WHITE PAPER

Enhanced UVC Technology

EcoZone, EcoFrame and Dynamic 3DNR

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1. Introduction

Why Enhanced UVC?

When it comes to diversified IP surveillance applications, the critical bandwidth consumption is always the first priority to deal with, especially with the imminent advent of 8K/4K UHD surveillance devices; that is to say, higher the resolution with advanced video quality entails much larger size in bit rates, thereby exploiting more network traffic. Consequently, several leading companies are making colossal efforts to pursue unique methods to sharpen video codec.

There are many factors to influence performance of codec, among which compression ratio, group of picture and digital noise altogether weigh heavily in this field. Compression level, firstly, determines the scale for squeezing video stream, and higher the level, lower the quality, whereas lower the level, higher the quality. Group of picture, secondly, is crucial in its I-frame frequency, which has pros and cons respectively in either dense or sparse frequency. Digital noise, lastly, acts as an indispensable element for night vision clarity, but excessive volume of digital noise, though boosting night view, comes along with cumbersome bit rates. In general, how to make compromise between image quality and bit rate to deal with each factor intelligently becomes the very kernel with a number of variables to overcome.

Our company, a passionate practitioner, have accordingly dedicated our great resources to fulfil the Enhanced UVC, the proprietary technology that provides worldwide users with fruitful benefits for all-dimensional video applications 24/7. We are going to have a precise discuss, via this white paper, on the several advantages from Enhanced UVC in the following chapters.

2. Video Size Fluctuation

Factors Influencing Video Scale

It is definitely vital, before introduction the Enhanced UVC, to illustrate what causes fluctuations on the scale of video size beforehand. The 3 primary factors below have been usually considered; Compression Ratio, GOP (Group Of Picture) and Digital Noise.

Compression Ratio

The scale of video size is firstly determined by the compression ratio, which, in theory, is prone to be “static” meaning the expected compression level for varied surveillance scenarios are fixed with steady ratio, regardless of differences among diversified scenes, thus leading to huge amount of bandwidth squander for static field of views, e.g., storage with sparse people, or inefficient leverage against scenes with complicated compositions, e.g., brook with canoes to and fro. Consequently, how to dynamically react to different scenarios with flexible compression ratio is no doubt the key to better performance for challenging surveillance applications.

With fixed compression ratio, large amount of waste in bandwidth consumption for motionless scene

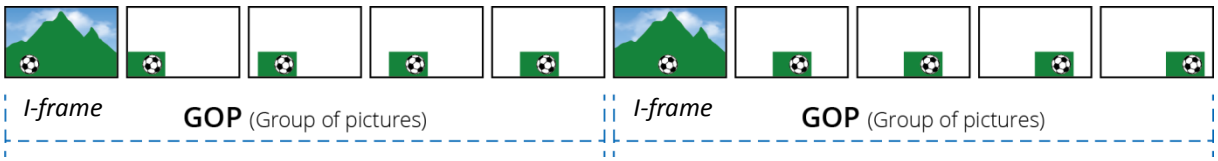
With fixed compression ratio, clarity of both moving objects and background are with same level, an inefficient way of compression for complex scene

2. Video Size Fluctuation

Group Of Picture (GOP)

Basically, GOP (Group Of Picture) represents the elements to form video and can specifically be split into 3 individually fundamental items, I-frame, P-frame, and B-frame.

I-frame, first of all, acts like a lead role which results in larger file size and comprises the complete information for field of view, whilst the rest P-frame and B-frame are way like lighter alternate complements for changes in scenes between each I-frame. Traditionally, the frequency of each I-frame is permanent in accordance with defined settings; in other words, fixed frequency of I-frames rendition for scenarios like storage with barely moving object will be a huge burden concerning video scale, also a critical waste for resources allocation.



A GOP structure in which moving object happens in sequence has seen changes between the interval of 2 I-frames

A GOP structure where none of motions occurs has the fixed frequency between each I-frame, causing waste in bit rate and storage consumption

2. Video Size Fluctuation

Digital Noise

Derived from photon transition to electronic pixel on image, digital noise is particularly inevitable in night view since it helps, though image quality is influenced by “film grain” effect simultaneously, boosting visibility in low-light environment.

