the end of a heated debate.

Is Vision of Allocating Common Global Frequencies a Chimera?

WRC-15 was the toughest conference that I have ever experienced. Even reaching agreement on a frequency allocation outside the 3 GHz band for IMT agreement proved impossible, and the Asian Region could not reach agreement beyond the 200 MHz bandwidth, half the allocation identified in Europe and the Americas. The countries of Southeast Asia placed high priority on using a significant amount of C-band spectrum for satellite communications. Yet in a private conversation, these same countries admitted that they would migrate over to high-speed mobile communications in the long run. The reality is that many of the developing countries—including those in Southeast Asia—are transitioning slowly from plain mobile telephony to broadband mobile communication while sustaining their economies and meeting the demands of their citizens.

One observes a similar phenomenon in the advanced countries of Europe and the Americas, where there is little agreement outside the 3 GHz band. The frequency bands that might be used differ from country to country because the bandwidth has already been allocated to existing services. Consequently, the world frequency use chart ends up looking like a disjointed mosaic or patchwork. Is there some way of resolving this global patchwork of frequency usage? It would certainly be a monumental challenge. Indeed, some from countries leading in mobile technology are beginning to cast doubt on whether continuing to pour energy into reducing this patchwork of frequencies is really the right approach. Rather, they have started to believe that seeking bilateral agreements between major countries based on national allocation is a better approach. Especially considering the rapid progress in terminal technology in recent years, handling multiple frequencies is no longer the technical problem it once was. Although this concept may be out of step with basic ITU precepts and the principle of consensus, it does suggest that even the ITU is not immune from rapidly changing business models. While

Photo 1: Plenary Session of WTC-15

Photo 2: Signing Ceremony of WRC-15

Photo 3: Informal discussion during a break period

discussions based on the promise of common global frequencies and business that is aware of the speed of economic expansion have always coexisted, I wonder if we might be approaching the age when we have to choose one or the other.

Confusion Surrounding Unmanned Aerial Vehicles (UAVs)

The agenda item dealing with frequency allocation for UAVs is being considered on a totally different level from the allocation for IMT. National intentions regarding UAVs have become quite entangled—some countries are pursuing UAVs for civilian purposes, other wary countries are envisioning military applications, while still other countries are interested in the political implication of UAVs—and this diversity of objectives makes it extremely difficult to move forward. Listening to the discussion, seated in the front row, I felt a sense of helplessness at not being able to achieve anything regarding this issue at the WRC, but then, on the second to the last day, the majority of countries expressed their views and pushed through a draft resolution to describe multiple frequency candidates. A round of spontaneous applause erupted as soon as the decision was reached, and this has really stuck with me.

What Is Expected of the RRB?

While obscured by the two agenda items discussed above, the issues pertaining to RR (Radio Regulations), i.e., the considered opinions of the RRB, are often attended by heated debate. As a practical matter, the RRB is constantly forced to choose between RR that should be applied strictly and RR that should be taken as a practical solution in line with actual business practices. While some member states believe that RR should always be strictly applied, I think that a more lenient and practical approach can be beneficial.

Consider, for example, the problem we had with the LAOSAT-1 satellite when it was facing the deadline for being brought into use. The deadline was postponed once by a previous WRC, and a new request for further extension came to the RRB in May 1995. However, we were not prepared to accept yet another delay. Then in May, the Lao PDR presented an actual launch schedule in addition to the usual planning documentation. After further deliberation based on this additional information, it was agreed to accept the request from the Lao PDR and extend the deadline until the end of the year. Fortunately, while WRC-15 was in session, we learned that LAOSAT-1 was launched successfully. RRB is considered to be a custodian of the Radio Regulations, but it also exists to help genuine programs through extra-legal decisions. I believe that a middle-of-the-road approach—not overly strict but not excessively lenient—is the most important role for the RRB.

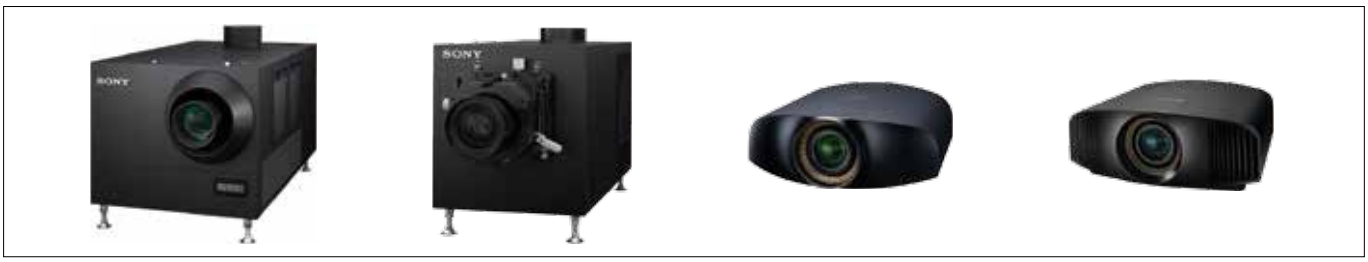
The RRB was assigned a good deal of homework to accomplish following WRC-15. Treatment of "force majeure" including launch failure is one of the most controversial tasks, and the creation of a Rule of Procedure for handling filing applications for the newly allocated 13 and 14 GHz bands is a very difficult task.

Having served as a spokesperson for the RRB at WRC-15, my term as chairperson of the RRB will come to an end at the end of 2015 although I will still serve as a member. I am deeply grateful to the many people who supported my efforts during my term, and I certainly wish that someone from Japan will be sitting in the front row at WRC-19.

Beyond 4K: Providing a High-definition Immersive Video Experience

Tomoya Masuda
Senior Business Planner
Planning Department
Visual Presentation Solutions Division
Sony Corporation

Figure 1: Sony current line-up of 4K projectors: (From left) SRX-T423, SRX-T615, VPL-GT100, VPL-VW520ES/VW320ES



1. Introduction

There are various different enterprises that aim to provide an immersive video experience, including theaters, museums, theme parks and planetariums. Here I would like to focus on planetariums — which are increasingly switching from optical to digital systems — and on the projectors they use.

This article discusses the attributes that an ideal planetarium projector should possess in order to inspire people, and introduces Sony's efforts to develop a high-quality display that has the ability to provide people with a truly moving experience.

2. Projectors suitable for planetariums

The projector in a planetarium needs to provide people with an immersive and captivating experience by showing them the vast multitude of stars that exist in the world of astronomy. The most important requirements in this regard are high resolution and high contrast (allowing it to display glittering stars against a pitch black sky). It hardly needs to be said that planetarium operators prefer a product that is not only simple to install according to the ideal layout, but also achieves low maintenance and running costs by constantly adjusting its picture quality. To respond to the needs of planetarium applications, Sony is working on the development of projectors using leading-edge technology. The efforts we are making in each field are introduced below.

3. Sony's efforts

• High image quality

The highest resolution currently available from a commercial projector is 4K, which has over four times the resolution of full HD video. Reflection-type devices are advantageous for the design of high-resolution systems. At Sony, we have developed a reflection-type high-resolution display device called SXRD™ (Silicon X-tal Reflective Display) that combines the advantages of both higher resolution and higher contrast. Since 2005, we have been introducing 4K projectors into the movie theater, consumer and special industry markets. We have also introduced many products in planetariums around the world, and their picture quality has been highly acclaimed. (Figure 1)

Our 1.55-inch panel that was first mounted in large-scale equipment has now been reduced to a quarter of the size (0.74-inch diagonal) with the pixel pitch reduced from 8.5 µm to 4 µm, enabling us to pack in approximately 8.85 megapixels in an area of about 1.5 cm². This miniaturized 4K projector has been put to use in an even wider range of applications.

Also, by optimizing the fabrication process for this panel, we have arrived at a native contrast level of 20,000:1 without resorting to optical aperture control. (Figure 2,3,4)

Figure 2: SXRD panel

Figure 3: Reducing the pixel pitch

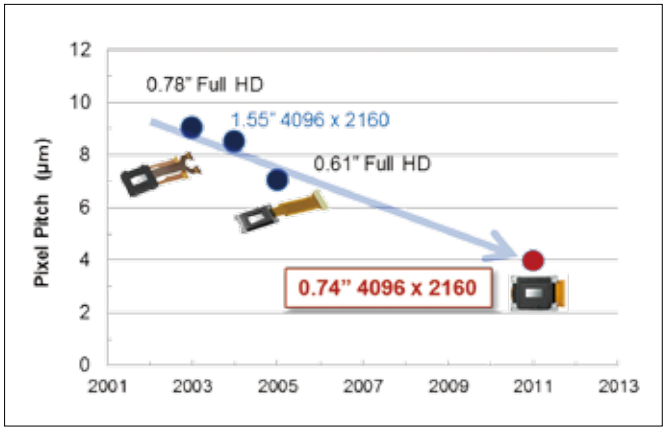


Figure 4: Improving the panel fabrication process

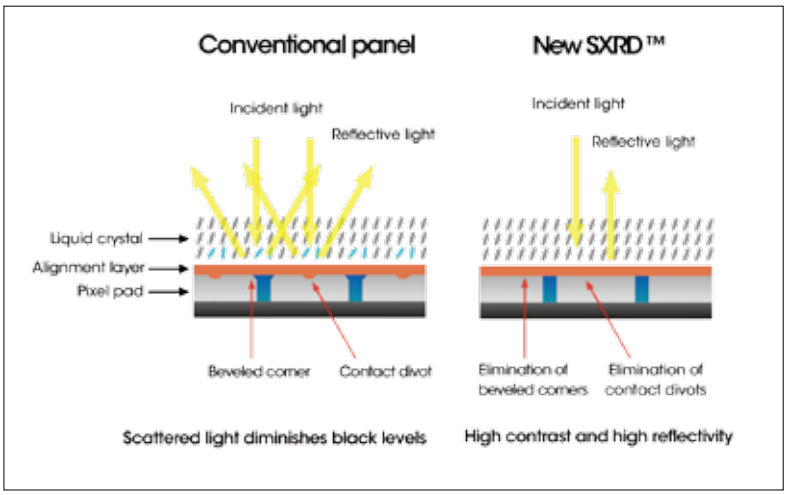


Figure 5: Laser light source (image)

We have achieved roughly 80% coverage of the BT.2020 color range by incorporating a blue laser light source that has two different wavelengths for excitation and blue reproduction, and expanding the display gamut with phosphors that provide a wider range of colors. This contributes to the reproduction of subtle color differences in each star, which will not only improve the projector's ability to display variations of light and dark regions but also enables it to reproduce higher density video by plotting a subtle gamma curve.

