

WHITE PAPER

## **Smart Coding Technology**

Panasonic Video surveillance systems

The Panasonic logo is located in the bottom right corner of the page. It consists of the word "Panasonic" in white, bold, sans-serif font, centered within a blue rectangular background that has a subtle gradient from top to bottom.

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## 1. Introduction

Surveillance cameras are seeing almost daily advancements in the areas of lenses, imaging sensors, and image signal processing. This is done to allow subjects monitored, such as people and cars, to be more clearly recorded. Resolution in particular has gone from analog resolution (720 x 480) of a decade ago to HD (1280 x 720), FHD (1920 x 1080), and 4K (3840 x 2160) in the past few years, and even higher definition will likely be achieved in the future.

With the advance to high definition, data volumes for video are increasing to levels incomparable with those of the analog age. Due to that, costs for networks to deliver that video data and recording media to store it are becoming major issues.

Meanwhile, not all of the video recorded is of use by customers, and in most cases it is disposed of without being checked even once. For that reason, technology to allow delivery and saving/storing of just the video really needed (video that includes the subject monitored) and thereby reduce costs is demanded.

## 2. Panasonic's Smart Coding

Panasonic network cameras have been equipped with cutting-edge image compression technologies (H.264) amassed in consumer digital cameras and cameras for movies and broadcasting. We have also developed technology that makes use of surveillance camera knowhow amassed over a long time to enable just the video needed to be saved in high image quality.

Panasonic's Smart Coding is composed by two main technologies.

- 1) Technology to assign data only to subjects monitored, such as people or cars
- 2) Technology to reduce noise generated at night or in low-illumination environments and to reduce data volume

Smart Coding is a function available on Panasonic i-PRO cameras simply by updating the firmware. Data volume reduction up to 80% over conventional surveillance cameras can be expected by combining the technologies above, and even greater effects can be exhibited by combining Smart Coding with Panasonic high-resolution surveillance cameras such as 4K cameras. And as this is compression technology based on the H.264 standard, special modules and the like are not needed for display or playback by a client.

### 3. Technology to assign data only to subjects to be monitored

Data volume is sufficiently assigned to subjects monitored, such as people or cars, so that data can be saved as clear video. However, so-called background elements such as walls and roads are data that does not really need to be sharp, so data is not assigned to such video, thereby enabling overall data volume to be reduced. Depending on the scene, data reduction of up to about 65% (with FHD, compared with previous Panasonic technologies) or up to about 80% (with 4K, compared with previous Panasonic technologies) can be expected.

#### 3.1. GOP Control

With H.264, the video stream is comprised of I-frame data encoded closed in the screen (as still image) and P-frame data where the difference from the previous frame is encoded. If the refresh cycle is set to 1 second (the default setting for Panasonic cameras) at a frame rate of 30 fps, stream data is generated where 29 P-frames follow after one I-frame. The data from this I-frame to the next I-frame is called Group of Picture (GOP).

To play back stream data generated in this way, decoding must be done in order from the I-frame. For that reason, the I-frame is also called the key frame or reference frame. If the refresh interval (interval between I-frames) is long, much decoding must be performed until playing back the end frame of that GOP.

I-frames encode the entire screen, so the volume of data is large. P-frames encode the difference from the previous frame, so the volume of data becomes smaller.