However, with more digital noises produced, the expected bit rates increase, one of the shortcomings itself. Also, we all know that surveillance applications relate to a long course of time period, which endures, of course, daytime and nighttime, meaning lux, the value measuring luminous flux per square meter, fluctuates through a day. Typically, users rely on conventional method with predefined parameter to decrease digital noise, but it comes with critical inconveniences, because of repetitive reset on defined parameter for noise reduction, when lux changes in accord with different time span.

Consequently, the suitable countermeasure to have a flexible leverage on quantity of digital noise distribution for varied scenarios, also to effectively cut down bit rate consumptions, thus becomes a main topic for us to endeavor.

Image with digital noise in low-light environment

Image without digital noise in low-light environment

3. Enhanced UVC Technology

Enhanced UVC Technology Attributes

With the aim to address the topic of video size agilely for ever-changing surveillance applications worldwide, we bear the firm belief that only by intelligent algorithm can the satisfying output be reached for every user in diversified applications. As a result, the proprietary Enhanced UVC, based on the standard UVC (Ultra Video Codec), is proudly developed, utilizing EcoZone, EcoFrame as well as Dynamic 3DNR technologies to not only efficiently wield leverage between different regions within field of views and expected compression levels, but, most importantly, also effectively reduce the average bit rate of video scale anytime, anywhere.

EcoZone

There are usually reoccurring scenes where both moving objects and still background happen concurrently in reality, and it is of no exception for surveillance world. In view of this, we have put greater efforts in striking a balance for bit rate compromise between motion and motionless parts within same field of view that results in critical image, namely objects with motion, can be perfectly retained without sacrifice in image quality but, in the meantime, squeeze the overall bit rate economically via smoothing the rest of motionless parts, i.e., still background. This technology has been entitled “EcoZone” to feature its greatly economic algorism for compression ratio among each zone and is intelligently practical for a wide range of surveillance applications, especially for scenarios of complex scenes.

Image with EcoZone On where the jogger is clearly identified

Image with EcoZone Off where the jogger is partially blurred

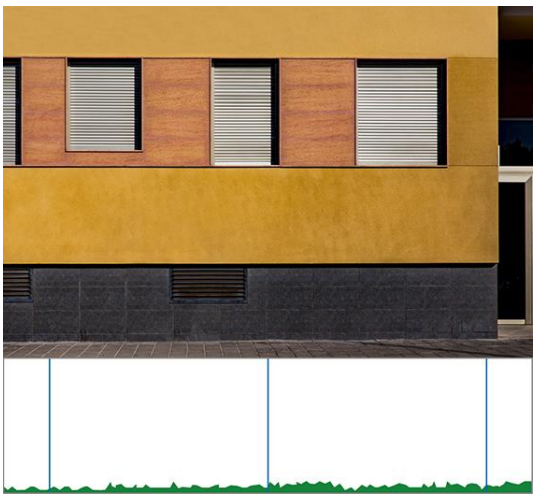
3. Enhanced UVC Technology

EcoFrame

For IP surveillance environments of less motions happened, e.g., vault within bank, what matters to administrators is only when moving objects occurs, which will probably become the critically forensic evidence in the future use. Nevertheless, to have surveillance of low-movement scenario in lasting period is not only a consumption of huge amount of bandwidth due to certain bit rate, but a lumbersome burden on storage apparatus.

In light of specific purposes, we have proudly developed the so-called “EcoFrame”, which swiftly shifts, through the proprietary algorism, the frequency of each I-frame for varied situations. Expected bit rate can be evidently lowered down due to less I-frame auto arrangement for lasting motionless scenes, whereas, while moving object emerges, frequency of I-frame increases to effectively enhance the overall image quality, thereby gripping object within critical scenes.

EcoFrame On for motion object within field of view; the I-frame frequency adjusts to intense pattern for possible critical image



EcoFrame On for static images in a sequence of period; the I-frame frequency dynamically decreases to effectively save bit rate capacity

3. Enhanced UVC Technology

Dynamic 3DNR

The presence of digital noise, in reality, is unavoidable in formation of image under low-light environment. And there are in fact 2 obtrusive defects from digital noise. One is bit rate volume which tends to increase vastly when digital noises amplify. The other one is unfavorable image quality in that excessive digital noises suppress certain critical details within field of view, e.g., license plate.