It is hoped that this will increase the options for providing a more impressive immersive experience by leading to the development of better planetarium operations including, for example, the creation of content that takes advantage of this wide color gamut. (Figure 5,6)

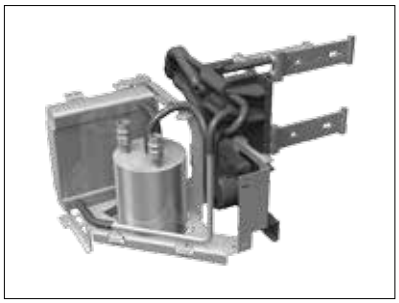
• Ease of installation

Depending on the dome size, a single projector may be sufficient in some cases, while in others it may be necessary to produce a single image with multiple projectors oriented in different directions. The shape of a planetarium domes can be "horizontal" or "tilted", and since these require the projectors to be installed at different angles, it is important that projectors are able to be installed at various different angles. The design of the light source and cooling system has a strong bearing on this capability, and products that are not optimally designed are liable to have a severely impaired lifetime and require frequent maintenance.

In some cases it may be necessary to project onto a large screen from a short distance or to operate quietly because it is installed behind the viewers.

To resolve these issues, we focused on using a laser light source instead of a lamp light source that is strongly affected by the angle of inclination, and we made it possible to orient the projector at any angle horizontally or vertically. We have also developed a system with a lens that can be shifted up/down and left/right to faithfully reproduce 4K high-definition images despite having a short focal length with a throw ratio of 0.8 to 1.0, and a hybrid cooling system that combines air-based and coolant-based techniques to provide optimal cooling in each internal area. This resulted in equipment that is easier to install, provides more stable cooling of the light source, and produces less noise.

Figure 7: Liquid cooling system

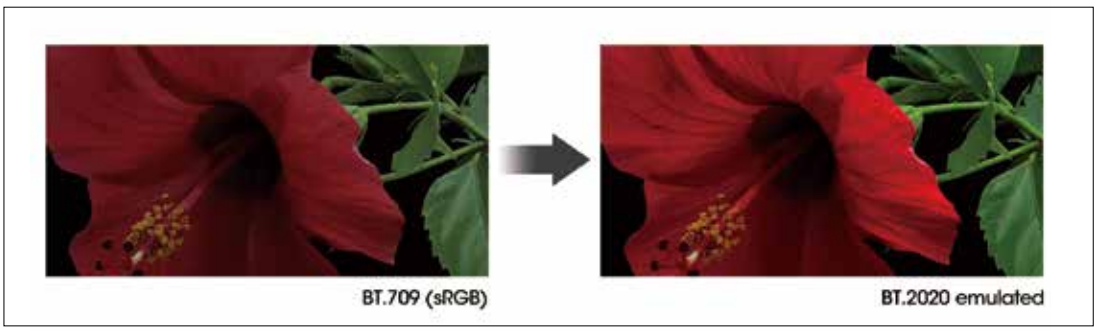


• Reduction of maintenance

When a projector is operated in a public place, routine maintenance is generally required due to the following factors:

(1) Dimming over time: Routine replacement of the lamp after it has been operating for a few hundred or a few thousand hours

Figure 6: Wide color gamut



(2) Variation of brightness/picture quality over time: Combined readjustment of multiple projectors

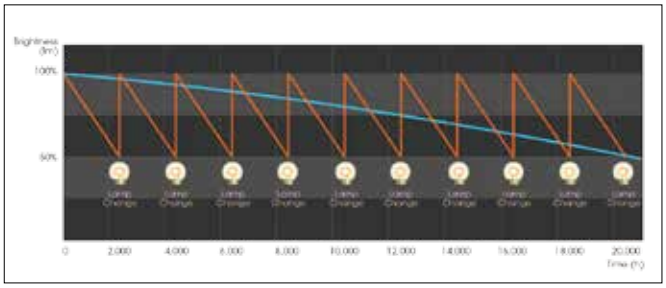
(3) Routine cleaning of optical components: In an environment where there are lots of people coming and going, dust can enter through the cooling vents, causing reduced light intensity.

Sony has devised features that alleviate the burden of these maintenance tasks.

(1) A laser light source with a lifetime of at least 20,000 hours (depending on operation mode)

This lifetime is over ten times that of a conventional lamp light source, thereby reducing the cost and effort of replacing the light source.

Figure 8: Comparison of lifetime with an ordinary lamp light source (laser light source: blue line)



(2) Uniform intensity mode aimed at avoiding intensity fluctuations until the light source lifetime has been exceeded Sensor with a built-in auto-calibration mode to restore the color gamut and color temperature of the original settings

Figure 9: Constant brightness mode

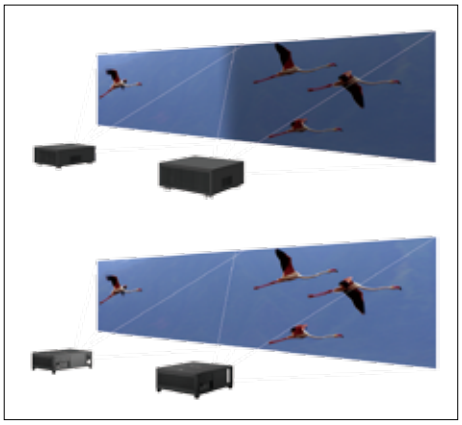
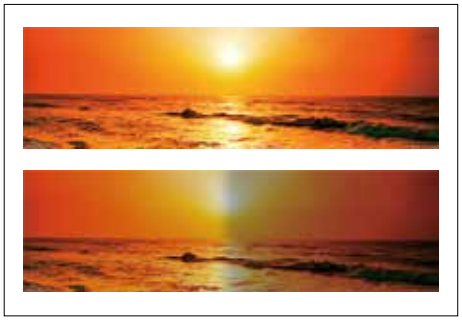


Figure 10: Auto-calibration



(3) Preventing the infiltration of dust by adopting a sealed optical unit with the panel cooled by liquid coolant.

Figure 11: Sealed optical unit

In spring 2016, we plan to launch a new projector incorporating Sony's unique technology for planetariums as introduced above.

	VPL-GTZ270 4K SXRD Laser Projector
Light output	5,000 lm
Resolution	4K (4096×2160×3)
Native contrast ratio	Up to 20,000:1
Maximum color gamut	BT.2020 (80% equivalent)
Light source	Laser diode
Installation angle	360° free angle
Input/output terminals	HDMI (HDCP 2.2)×2, display port (HDCP 1.3)×1, display port (HDCP 1.3 for Vsplit)×1
Operating noise level	≥35 dB (depending on operation mode)
Cooling system	Hybrid (liquid cooling + air cooling)
Maintainability	Light source lifetime of ≥20,000 hours, constant brightness mode, auto-calibration, sealed optical unit

Figure 12: VPL-GTZ270 4K SXRD Laser Projector

Conclusion

Planetariums are widely supported as a type of edutainment that stimulates people's intellect and curiosity. There is no doubt that planetariums will continue to fascinate audiences with an overwhelmingly immersive experience. At Sony, we intend to devote even greater efforts to the creation of industries that provide people with a moving experience and stimulate their curiosity.

Achieving Both High Resolution and High Sensitivity: A 4K-Enabled Network Camera That is Ideal for Wide Area Surveillance

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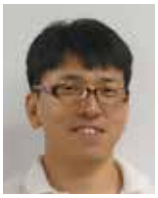


1. Introduction

At Sony, we are working on video surveillance systems such as security cameras and video recorders under the IPELA brand, and we are developing a line-up of products that meet the needs of diverse fields including city surveillance, traffic/infrastructure, school monitoring, retail, finance and business.

The most important requirement of security cameras is "identifiability", or in other words, the ability to identify subjects in any environment. In the pursuit of identifiability, Sony has already made advances such as developing cameras with better sensitivity and resolution, and introducing our proprietary wide dynamic range technology that can handle backlit conditions. This has resulted in picture quality that is highly rated by our customers, and Sony security cameras are providing safety and security all over the world.

2. The development of 4K-enabled network cameras: global trends in security business

With the recent rise in the need for crime prevention, people's perception of security cameras has made a positive turn from "being watched" to "being protected", and these cameras are now being put to use an increasingly diverse range of situations. In particular, there has been continual strong growth in the market for network cameras that not only capture images but also convert them into digital data that is sent directly to a computer network, offering greater flexibility in terms of ease of installation and extensibility, and the ability to transmit, video, audio and control signals via a single LAN cable. This is a field in which Sony has been actively involved since 2002.

The market for network cameras has been growing year-on-year at an annual rate of at least 20% in terms of the number of units sold and gross sales figures, and is expected to continue growing steadily in the future. With the growing need for recognition of details such as people's faces and vehicle number plates, there has been a progression towards higher resolution images (SD→HD→full HD), and on a per-pixel basis, high-resolution network cameras including 4K cameras (4 megapixels and above) have the greatest potential for value-based growth. (Source: IHS Technology)

In this category, which is showing remarkable growth, Sony aspires to become the leader of the 4K security market, and has recently launched its first 4K-enabled network camera, the SNC-VM772R (Figure 1).

Figure 1: The SNC-VM772R 4K-enabled network camera

3. Challenges faced by traditional 4K security cameras

As mentioned above, the identifiability of subjects (even in harsh environments) is the most important quality of security cameras. However, as the resolution of cameras increases, a correspondingly smaller amount of light reaches each pixel. Therefore, although clear 4K images can be obtained in brightly lit scenes, some 4K cameras suffer from inadequate identifiability as a result of having insufficient sensitivity for night time environments or in dark places where security cameras are needed the most. Furthermore, since a 4K camera has approximately four times the resolution of full-HD video, it uses more network bandwidth and storage capacity, which can elevate the overall cost of the customer's surveillance system.

As Sony, we realize that it is essential to overcome these issues if 4K technology is to make further progress in security applications, and we are therefore developing products aimed at fulfilling three primary aims: combining high resolution with high sensitivity, reducing the cost of our customers' security systems, and making the installation of systems an even more user-friendly experience.

