

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

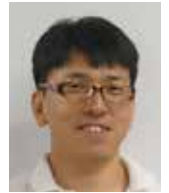
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## 1. Introduction

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 in 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

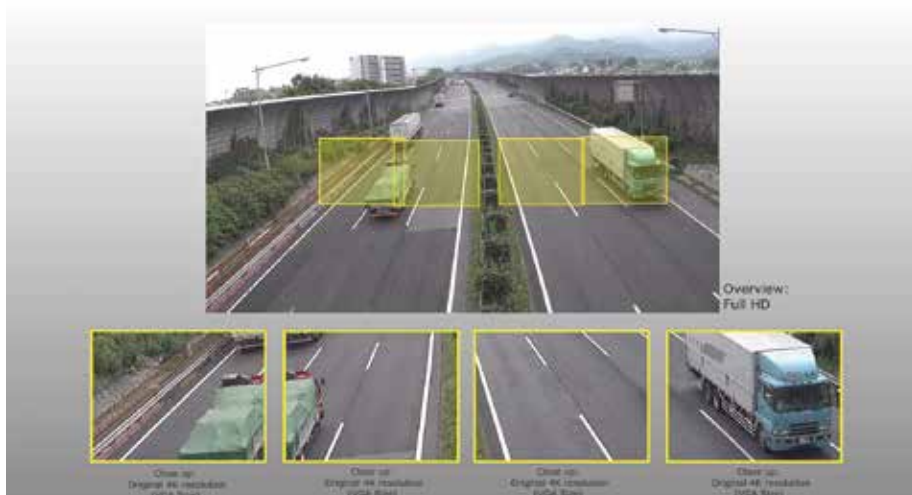
■ Figure 3: Image sensor structure



■ 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.

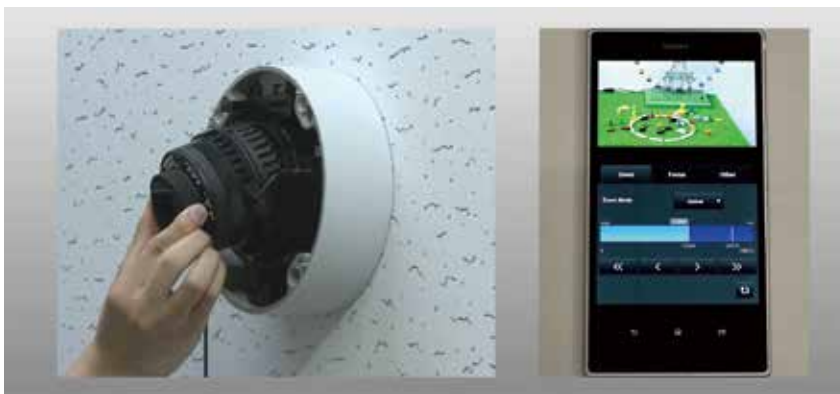
\*Assuming 4K 30fps video, with regions of interest set to 30% of the total image.

## 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