Dynamic 3-Dimensional Noise Reduction, thereafter referred to as D3DNR, was developed by our solid R&D resources for conquering the major defects described above, while represent a preferable image quality even under dimly lit circumstances. The core of D3DNR can be sorted to 2 primary parts. For the field of view in low-light situation with bare moving object, e.g., bank vault, first of all, D3DNR employs exceptional algorism to largely lessen digital noises upon the image, but retain the required brightness with clarity, to greatly drop overall bit rate. In another case of low-light bank vault where staff is walking by, second of all, D3DNR, by smartly detecting moving object, adjusts its efficiency automatically on noise reduction to strike a perfect balance between clearness of moving object and bit rate decrease; that is to say, free from blur of walking staff but flexibly implementation subtle noise reduction level for better outcome.

In comparison with the conventional 3DNR that simply allows users to predefine a fixed value of efficiency in noise reduction, D3DNR acts a better way more agile to cater varied conditions in accordance with light extents and movements within scenes, thus providing users with a hassle-free solution of dynamic digital noise reduction.

Digital noises proliferate in the whole image under low-light environment when D3DNR Off

Digital noises are neatly smoothed but details are remained perfectly; thus bit rates lower down when D3DNR On

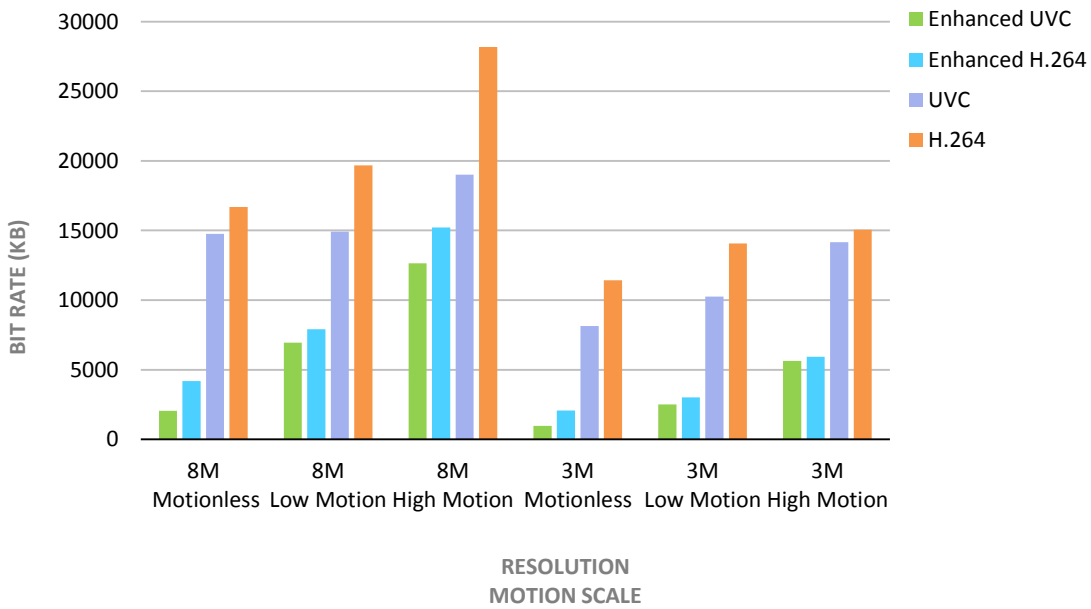
3. Enhanced UVC Technology

Benchmark Comparison

To make abstruse technology user-friendly and easy understanding, the following charts with realistic measurements validated by hi-tech products from us have something to say loudly.

We have made rounds upon rounds practical comparisons among different resolutions and varied codecs. In addition, scenarios with diversified motions from critical to static are also taken into account for our overall benchmark.

We may observe from the following chart, by and large, that Enhanced UVC in green strips have the least bit rate (KB) consumption compared with other codecs. More than that, test in higher resolution (8MP) reads a superior result to that of lower resolution (3MP); that is to say, higher the resolution, better the performance it can bring about for bit rate reduction. What's particularly interesting is that with less motion occurrence within scenes, it is obvious to tell that Enhanced UVC further performs a more brilliant job over other codecs. In comparison of motionless cases, Enhanced UVC confidently proves its best efficiency in bit rate economy among several codecs benchmarks.