Figure 2: High-level fusion of Sony's proprietary technology

4. Using our proprietary technology to combine high resolution with high sensitivity

To achieve both high resolution and high sensitivity, we have optimized and improved our device, design and manufacturing technology for security applications. Specifically, by using an image sensor, signal processing engine and lens developed by Sony and performing precise assembly and adjustment in our own factory based on a high-density design, we have achieved vertical integration from device development all the way through to mass production. (Figure 2)

For example, this is the first Sony camera to include the Exmor R™ CMOS image sensor, which is a large back-illuminated device that provides improved sensitivity and reduced noise.

As shown in Figure 3, a conventional front-illuminated structure sensor is constructed with metal wiring and transistors between the incident light surface and the photodiodes. This not only prevents some of the incident light from reaching the photodiodes, but can cause other issues such as reduced sensitivity at larger angles of incidence. Sony has therefore developed a proprietary back-illuminated structure in which the metal wiring and the photodiodes have swapped places. In a back-illuminated structure, there are no metal wiring or transistors between the incident light surface and the photodiodes. Instead, it has a vertical structure where the photodiodes are sandwiched between the incident light surface and the metal wiring/transistors. This increases the amount of light reaching each individual pixel, and is also able to suppress the loss of sensitivity to light arriving at higher angles of incidence. As a result, we have achieved a 6 dB increase in sensitivity compared with a conventional device.

Although an image sensor based on this model has a very high resolution of 20 megapixels (5472×3648), we have achieved high picture quality by incorporating our own bright, high-resolution lens that makes full use of this high resolution, and a signal processing engine that brings together a range of image processing techniques developed by Sony for cameras ranging from consumer-level to professional equipment. This enables us to achieve a clear reduction of distortion and noise even at the periphery of the lens, where loss of sharpness and resolution normally occur.

By applying these measures, we have substantially improved the identifiability of subjects in low-light conditions where conventional 4K security cameras have run into difficulties as shown in Figure 4. As a result, we have managed to produce an industry-leading surveillance camera that not only has 4K resolution but is also able to capture subjects with as little as 0.06 lx of illumination.

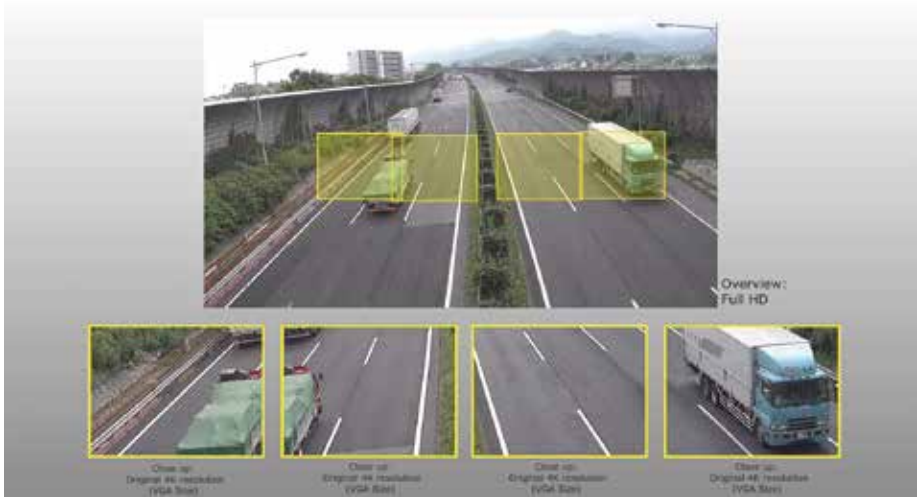
5. Diverse output modes to reduce the cost of security systems

Since it is not always necessary to monitor and record images with 4K resolution, the camera supports diverse output modes that

Figure 3: Image sensor structure

Figure 4: Comparison of images captured in low-light conditions

■ **Figure 5: Intelligent cropping (illustration)**



■ **Figure 6: Intelligent coding (illustration)**

customers can use to save only the parts they need at 4K resolution, thereby alleviating the burden on network bandwidth.

(1) Intelligent cropping to reduce the amount of data by cropping the region of interest (Figure 5)

By specifying a region of particular interest in the 4K image, it is possible to take full-HD video from two locations or VGA (640×480) video from four locations by clipping these regions directly from the original 4K video. Instead of specifying regions in advance, it is also possible to set dynamic regions that automatically track the movements of subjects such as people or vehicles detected in the image.

For example, although full-HD resolution may be adequate for a bird's eye view, cropping parts of this image may produce results that are blurry and have insufficient resolution. With this function, instead of storing the 4K bird's eye image directly, the image is reduced to full-HD resolution, while only the regions of interest are saved in the original 4K resolution. This makes it possible to save the necessary information while reducing the amount of data, and can thus help to suppress the bandwidth and storage requirements that have caused issues with 4K surveillance systems.

(2) Intelligent coding to suppress the network bandwidth by varying the compression ratio between different regions (Figure 6)

With this function, when it is not necessary to have a clear view over the entire region, the image is recorded with a compression ratio that varies between different regions. By using a low compression ratio to encode points of interest in the high resolution 4K image, and a high compression ratio for other regions, the network bandwidth can be suppressed by up to 50%*. As in the intelligent cropping mode, it is also possible to set dynamic regions that automatically track the movements of subjects in the image.

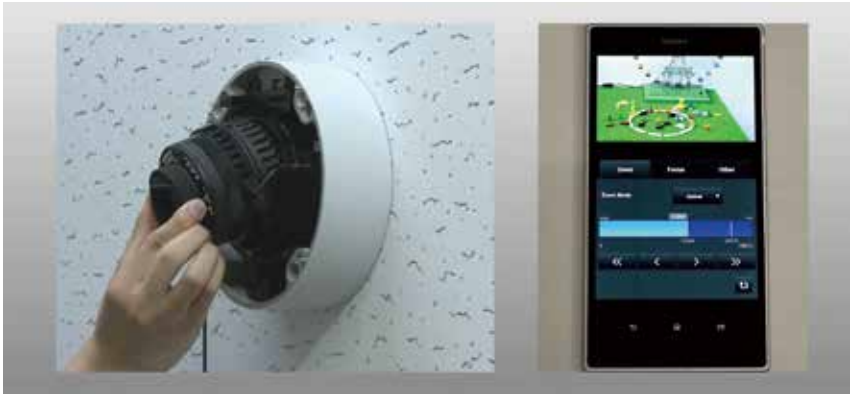
*Assuming 4K 30fps video, with regions of interest set to 30% of the total image.

6. Improved ease of installation

When capturing high-definition video such as 4K, in addition to improving the performance of the camera body, it is also essential to ensure that the camera is set up with the correct alignment and properly focused to make the most of its performance.

When a conventional surveillance camera has been attached

Figure 7: Using the dedicated SNC toolbox mobile app



to a ceiling or a wall, there are basically two ways of adjusting the camera angle. One method is to adjust the camera angle while checking the analog video (composite video signal) output from the camera body. Although this allows angle adjustments to be made without setting up a network, there may be a gap between this signal and the actual high-resolution video because the adjustments are made while viewing the live low-resolution video. The other method is to perform adjustments while checking the video on a PC. Although this allows adjustments to be made while viewing the live high-resolution video, it requires two people; one to adjust the orientation of the camera where it is mounted, and the other to provide this person with instructions while checking the video remotely on the PC. For this product, we therefore added improved installability by making it possible to perform picture angle adjustments simply from a smartphone or tablet using wireless technology. (Figure 7)

Specifically, we made it easier to check the live video by plugging the optional USB wireless LAN module IFU-WLM3 into the camera body so it can communicate wirelessly with devices in which a dedicated app (SNC toolbox mobile) available for smartphones and tablets has been installed. When there are multiple cameras installed, it is possible to display live video by automatically connecting the app to another camera simply by inserting the IFU-WLM3 into the camera, thus making it easier to accomplish the setting up of multiple cameras.

Furthermore, since the basic functions needed when setting up a camera (such as zoom adjustment and focus adjustment) can be operated by the app, we can improve the ease of installation by making it possible for one person to set the optimal camera angle without needing the help of others.

7. The possibility of growing security with 4K

Since 4K technology not only has higher resolution but also makes it possible to acquire a lot of other information at once, it is thought that it will give rise to new styles of use outside of conventional surveillance applications. For example, even if there are many cameras used to cover a wide area, there is a limit to how many cameras a single surveillance operator is able to watch. Although there are also systems where a surveillance operator can watch over a wide area by using a PTZ camera (a camera that can rotate and zoom), this approach creates blind spots everywhere outside the camera's current field of view, resulting in an increased likelihood of overlooking or failing to capture important events. With a 4K security camera, a single camera can be used to obtain a bird's eye view while at the same time producing detailed and identifiable images that prevent important events from being overlooked or missed, enabling the implementation of an advanced security system that does not rely on a skilled operator.

Also, despite recent growth in the demand for city surveillance and the like, there are a growing number of cases where security systems are shared by a diverse range of users for purposes other than crime prevention. Since a single 4K security camera is able to capture a large amount of information down to the finest details, it is thought to expand the range of possibilities in various other applications besides surveillance, such as making traffic flow measurements, ascertaining the state of a train service, recognizing accidents on highways, and managing safety on construction sites.

By equipping our cameras with Sony's proprietary CMOS image sensors and signal processing engines, we are deploying a broad line-up of network cameras from high image quality models to models at ordinary price levels. We hope that the introduction of these 4K-enabled products will help us to propose new solutions for the security market, whose needs are continuing to grow.

Cover Art

Gonin bijin aikyo kurabe "Hanazuma"
Comparing the Charms of Five Beauties Hanazuma of the Hyogoya

Kitagawa Utamaro (1753-1806)

Woodblock print:
Courtesy of Sakai Kokodo Gallery

Proposed New Applications for 4K Tablets

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IT Products Business Division,
AVC Networks Company, Panasonic Corporation

1. Introduction

As 4K technology (which has four times the resolution of Full HD) starts to gain traction in connection with video content such as broadcasting, VOD (video on demand) and Blu-ray disks, work is now under way to establish 4K production environments. For example, there are plans to begin 4K/8K broadcasts in time for the 2020 Tokyo Olympics. In fact, some commercial services such as VOD have already started offering 4K content.

However, the high-definition expressive capabilities of 4K are not limited to video content applications such as broadcasting and VOD, but can also be applied in a wide range of other fields. In particular, when 4K video is shown on an ultra-high definition display, it can produce images with no perceivable graininess that are a world away from what can be achieved with conventional video technology. By concentrating on this new expressive capability, we have developed a 4K tablet as a "paper substitute" to make the expressive capabilities of 4K technology available in new domains outside of TV.