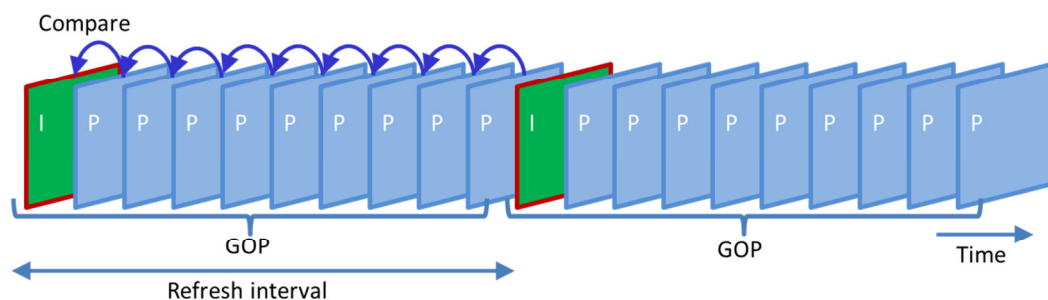


Figure 1: The image of video stream

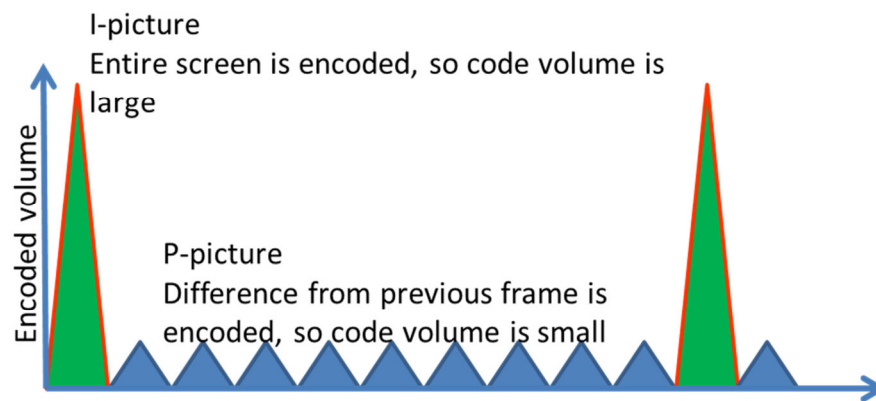


Figure 2: The encoded volume of I-picture and P-picture

The GOP Control function detects motion of subjects and makes the interval between I-frames shorter if there is motion or longer if there is no motion. By making the interval longer in scenes with no motion, the number of I-frames with large data volume can be reduced, greatly reducing the total data volume. And in scenes with motion, the interval is made shorter to secure accessibility to scenes the user wants to view.

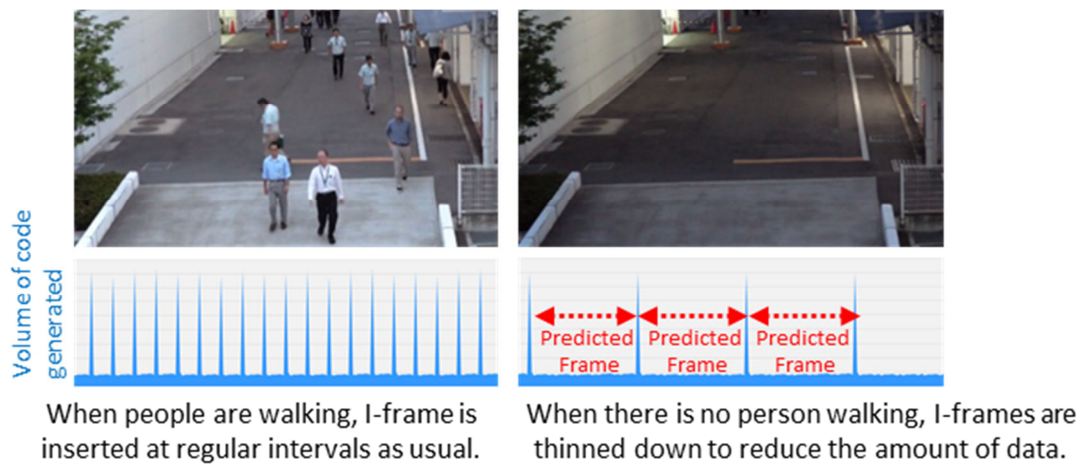
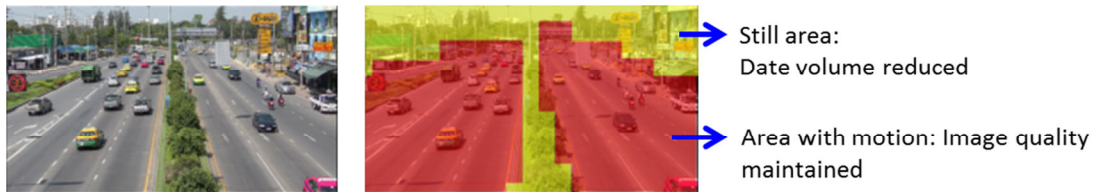


Figure 3: The difference of I-frame insertion interval

### 3.2. Auto-VIQS Control

The Variable Image Quality on Specified area (VIQS) function is a function equipped to Panasonic network cameras, and it can minimize data size by making areas other than those specified be of lower image quality. With the conventional function, however, areas must be specified manually. Auto-VIQS Control can automatically determine areas with and without motion and reduce the data volume of those without motion.