2. Features of the 4K tablet

High-definition display

The biggest feature of our 20-inch 4K tablet (the world's first such device) is the new ultra-high resolution 4K liquid crystal display that we developed for this product. This is a 230 ppi (pixel per inch) high-resolution liquid crystal panel that is capable of displaying pictures in which it is impossible to see the individual dots. The aspect ratio of the display was set to 15:10 (3:2) instead of 16:9 (the aspect ratio of TV) in order to facilitate the display of catalogs, drawings and various forms that are used in many businesses. Specifically, a 20-inch 15:10 4K display (3,840 × 2,560 dots) is able to display about the same area as a printed page of A3 paper. Furthermore, the IPS (In-Plane-Switching)-α method used in this liquid crystal panel delivers a large aperture ratio, high brightness and a wide viewing angle (176°), which means that when laid flat, it can be viewed from any direction with hardly any hue distortion. This makes it ideal as a replacement for paper when, for example reviewing the context of printed matter or drawings.

Photo 1: 4K tablet with pen

High resolution pen

One of the advantages of working with paper is that it can be written on, so to provide this capability we also developed an electronic pen that can be used to write directly on the screen. This pen works by reading invisible address information printed into a film on the surface of the screen. Since this method can be implemented simply by sticking a very thin film to the surface of the display, it does not require the installation of devices to generate electromagnetic fields and receiving circuits next to the display, as would be necessary for electronic pens based on conventional electromagnetic induction technology. This has advantages in terms of the thickness, weight and cost of the device. Also, since the pen tip position can be calculated by directly reading the information representing the position on the screen the pen tip is in contact with, it is possible to judge the position of the pen tip very accurately. As a result, there is little discrepancy between the screen writing position and the position of the pen tip. This method also has the advantage that there is no need for routine calibration of the pen tip position.

Lightweight, thin, tablet configuration

Since this is a new product that can replace paper in business situations where paper has hitherto been used, we selected a tablet form that can be used when surrounded by several people instead of a traditional desktop PC or notebook PC format. By using our own display device that is comparable in size to a sheet of A3 paper, we developed a portable tablet that weighs 2.3 kg and is only 12.5 mm thick. Despite the thin package, we managed to include all the functions of a regular PC, including a high-performance CPU (central processing unit), GPU (graphics processing unit), memory, and SSD (solid state drive). It also uses Windows™, allowing a wide variety of business applications to be installed.

To make it possible for this exceedingly thin tablet to incorporate many devices, we have made use of our extensive technical expertise in the development of products such as mobile phones, portable audio players, and mobile PCs. For example, by using direct hot melt technology to attach the magnesium alloy frame to the liquid crystal display panel with a touch panel glued on by direct bonding, we can make the tablet very strong despite its very thin profile, thereby offering robust performance

in business situations. This result was achieved using Panasonic's mechanical design technology. Specifically, the device is tough enough to withstand a 76 cm drop test in the direction of its rear panel while operating, and 30 cm drop tests in 26 different directions when switched off. We are currently promoting this device for use in new 4K applications by various industries. (Figure 1)

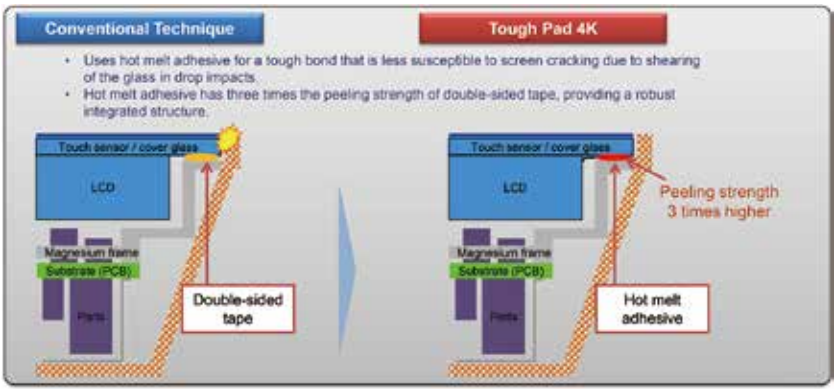
3. New 4K applications where the use of a 4K tablet is proposed

We propose exploiting the advantages of this 4K tablet for diverse industries where value is placed on characteristics such as providing a substitute for paper, improving the portability and east of installation of high-resolution displays, and substituting real objects. Some examples of our envisaged applications are introduced below(Figure 2).

In the office: A conferencing system for executives

In an electronic conferencing system using a 4K tablet, it is possible to display images of the same quality as the output of an A3 printed paper, and these images can also be used in the same way as ordinary paper. For example, on a conventional device, the text quality is liable to break down when displaying an overview of an entire document, while on the other hand enlarging the displayed image would make it impossible to see the whole document at the same time. However, since a 4K tablet provides a high-resolution display where it is possible to see an overview of a document equivalent to a whole sheet of A3 paper, there is no degradation of text quality. This feature is very popular among executives who often have the opportunity to see detailed numbers containing business figures or the like. Of course, it is also possible to enlarge the displayed image if required. It is also possible to use a pen to write directly onto the screen in order to leave handwritten notes in the same way as when using conventional paper documents. Since the materials are stored in digital form, they can be used in presentations that were not possible with conventional paper documents, and it is also possible for pointers and annotations (notes) to be shared simultaneously between remote locations. Since there is no need to print out paper documents, it is possible to operate business meetings more flexibly by, for example, replacing materials just before or even during the meeting. By going paperless with a 4K tablet in this way, it is possible to retain the advantages of paper while eliminating the cost of buying paper and the labor involved with printing, copying and distribution of paper documents. It is also necessary to manage security concerns in that when documents are printed on paper, there is a risk of information being leaked due to pages being dropped during printing or being left unattended, and the documents have to be shredded before disposal. These are things that do not have to be considered in a paperless environment. Since last year, we have been introducing a conferencing system based on 4K tablets in some of our executive meetings.

■ **Figure 1: Hot melt fabrication process**



■ **Figure 2: Overview of proposed solutions**

Applications of 4K tablets in various industries

Field / Values	Finance	Architecture/ construction	Transportation/ travel	Medicine	Broadcasting
Paper substitute	Executive conferencing systems				
	Counter terminals	Reviewing drawings	Digital catalogs		Electronic flip charts
A high-resolution screen that is easy to carry/install		CAD design	Kiosks	Endoscopy	Portable 4K monitor
				X-rays	
Substitute for real objects			Cosmetic simulators		
			Virtual museums		
			Car configuration		

■ **Photo 2: Tablets being used at an electronic conference**

In manufacturing: Reviewing drawings (PDF/CAD)

Using a 4K tablet, it is possible to see drawings very clearly with a resolution comparable to that of printed A3 hard copies, and to represent these drawings in a variety of different ways. This is achieved by exploiting the advantages of the display in the same way as the conferencing system described above. Detailed circuit diagrams can be displayed in their entirety without losing any lines, so that detailed parts can be checked while viewing the entire circuit. In this way, since it is possible to display images with the same quality as A3 print-outs, there is no need to carry

around large quantities of paper diagrams. Also, since the screen can display curved surfaces without any visible "jaggies" (jagged edges), it produces results that are closer to reality.

Photo 3: Reviewing a drawing on the tablet

In particular, the process of reviewing three-dimensional models using technologies such as 3D-PDF (3 Dimension-Portable Document Format) has hitherto entailed printing out many hard copies of the models from various different angles, whereas the 4K tablet can display 3D objects from any viewpoint. Furthermore, 3D-PDF documents can be directly annotated with handwritten comments and shared via network connections to reviewers in remote locations, thereby making the review process more convenient than the conventional paper-based approach, while maintaining the same image quality as documents printed on paper. In addition, by bringing design tools such as CAD (computer-aided design) software into the review process, it is possible to implement a more efficient design workflow by modifying, checking and authorizing the design at the review stage. Here, it is possible to eliminate the cost of paper, printing and delivery, the time and effort involved with printing out the documents, and the work associated with sending design alterations back to the design room, having these alterations reviewed again, and so on.

Photo 4: 3D CAD

In broadcast program production: An electronic flip chart

When a 4K tablet is used to display an electronic flip chart, it generates no Moiré effects (striping) when its screen is captured on a FHD (full high definition) broadcast camera or the like. This is because the display resolution of the 4K tablet is at least as large as the camera resolution. It thus produces the same captured picture quality as a paper flip chart, making it a realistic alternative to paper. With a conventional paper flip chart, it is necessary to perform various steps such as preparing the data that is actually printed, printing the chart out, pasting it to a board, carrying it to where it is needed, and so on. This has made it difficult to keep up with situations where data is being urgently updated. The cost of board preparation, transportation and the like also have to be considered. However, as with the other paperless solutions, these issues can be resolved by making the flip chart digital and capturing images of the same quality as ordinary paper print-outs. By including content such as videos and animations, an electronic flip chart can display things that cannot be depicted by printing onto paper flip charts. It can also save on the costs of materials, printing, transportation and the like, and on the labor costs of printing and binding, and makes it possible to replace the contents of the flip chart just before or even during a program. Since it can also send data over the network, it facilitates a new and unprecedented style of reporting where up-to-date information such as disaster alerts can be prepared by the broadcaster, delivered as data to the relay destination, and then described at the location of the corresponding news story.

Photo 5: Electronic flip chart example

In banks: A counter terminal

Since the 4K tablet has a high resolution display, it can display documents such as catalogs and customer agreements clearly and without blurriness, with the same quality as documents printed on paper. Furthermore, these documents can if necessary be enlarged to any size to suit the customer's viewing preferences. As described above, since this display can be viewed from any angle without hue distortion, it is suitable for being used while laid flat on a desktop. It is also equipped with tools such as the ability to change the display orientation with a single touch. Since it is possible to write directly onto the screen, the tablet can be used to perform the same role as a conventional paper document in various application procedures. This eliminates the need to print out large quantities of catalogs and customer contracts. And since the 4K tablet is also a PC, it can be used not only for simply displaying data but also for retrieving customer details and running simulations of financial products, thereby making it possible to provide counter services that are explained better than by conventional paper pamphlets, such as descriptions that are tailored to each individual customer. We are starting to introduce this technology into counter businesses such as financial institutions.

Photo 6: Example of deployment at a financial services counter

In medicine: Displaying X-rays

The 4K tablet can be of particular use in the medical field, especially when describing a patient's symptoms. For example, mammograms used for breast cancer screening are stored at a resolution of about 5 Megapixels. This 4K tablet allows two mammograms to be displayed side by side on the screen, thereby making it easier to compare multiple images such as a patient's current and previous mammograms. Since this 4K tablet is lightweight and can run on batteries, it can also help to lessen the burden on patients by enabling doctors to explain their diagnosis wherever the patient is. Doctors can also use the screen writing function to write down their observations and other notes in the medical records on the screen, and can even be used in discussions and the like at remote locations. Of course, when taken to a conference or the like, it is possible to connect to a 4K large-screen device to display a clone (copy) of the current high resolution display while the presenter provides a description that is easy to understand while adding annotations and the like by writing on the 4K tablet screen.

Photo 7: Displaying mammograms on the tablet
Screenshot of Plissimo network system (Panasonic Healthcare Co., Ltd.)

In the sales room: Digital catalogs

When using the 4K tablet as an electronic catalog, it is not only possible to provide a display of at least the same quality as a conventional paper catalog, but it is also possible to videos and animations and "real reproduction" content that cannot be shown on paper, including simulations of different colors and optional parts. An example would be a car configuration tool in the showroom of an automobile dealer. Since a large amount of catalog data can be completely stored in the tablet, there is no need to follow wealthy customers around with bulky printed material from foreign traders and the like, allowing the salesperson to provide the client with high-quality presentations. The high-quality screen can also be used for various enhancements of conventional catalogs, such as presenting simulations of cosmetics and the like, which are expected to be increasingly used for sales promotion in the future.

Photo 8: Electronic catalog example

In the studio: A portable 4K monitor

The 4K tablet also has a 4K video input. Instead of using conventional 4K monitors that can be impossible to carry onto the shooting location, it is expected that the 4K tablet will be used as a thin lightweight 4K field monitor, allowing the captured video to be instantly played back and checked. The 4K tablet could also be used as a space-saving, portable monitor for endoscope equipment in hospitals.

4. Summary

In this article, I have introduced some applications of 4K tablets in a range of different fields. In summary, we have implemented a 4K, 20-inch tablet with an aspect ratio of 15:10 and a high-precision pen. This device offers the clarity of printed material together with functionality that is not available in printed material. In diverse businesses using this 4K tablet, it is possible to eliminate the costs of paper and printing, the labor costs associated with the preparation of these printed articles, and the transportation costs associated with delivering the printed results to where they are needed. Also, the time saved by eliminating the need for printing and transportation means that content can be substituted right up until the moment it is used. Using digital technology makes it possible to display content in combination with movies and interactive systems, which is not possible in printed material. Furthermore, since the frame is not just a substitute for paper, but also a portable tablet with a 4K display, it can be used in places where high-resolution information is preferred but was not hitherto available. This means that it can be used as an "on-the-spot" device for checking CAD data, diagram data, medical X-ray images and the like. In the future, we hope to work towards making this 4K tablet even more useful so that it can be used in a wide range of applications in diverse industries. I will continue to work towards expanding the range of applications for this device in diverse industries.

An RGB Laser-backlit Liquid Crystal Display

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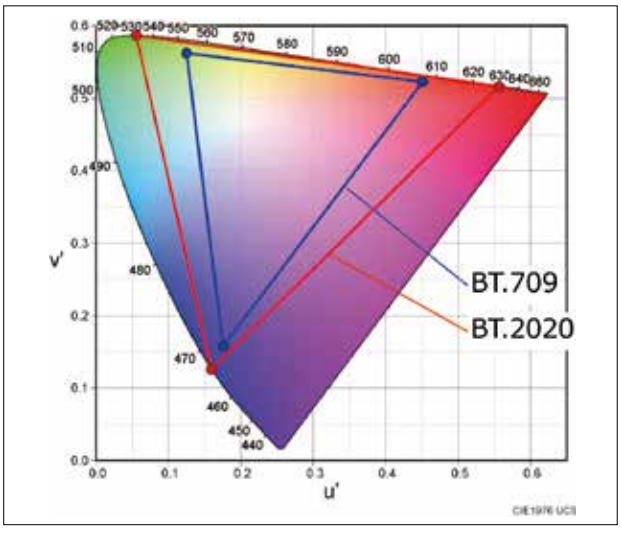
1. Introduction

Test broadcasts of 4K video began in Japan in 2014, and actual 4K broadcasts are scheduled to be started by CS during the 2015 fiscal year. In addition, according to the roadmap of the Ministry of Internal Affairs and Communications, the plan is to commence practical broadcasting of 4K/8K programs in 2018, and to broadcast most of the events at the 2020 Tokyo Olympic and Paralympic Games in 4K and 8K. This move towards high-definition video is due to the establishment of ITU-R Recommendation BT.2020 by the International Telecommunication Union (ITU) in 2012. This recommendation prescribes not only video formats for ultra-high definition television (HDTV), but also the color gamuts of display devices. Compared with the earlier ITU-R Recommendation BT.709, which relates to HDTV, BT.2020 calls for a gamut that is approximately 1.7 times larger on the u'v' chromaticity diagram (Figure 1).

To take advantage of the wide gamut characteristics of BT.2020 in a liquid crystal display, it is necessary to not only improve the performance of the color filters in the liquid crystal panel, but also to expand the color gamut of the backlight by increasing the color purity of the light source. Mitsubishi Electric has already researched the expansion of color gamuts by using laser diodes with high color purity as light sources for televisions, and in 2012 we released the *Real Laservue (LCD-55LSR3)* laser-backlit liquid crystal television. The *LCD-55LSR3* was the first consumer-oriented liquid crystal television to incorporate a backlight made using red semiconductor lasers.

We have now applied our laser backlight technology to a wide-gamut 4K liquid crystal display monitor that can display the BT.2020 gamut by using a backlight with semiconductor lasers in three primary colors (RGB), which we developed in partnership with NHK's Science & Technology Research Laboratories. This article presents an overview of this new display monitor.

Figure 1: Color gamuts of HDTV (BT.709) and UHDTV (BT. 2020)



2. Expanding the color reproduction range of a liquid crystal display

In a liquid crystal display, the liquid crystal display elements contain color filters that extract the red, green and blue spectral ranges of the light emitted from the backlight in order to display any color. If the backlight uses light-emitting elements that have a continuous spectrum over a wide bandwidth, like white LEDS for example, then to improve the color reproducibility it is necessary to use filters with a narrower passband. However, this means that less light passes through the color filters, making it difficult to achieve sufficient brightness. In other words, it is necessary to use more light-emitting elements and/or increase the input power, resulting in increased power consumption. Therefore, to improve the color reproducibility of a liquid crystal display, it is necessary to increase the color purity of the light source.

3. An RGB laser-backlit liquid crystal display

3.1 Backlight system

The backlight in a liquid crystal display is required to provide the liquid crystal panel with uniform planar illumination from its back surface. When using lasers as the backlight light sources, it is important to be aware that lasers and LEDs have very different emission characteristics. Compared with an LED, a laser has a much smaller light-emitting area and a smaller divergence angle, and it is thus not possible to ensure uniform illumination without performing adequate diffusion. Our newly developed RGB laser backlight has laser light sources places along the left and right edges of the screen, and diffuses this light by means of a diffuser component made of cylindrical light guide rods. These light guide rods are made from a transparent substrate containing a small quantity of a diffuser material, and have a laser light source situated at one end. Light emitted from the lasers enters the light guide rods in opposite directions and propagates along them by total internal reflection. Light that shines on the diffuser material contained in the light guide rods undergoes diffuse

Figure 2: Principle of light emission from light guide rods

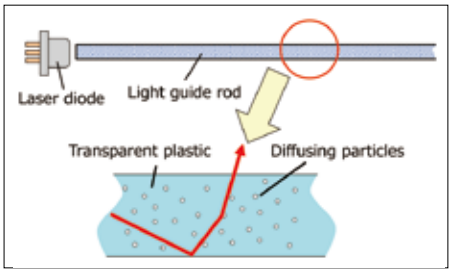
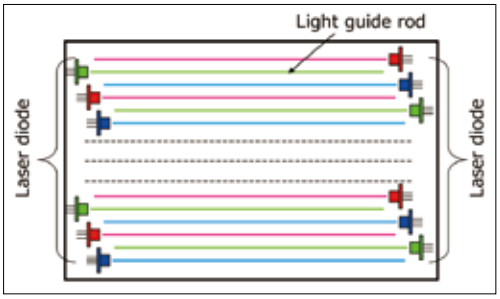


Figure 3: Layout of light sources



reflection (or transmission), which causes its propagation direction to change. When light whose direction has been changed in this way reaches the surface of the light guide rod at an angle that is too steep to satisfy the conditions for total internal reflection at the air-rod interface, it escapes from the rod in the circumferential direction and is emitted like light from a fluorescent tube (Figure 2). Although the light emitted from the light guide rods has a longitudinal intensity distribution, this is optimized by appropriately adjusting the concentration of diffusing material contained in the rods. As shown in Figure 3, the light guide rods are aligned with the light sources in the vertical direction of the screen.

3.2 Light sources

The gamut stipulated by BT.2020 is defined by RGB primary colors on a spectral locus shown on the chromaticity diagram corresponding to wavelengths of 630 nm (R), 532 nm (G) and 467 nm (B). In an RGB laser backlight, each of these light source wavelengths is selected as a target. For ease of handling, the light-emitting elements for each color are sealed inside a metal container (package) of the same shape, with a flange part (stem) diameter of 9.0 mm.

3.3 Liquid crystal panel color filters

As shown schematically in Figure 4, the color filter transmission characteristics have different passbands for the R, G and B colors. In particular, there is an overlap between the B and G passbands. Therefore, when displaying B on the screen, the color is diluted by being mixed with G light (reducing the color purity). To remedy this mixing, we adjusted the B filter. In Figure 4, the dotted line for B shows the initial transmission characteristic, and the solid line shows the improved transmission characteristic. By improving the color filter transmission characteristic in this way, we have actively suppressed the panel's loss of color purity.

3.4 Optical characteristics of the display

Figure 5 shows the results of using a spectral radiometer to measure the color reproduction range of this display, plotted on a CIE 1976 chromaticity diagram. The gamut is almost identical to that of BT.2020, thus confirming that this is an ultra-wide gamut liquid crystal display that can cover 98% of the BT.2020 gamut.