*Figure 4: Left: Original image. Right: The image is an example of separate a still area and an area with motion.*

With H.264, the compression rate can be adjusted by the encoding parameters, but still area data volume can be further reduced by changing the encoding parameters with this function depending on whether the area is a still area or an area with motion.

This function cannot be used concurrently with conventional VIQS.

When variable bit rate (VBR) is selected in Transmission priority, Three levels as Smart Coding mode become selectable. Two levels, Low and Mid, can be selected according to difference in I-frame insertion interval. When in Mid mode, the I-frame insertion interval is up to four times greater than when Low is selected. <sup>\*2</sup> When selecting High mode, Auto-VIQS Control is added to Mid mode.

<sup>\*2</sup>: I-frame insertion range differs by model.

## 4. Noise Reduction Technology

Noise from image sensors when monitoring at night or in other low-illumination environments is completely unnecessary for monitoring, but much data volume is assigned to noise with current compression technologies, resulting in tremendous volumes of data being created. With Panasonic's Smart Coding technology, two technologies are used to analyze that noise and reduce noise in real time, thereby reducing data volume by 20% or more compared with conventional surveillance cameras without noise reduction functions. This function is always enabled with Panasonic i-PRO cameras.

### 4.1. 3D-MNR

3D-Multi-process Noise Reduction (3D-MNR) analyzes differences in signal level and reduces grainy noise generated in low-illumination environments to achieve a low bit rate. Noise generation patterns can be estimated and predicted by individual luminance level using Panasonic's own noise reduction algorithm. Noise generated when increasing gain to secure brightness in video is reduced by individual pixel accurately and in fine detail.

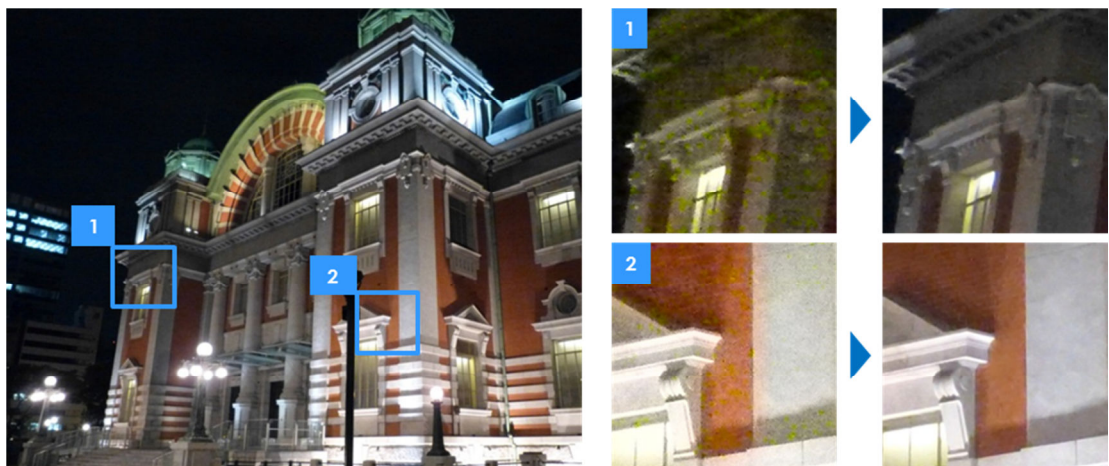


Figure 5: The image diagrams for the description of 3D-MNR

First, noise detection is performed with high precision by creating statistics for the difference of the signal level of the surrounding pixels by luminance level, deciding the threshold, and estimating a noise model in advance. Pixels with a signal level lower than the threshold are averaged with the surrounding pixels to reduce noise. Bayes estimation is performed on the

estimated noise model and the noise model that shifts in the time axis direction. If the patterns are similar, they are reduced as noise; if they differ, the afterimage is minimized as motion. Up to approx. 25% of data can be reduced by this function

## 4.2. FDF

Frequency Divided Filter (FDF) analyzes frequency and reduces fine noise that is generated at slightly low illuminance to achieve low bit rate. Images are divided into multiple bands, and an optimum coring filter for each is applied to enable noise to be reduced while leaving edge components.