4. Summary

In a joint project, Mitsubishi Electric and NHK Science & Technology Research Laboratories have developed a laser-backlit liquid crystal display that has a wide color gamut corresponding closely with the provisions of BT.2020 by using RGB semiconductor lasers in the backlight. This display was presented at NHK's Science & Technology Research Laboratories Open House event in May 2015, and at CEATEC JAPAN 2015 in the following October.

Figure 4: Light source spectra and transmission characteristics of color filters (schematic)

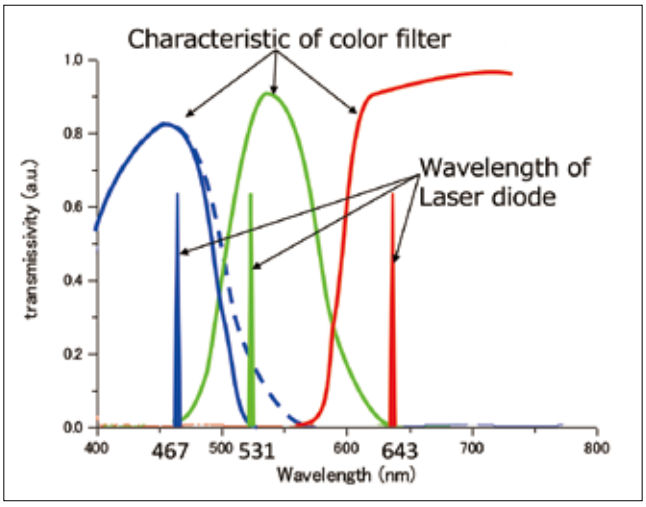
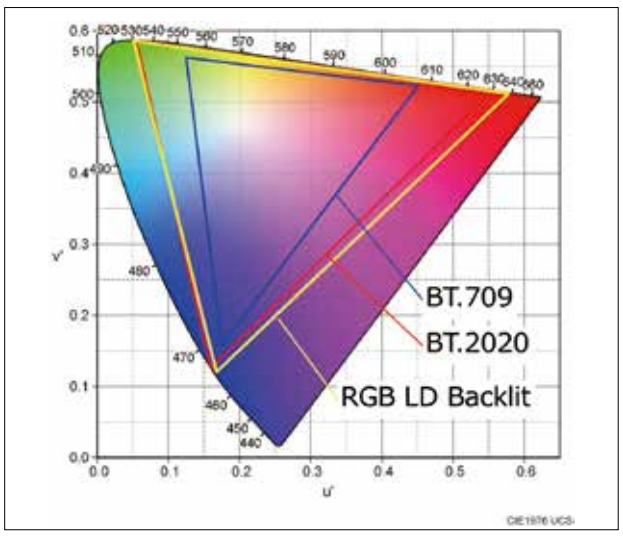


Figure 5: Measurement results: chromaticity diagram



Creating an Innovative Environment with FabLab – Case study: Bohol, the Philippines

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1. Introduction

A recent trend in ICT has been the creation of products by private citizens using digital fabrication equipment such as 3D printers and laser cutters based on data available on the Internet, and producing no more than the required quantity of products at a time. This new style of production has been called the "maker movement" and even the "third industrial revolution" in contrast to the conventional mass-production/mass-consumption model.

Governments around the world have started to adopt this new trend in their economic policy. In Russia, FabLab digital fabrication facilities (described below) were set up at a hundred locations in 2013. And in the US, the government has pledged that the 2015 national annual budget of $2.9 billion would be devoted to installing digital fabrication facilities in a thousand public schools. In France, the government announced that it would establish digital fabrication facilities in all regions under its digital district policy.

This movement is also prevalent in emerging/developing countries, which are keen to bolster economic growth by joining the "third industrial revolution" following the success of India and Korea, which achieved rapid growth during the IT revolution of the 1990s and early 2000s.

2. Making Products with the FabLab Network

The creation of new products in emerging/developing countries is supported by a set of laboratories and a worldwide network called FabLab (Fabrication Laboratory / Fabulous Laboratory). FabLab is a worldwide creative network aimed at supporting mutual cooperation to make better use of ICT. There are 581 FabLabs across 82 countries as of November 2015 (Fablabs.io 2015). Each FabLab offers a product development environment equipped with a set of digital fabrication hardware such as 3D printers and programmable micro-controllers, but is also open to citizens who want to fabricate personalized products utilizing ICT and open-source devices.

There have been quite a few cases of FabLab-enabled innovations, from the original 3D printers to smart houses at the grass-roots level all over the world (Tanaka 2012). Some innovations have occurred in developing countries like Ghana and Kenya, where unique processors for local food ingredients were developed. In Afghanistan, a young 'Fabber' produced wooden WiFi routers that make it possible to provide wireless Internet access even in remote hilly areas. Other interesting examples include a sensing device for the fat content of milk, and a hundred-dollar weather data logger for local agriculture, developed at the FabLab in Pabal, Pune, India (Gershenfeld 2007). These innovations were born in rural areas far from cities, clearly demonstrating the innovation potential of using FabLab in rural areas of developing countries.

The first FabLab in the Philippines was established in May 2014, since when the government has actively supported its expansion for economic growth and micro/small-sized economy build-up.

To examine the possibility of creating new products with ICT and FabLab in a developing country, this article describes a case study of how the first FabLab in the Philippines was established as part of a project to reduce poverty by building up an innovation environment using FabLab.

Photo 1: Delta type 3D printer produced at the FabLab Kannai in Japan

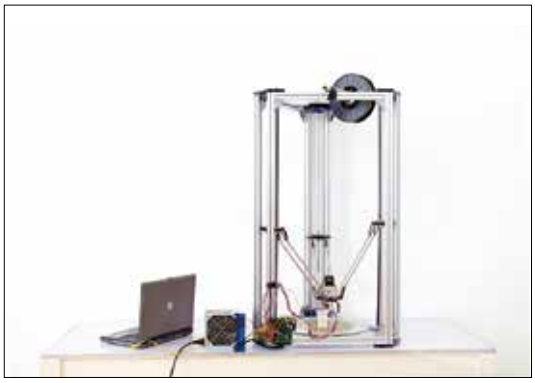


Photo 2: A "FabFi" wooden WiFi router produced at the FabLab in Afghanistan

Photo 3: Inside the Bohol FabLab

3. FabLab for Local Problem-Solving

The first FabLab in the Philippines was established in Bohol, which is two hours' flight from the capital Manila, and two hours by ship from the second largest city, Cebu. The total population of the province is 1,255,128. The provincial capital, Tagbilaran City, has a population of approximately 100,000 (Province of Bohol 2015). Bohol is now known as a safe island, but the local economy is still suffering from under-development due to the post-effects of anti-government activities in the past.

The project aimed at reducing poverty by using FabLab to build up the innovation environment was handled by the Provincial Office of the Department of Trade and Industry Bohol Office (DTI Bohol), which is a local government organization composed of 27 staff whose main mission is to promote economic growth in the locality.

One of the main reasons why DTI Bohol decided to adopt the FabLab concept without any prior experience is because the region faces serious logistical problems due to its geographical situation. The Province of Bohol consists of a main island and more than 70 other small remote islands, which means that product distribution has to rely on sea transport. However, it has no ports that are able to carry large-scale vessels, and therefore all product distribution is centered around the Port of Cebu on the other side of Bohol, which takes two hours to reach by high-speed boat (or 4–5 hours by freighter).

Almost all freight destined for Bohol is shipped in large containers that are first carried to the Port of Cebu for temporary storage in warehouses. It is then divided and repacked into smaller containers so that small carriers can come to pick them up for transport to the smaller Port of Bohol.

Manufacturing industries require that various materials and consumables are available in stock almost all the time. But in Bohol, this is too expensive due to the high cost of shipment and storage. Thus high procurement costs push up production costs, making products from Bohol less competitive than products made in Cebu that can be marketed in the same town. It is therefore very difficult for Bohol to create products whose market value can cover the production cost.

In an extreme instance, there are only two ways in which manufacturing-based local businesses can be promoted under these circumstances:

- Producing high-quality products that can compete with their counterparts from outside the province
- Creating innovative products that are not sold outside the Province

The DTI appears to have been unsuccessful so far in finding solutions and measures to overcome this logistics problem in Bohol, which has been one of the major problems preventing growth of its manufacturing industry.

While visiting the area with the Japan Overseas Cooperation Volunteers (JOCV) of the Japan International Cooperation Agency (JICA), I proposed that this problem could be solved by implementing the above-mentioned project to reduce poverty by introducing an innovation environment with FabLab. This project was aimed at generating innovation that could benefit the local economy by using digital fabrication, while drawing on FabLab's worldwide product making network. The first step was to establish a FabLab as a production environment and as a base for further work.

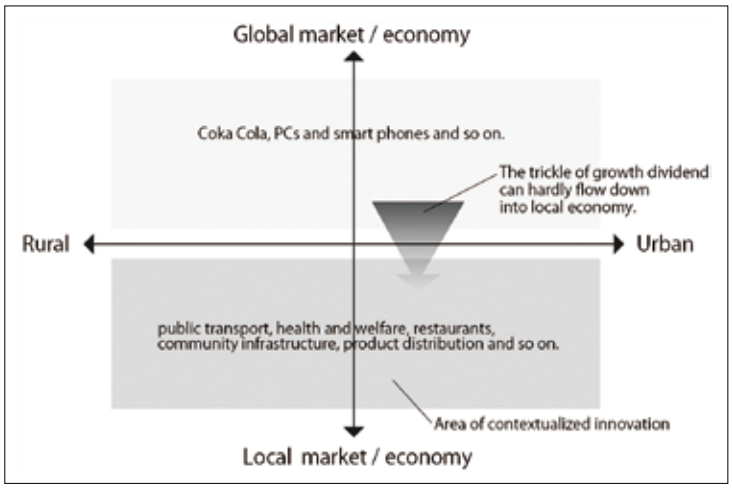
This project was conducted jointly by DTI Bohol, JICA, the Department of Science and Technology (DOST) Bohol Office, and the Bohol Island State University (BISU). These organizations shared the initial cost of about $122,000 (Php 6,300,000), including the cost of equipment and consumable goods, and the renovation of building facilities.

Although this project was proposed and started by one JOCV volunteer, it was allocated a fairly large budget because the local government supported its core idea of "contextualized innovation" in the form of local projects.

I should point out that "contextualized innovation" is not limited to innovations that are adequately competitive in the global economy, but also to innovations that can improve the well-being of a small local area, including the effectiveness and efficiency of local institutions or individuals. Specifically, contextualized innovation is context-based innovation that brings breakthroughs or improvements to the *status quo* of local individuals and organizations engaged in businesses such as transport, health and welfare, restaurants, community infrastructure and product distribution, and local groups that mostly consist of such people. The overall goal was to revitalize the local economy by contextualized innovation. To explain contextualized innovation more concretely, micro recycling facilities would be a good example.

In Bohol, a lot of plastic waste is discarded everywhere by the roadside. The situation gets worse further away from the provincial capital. On the other

Figure: Conceptual diagram of contextualized innovation



hand, there is no steel waste, because steel is easy to process and recycle at the local steel mills, so scavengers collect and bring the steel waste to local mills for cash. If there are many local facilities that process plastic waste as a new production material, plastic waste will disappear from the streets. Community projects such as micro recycling facilities can therefore improve the *status quo*.

At the planning stage, this facility was quite simple, consisting of a customized glue gun with an attached device that uses heat to reprocess waste plastic (polyethylene/plastic) from shopping bags into long strings. The actual presentation regarding the micro recycling facilities went like this:

> "When plastic is heated, it becomes soft and can be reprocessed into a recyclable material. It's not difficult to build a facility by ourselves. But if we want to improve the quality and make this string salable at the market, we need to cut aluminum parts more precisely. This can be done using the digital fabrication facility installed in the FabLab."
>
> "The existing local MSMEs could then weave a new fabric of Bohol origin using the reprocessed strings, and local bag producers could make a new eco-friendly bag from the new fabric. The resulting project could simultaneously achieve a more beautiful Bohol and a new local industry while creating a strong brand of *Made in Bohol*."

Despite its simplicity, this idea can create highly intense and durable local fabrics by keeping traditional and natural textures made from plastic strings as the warp, and local natural raffia fibers as the woof. If the production of a "micro recycling facility" is realized, then

- Scavengers collect plastic waste, and local recycling processors make plastic string out of the wastes as a new industry
- Existing local MSMEs can use the reprocessed strings weave a new fabric of Bohol origin
- Local bag producers can make new eco-friendly bags from this fabric

At the beginning of the project, a series of preliminary meetings were held with each organization. We stressed the ease with which simple facilities can promote local production using digital fabrication tools at FabLab. As a result, these organizations recognized FabLab's importance, and were persuaded to go ahead with the project.

The development of this micro recycling facility has continued in collaboration with FabLab Kannai through the FabLab network. This facility makes it easier to recycle plastic and create products using new recycling materials based on the concept of local production for local consumption. The Tagbilaran city government is currently planning to build up these facilities at all 15 barangays.

At the time of writing (November 2015), a year and a half has passed since FabLab Bohol was established, and other contextualized innovations have been made besides the micro recycling facility. For example, people have created crafts and food packaging for local firms, and used a 3D printer to produce molds for the mass-production of local foods and soaps. Coconut shells have been adapted to make coin cases based on an original design, and production was started by local people who lost their jobs due to the aftermath of

Photo 4: Material from reprocessing plastic bags to form long strings (upper), fabric hand-woven with the plastic strings as warp and wool as woof (lower left), and fabric hand-woven with the plastic strings as warp, and local natural fibers called raffia as woof. The raffia is made from buri palm trees (lower right)

Photo 5: Low-cost construction of public office buildings built with digital fabrication facilities designed by Keio University

Photo 6: The product of an entrepreneur who aims to launch a lighting system that can be controlled by a smartphone app

the earthquake disaster. Public buildings are also being constructed inexpensively by combining traditional Asian joint structures with digital fabrication technology. Several other innovations have been achieved in a similar manner.

Moreover, a young entrepreneur created a controllable lighting system based on a smart phone and a micro controller. His interest in starting a business came about as a result of an encounter with FabLab, so we are achieving overall goals of stimulating projects that have a positive economic impact.

The impact of the Bohol FabLab has been highly praised at the national government level by President Aquino, and this endorsement has led to a range of government activities promoting FabLab, such as a multi-sector FabLab study meeting held by the DTI Secretary (Manila, Dec. 2014) and a large-scale awareness-raising event for citizens (Feb. and Oct. 2015, Manila).

Thanks to these promotional activities, the number of FabLabs in the Philippines increased from one in 2014 to three at the time of writing (Nov. 2015). At least eight more labs are in the pipeline, and I am certain that the number of FabLabs will reach 11 by early 2016.

4. Concluding Remarks

At Fab9 (the 9th Global Conference of FabLabs), the Japan International Cooperation Agency announced that it would seek to exploit the potential of FabLabs for socio-economic development and project formulation in development cooperation programs. The World Bank also reported on the scenes of the 10th conference (FAB10) and FabLab's impact on development. With this level of exposure, I expect that new forms of manufacturing, FabLabs, and development cooperation using innovation will gain momentum.

However, there are still questions remaining, such as how exactly can a development cooperation program including FabLab be implemented, and what conditions do we need for Fablab to generate further contextualized innovations? Scholarship in this area has just begun, and various challenges will emerge in due course. Yet I commit myself to move ahead my research program, which might contribute to innovative joint development projects in developing countries.

Note: This article is based on the personal views of the author, and is not an official view of any specific organization such as Keio University and JICA.

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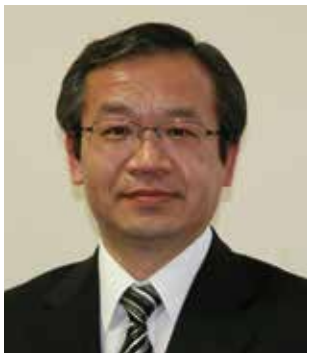
Photo 7: President Benigno Aquino III evaluated this activity highly and announced the expansion of the FabLab network all over the country

Appointment of a New ASTAP Chairman



Yoichi Maeda
CEO & S.V.P.
The Telecommunication Technology Committee

ASTAP, Asia-Pacific Telecommunity Standardization Program, is a program established in 1998 for the standardization of telecommunications in the Asia-Pacific region. Its aims include (1) contributing to international standardization by constructing systems for cooperation and coordination of standardization efforts in the Asia-Pacific region, (2) cultivating standardization proponents within the region and supporting the development of telecommunication skills among members within the region, especially in developing countries, and (3) submitting the region's joint standardization proposals to the ITU and other international standards organizations.

Until 2010, ASTAP was chaired by Bob Horton (Australia), one of the committee's founding members. However, following the changes made to the ASTAP's working methods in 2010, this post was limited to two two-year terms and Seyed Mostafa Safavi (Iran) was appointed as the second chairman. At the 24th ASTAP Forum in August 2014, I was accepted as the third chairman.

The Telecommunication Technology Committee (TTC) has been an affiliate member[1] of the APT since 2008, and with the aim of contributing to studies to strengthen cooperation among developing countries in Asia and bridge the standardization gaps, it has been playing an active role in ASTAP's standardization efforts. In particular, we have been part of the APT project since 2007, where we have been ascertaining the demand for, and utility of, solutions that use ICT to address social issues in fields such as healthcare, education, agriculture, the environment, and disaster relief, and we have been actively developing the fruits of this work within ASTAP.

The photograph shows the plenary session of the 25th ASTAP, which was held in Bangkok from the 2nd to the 7th of March[2]. I am seated in the middle, between the new APT Secretary-General Ms. Areewan Haorangsi and the new APT Deputy Secretary-General Mr. Masanori Kondo. This ASTAP forum was attended by approximately 130 people, including senior representatives from 23 of the 38 member countries[3] of APT (Asia-Pacific Telecommunity)[4].

Photo: ASTAP plenary

The new system of the ASTAP has a three-layer structure. Standardization issues are assigned to a first layer comprising 12 Expert Groups (EGs). These EGs are consolidated and classified into a second layer comprising three Working Groups (WGs): a Working Group on Policy, Strategy and Coordination (WG PSC), a Working Group on Network and System (WG NS), and a Working Group on Service and Application (WG SA). The WGs collect results from their subordinate EGs and iron out any differences between them. The third layer is formed by the plenary, which performs overall adjustment and gives final approval.

The EGs hold discussions on technical subjects such as bridging the standardization gaps, the relationship between ICT and the environment, M2M, future networks and next-generation networks, security, speech translation/natural language processing, seamless access, disaster prevention/recovery systems, multimedia services including the next-generation Web, and accessibility.

In the ITU, which has 193 member countries, when the government officials of each country vote on important matters such as standardization policies and the personnel of standards organizations, the Asia-Pacific region can exert influence on the ITU's decisions if the opinions of all 38 countries in the region can be combined together. To facilitate joint proposals as a regional standards organization to international standards organizations such as the ITU, the ASTAP forum always provides a valuable opportunity to promote exchanges with the Asia-Pacific region. Furthermore, since the Asia-Pacific region has a population of about 4 billion, many of whom live in developing countries, it constitutes a large potential market for future development, and I think it is essential to support the development of standardized technology that takes the needs of this region into consideration.

At ASTAP, through cooperative standardization efforts across the Asia-Pacific region, our policy is to promote the development of technology for disaster management, cyber security and ICT platforms, and to contribute to regional standardization and the cultivation of human resources.

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[2] http://www.aptsec.org/2015-ASTAP25
[3] http://www.apt.int/aptmembers
[4] http://www.apt.int/

Taking Over as Chairman of the AWG

Kohei Satoh
Executive Manager on Standardization
Association of Radio Industries and Businesses (ARIB)

I became Chairman of the APT (Asia-Pacific Telecommunity) Wireless Group (AWG)—the second Chairman since the group was established—at the closing plenary of the 17th Meeting of the AWG (AWG-17) in Macao, China in September 2014.

My first contact with the APT was over ten years ago in November 2003 as a member of Japan's delegation to the 4th Meeting of the APT IMT-2000 Forum (APTIF-4) held in Bangkok, Thailand that year. Just before that in October 2003, the APT Management Committee reorganized the APTIF and approved establishment of the APT Wireless Forum (AWF) to deal with emerging wireless technologies, so the APTIF-4 was largely taken up with defining the purpose, areas of responsibility, and structure of AWF. The Republic of Korea suggested that the new AWF could provide expanded coverage of emerging wireless technologies and serve as a forum for sharing and discussing views on spectrum sharing. However, Japan was opposed to any taint of commercialism, and ultimately the AWF was organized along lines proposed by Japan. Involvement in lively discussions and compromises of the APT from the very beginning stood me in good stead in pursuing subsequent APT activities.