Up to approx. 25% of data can be reduced by this function

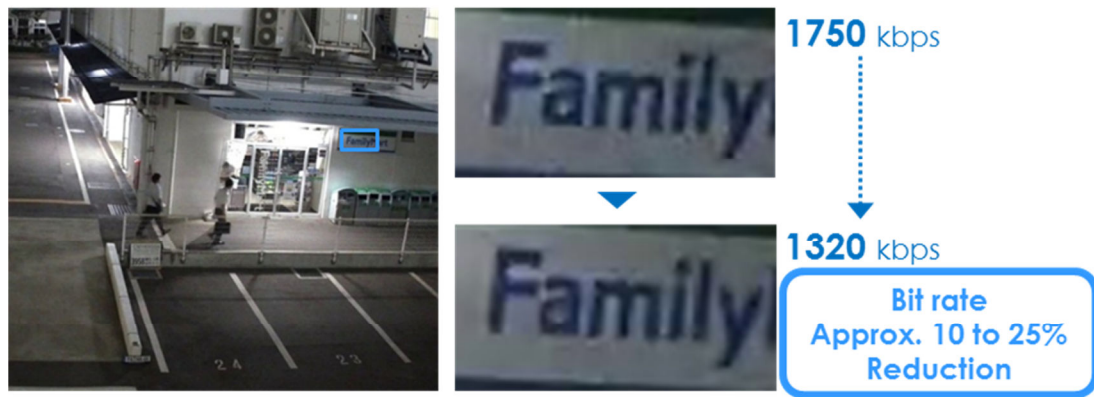


Figure 6: The image diagrams for the description of FDF

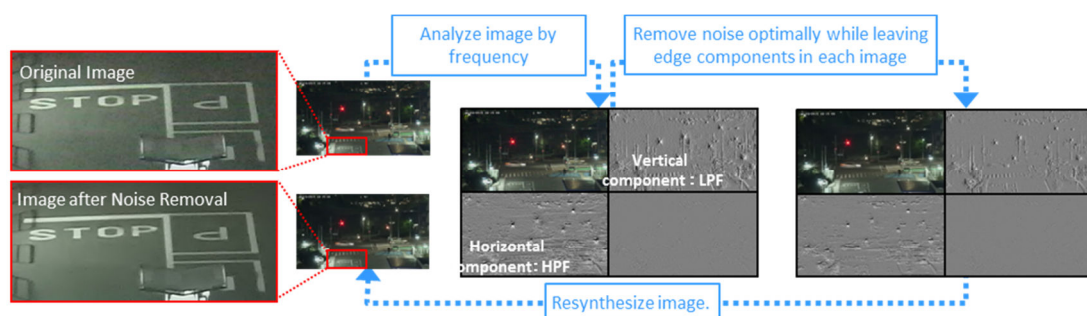


Figure 7: The outline flow of FDF processing



## **5. Conclusion**

Since 1957, Panasonic has over 50 years of experience in the surveillance camera industry and has served a broad range of customers around the world. Based on the Panasonic group's intellectual properties and technologies, Panasonic, the leading company in the audio and video solution market, continues to develop better video surveillance systems.

Panasonic's Smart Coding technology is technology to reduce video surveillance system costs. It concentrates data volume into that for important scenes and areas, and it reduces data volumes for scenes and areas without motion as well as reduces noise in low-illuminance situations, enabling data volume to be reduced.

Starting by equipping Panasonic H.264 cameras with this technology, we plan to equip even more advanced Smart Coding technology to cameras with the latest video encoding standard, H.265.