At the 6th meeting of the AWF (AWF-6) held in Da Nang, Vietnam in March 2009, a new arrangement involving two Vice Chairmen for the forum was approved. At the request of Dr. Young Kyun Kim (Samsung), the first Chairman of AWF, I was brought in as one of the Vice Chairmen. At the closing plenary of AWF-6, in my new role as Vice Chairman of the AWF, I proposed that "in light of the enormous changes in the environment surrounding AWF, we should change the name and reassess the organizational structure of the AWF," and this proposal was approved. A Correspondence Group was soon established (Convener: Satoh) to undertake further discussions while the group was in session, but consensus and agreement on the final structural arrangements and name change could not be reached until the 9th meeting of the AWF in Seoul, Korea in 2010, a year and a half later. Nevertheless, these discussions provided an excellent opportunity to forge deeper understanding and friendships with experts in other areas besides ITU-R Working Party 5D and 3GPP, and was time very well spent.

After I was elevated to Chairman of the AWG, I could not have been more pleased when we held the 18th meeting of the AWG (AWG-18) in Kyoto, Japan in March 2015. The meeting was hugely successful with spirited discussion, including the kickoff of new study items and issues that will be taken up in much greater detail at the World Radiocommunication Conference in 2019 (WRC-19). Here I would again extend thanks to the Ministry of Internal Affairs and Communications (MIC) for hosting the meeting, ITU Association of Japan (ITU-AJ) for serving as Liaison Secretariat for the meeting, and all the companies and individual members that provided support and cooperation to make AWG-18 a great success.

The 5th meeting of the APT Conference Preparatory Group for WRC-15 (APG-15) was held at the end of July this year in Seoul, Korea, and agreement was reached on the Preliminary APT Common Proposal for the Council items for inclusion in the agenda for the upcoming WRC-19. This involves eight new draft Agenda Items of which four items were proposed by Japan, including a proposal to "consider identification of IMT in the frequency band(s) above 6GHz." We can anticipate that much of the activity and discussion in the AWG for the foreseeable future will involve the four new draft Agenda Items proposed by Japan, which are certain to become critically important study items and issues. I would like to run AWG meetings in such a way that appropriate study results and findings can be output and delivered to related ITU-R Working Parties in a timely manner.

In order to streamline and expedite the activities of the AWG towards the WRC-19, I believe that we should reassess all areas of responsibility of working groups, sub-working groups, and task groups, and restructure these groups as required. Finally, I would again thank the Ministry of Internal Affairs and Communications and all members of the AWG for their steadfast support and cooperation.

= A Serial Introduction Part 2= Winners of ITU-AJ Encouragement Awards 2015

In May every year, the ITU Association of Japan (ITU-AJ) proudly presents ITU-AJ Encouragement Awards to people who have made outstanding contributions in the field of international standardization and have helped in the ongoing development of ICT.
These Awards are also an embodiment of our sincere desire to encourage further contributions from these individuals in the future.
If you happen to run into these winners at another meeting in the future, please say hello to them.
But first, as part of the introductory series of Award Winners, allow us to introduce some of those remarkable winners;.

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Fields of activity: ITU-T SG2

Standardization of Telecom Numbering

ITU-T Study Group 2 (SG2) develops telecom numbering standards that provide each telephone and networked device with a unique identifier, so this study group plays a critical role in shaping public switched telecom network services and operations. The ongoing worldwide transition to IP-based networks and the emergence of Machine-to-Machine (M2M) services have a tremendous impact on telecom numbering.

I have been closely involved in telecom numbering-related work for SG2 and ETSI, and frequently involved in IETF activities, and other standardization organizations for over ten years from June 2005 up to the present day. For the past several years since 2011 in particular, I served as editor of SG2 and rapporteur of ETSI when we have focused mainly on the challenges of implementing number portability while transitioning to IP networks.

Let us consider a few technical aspects of implementing number portability. Number portability enables subscribers to change their service providers without having to change their existing phone numbers, but this means countries around the world must deploy enormous number portability databases to provide routing data for call processing. The challenge is that in some countries like Japan domestic operators only retain data for their own subscribers, while other countries have a completely different system that enables operators to access other operators' databases as required.

Another challenge of implementing number portability is the substantial nationwide costs of upgrading existing networks. In order to hold down costs and avoid making major changes while shifting to IP technology, it would be preferable to implement some sort of scheme based on the existing legacy system. Considering that number portability is largely a national matter to be implemented by each individual country, it would obviously be beneficial to adopt a greatest-common-divisor approach.

In developing standards that address these challenges, ITU-T SG2 published a supplement on number portability [1] last year in June 2014, and ETSI also issued a technical report on number portability [2] in June 2014.

Finally, let me say that I am honored to receive the ITU-AJ Encouragement Award. For me personally, it has been a wonderful experience to work with study group members and colleagues from around the world, and I am very pleased to know that my efforts have been appreciated.

Notes
[1] ITU-T E.164 Supplement 2, "Number portability," June 2014.
[2] ETSI TR 103 282, "ENUM/ENUM-like options for Number Portability and actual use cases," July 2014.

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Initiatives and looking ahead to the future of 3GPP RAN Working Group 4

It is a great honor to receive the ITU-AJ Encouragement Award. The award recognizes the activities of 3GPP (3rd Generation Partnership Project) RAN Working Group 4 (RAN4) in drafting specifications that define RF transmission/reception characteristics and performance for mobile terminals/base stations, mobile terminal mobility, and a host of other performance-related provisions. Here I will briefly outline my own personal involvement in RAN4 activities up to now.

When I first joined the RAN4 Working Group in 2008, the LTE specification was in the final stage. With the guidance of many experienced predecessors from my company and other Japanese and foreign companies, I was involved in drafting not only common LTE specifications but also an LTE standard dealing with the 800MHz and 1.5GHz frequency bands in Japan.

Then around 2010, RAN4 started to get actively involved in LTE-Advanced, which is more enhanced than regular LTE in terms of data speed and so on, and it seemed like there was suddenly a greater diversity of participants and items to be considered. Carrier aggregation in particular offers a way of realizing very high data rates by accessing separate bandwidths of LTE at the same time, and this technique has been thoroughly discussed and examined by RAN4 over the last few years. Introduction of carrier aggregation will certainly complicate the development of specifications by RAN4 and increase the difficulty of implementing mobile terminals, so this has made us more aware than ever of the need to adopt a common global approach and common standards, so far as possible. By defining the frequency bands used and other technical conditions as a common specification—at least to the extent possible— this should open the way to a far greater number of mobile terminals that comply with this global standard.

Recently, we have seen a sudden transformation from specifying spectra in a way that is domestically available to Japan like 800MHz and 1.5GHz to developing globally available bands like 700 MHz and 1.7GHz spectra. At the same time, we are keenly aware of the high hurdles that must be cleared to complete this standardization work: as standards become more globalized, this increases the number of stakeholders so it becomes harder to make adjustments, and country-specific issues must also be accommodated.

Currently, discussion is ongoing at RAN4 on how to enhance LTE-Advanced even further, while 3GPP also starts to develop 5th Generation Mobile technology from 2016. Since taking over as Vice Chair of RAN4 in August 2015, I have aimed to facilitate discussions and address matters that come before the WG not only as a corporate participant but also as the delegated Vice Chair of the group. During the remainder of my term, I will continue to make contributions and encourage discussion in RAN4 based on the tutelage of my predecessors.

Satoshi Nagata

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Fields of activity: 3GPP TSG-RAN WG1

Through 3GPP Global Standardization Activities Enabling Next-generation Wireless Access Technologies

It is indeed an honor to receive the ITU-AJ Encouragement Award. I would like to express my sincere thanks to the ITU-AJ and to everyone who supported me.

Since joining NTT DOCOMO in 2003, my work has primarily focused on research and development of wireless access technologies for LTE (Long Term Evolution) and LTE-Advanced. In 2011 I was elected Vice Chairman of the 3rd Generation Partnership Project (3GPP) Technical Specification Group Radio Access Network Working Group 1 (TSG-RAN WG1), which is responsible for LTE and LTE-Advanced physical layer specifications, and in 2013 was elected Chairman of the same WG. 3GPP was initially established in 1998 as a partnership project among telecom standard development organizations from different countries and regions around the globe to study new standards for 3G mobile communications technology, but later the scope was enlarged to include development of standards for 4G and even next-generation 5G mobile communications technology. WG1, the group I preside over, is the largest group in 3GPP. We hold six meetings a year, which are attended by about 350 engineers and technicians from around the world. More than 1,000 documents or contributions are submitted at these meetings, and the number of participants continues to grow year after year. From these numbers alone one can get a sense of the importance of WG1 meetings.

The pace with which mobile phone and mobile communications technology has grown is truly phenomenal, and Japan has been a global leader in introducing many of these advanced technologies. The first publicly available 3G mobile communications system was launched by Japan in 2001, then as smartphones became increasingly ubiquitous, this was followed by LTE with far greater capacity and speed in 2010. To meet surging throughput/traffic demands, an LTE-Advanced mobile communications system was deployed in 2014, which promises to deliver true 4G speeds. Currently, 3GPP is gearing up to start work on 5G mobile communications technology, which is expected to go commercial in 2020. 5G is more than just a faster broadband communications technology with greater capacity, for it promises to support the Internet of Things (IoT), the ability to interconnect a host of different devices and equipment (sensors, appliances, vehicles, industrial robots, and much more) to the network. Personally, this extensive application of mobile communications technology across diverse industrial sectors is exhilarating, and I will continue to actively explore these technologies while helping to make them available through global standardization.

Encouraged by this award, I remain committed to global standardization work that enables even a single individual like myself to contribute to the joy and happiness of many people by making mobile technologies available to all.

New Breeze
平成二十八年一月十日発行（年四回一、四、七、十月の十日発行）第二十八巻第一号（通巻百九号）
定価 一冊 一、六二〇円（本体価格 一、五〇〇円、消費税 一二〇円） 年間購読料 六、四八〇円（本体価格 六、〇〇〇円、消費税 四八〇円）

The ITU Association of Japan