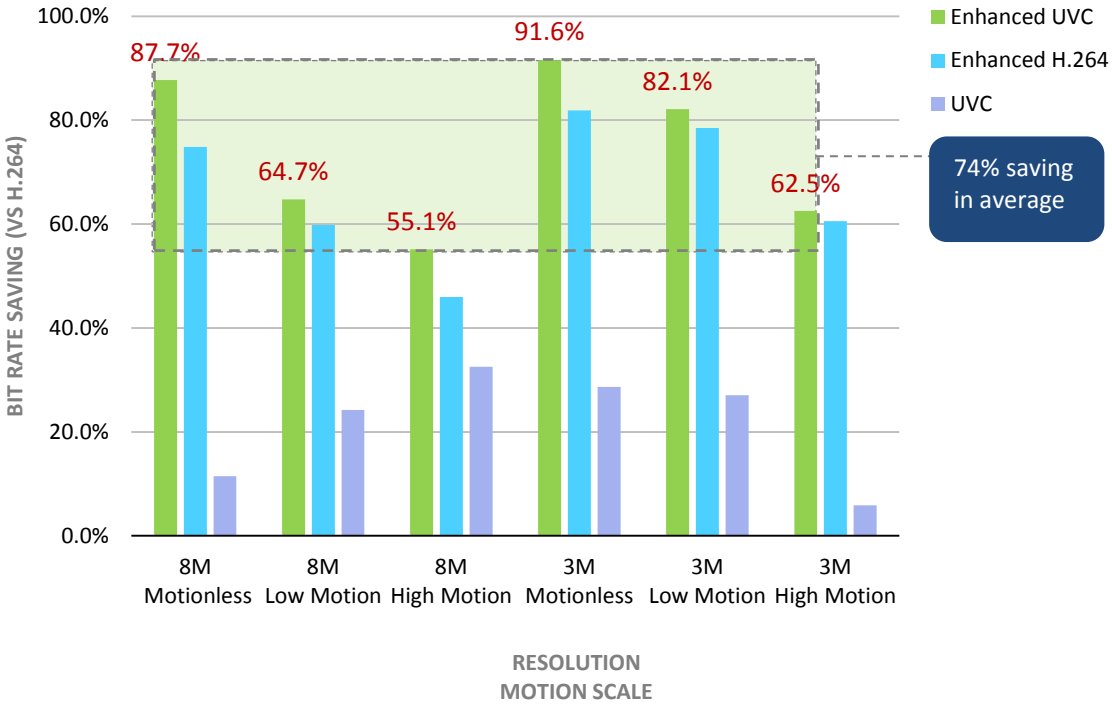
The benchmark of bit rate consumption by different parameters including codecs, resolutions and complexity of motions

3. Enhanced UVC Technology

Benchmark Comparison

In light of the previous comparison, we further compile an intuitive chart below, fairly depicting the bit rate saving in the actual percentage. All the exact savings in percentage of each codec are against the typical H.264. Apparently, Enhanced UVC in green strips dominate the top rank of the benchmark, among where the utmost saving of bit rate even reaches over 91% by Enhanced UVC versus H.264. From the minimum of approx. 55% to the maximum of beyond 91%, we are taught that Enhanced UVC radiantly outperforms H.264 by 74% on average, which is a substantial outcome saying the way of economical achievements it can offer to worldwide users in a wide range of surveillance applications.

When putting emphasis on Enhanced UVC versus Enhanced H.264 in light blue strips, still we have full confidences in its higher efficiency. In general, Enhanced UVC, on average, outpaces Enhanced H.264 with nearly 10% in terms of percentage of bit rate saving. The proprietary algorism of Enhanced UVC proves, once again, the far-reaching advantages in all-dimensional fields.



The benchmark of bit rate saving in percentage by different parameters including codecs, resolutions and complexity of motions

4. Conclusion

The scale of resolution has evolved to prevailing 4K UHD for mainstream image-related industries, and the upcoming era of 8K is just around the corner. The generated bit rate capacity, therefore, from IP cameras will entail further burdens on both encoding and decoding process, also lead to vast traffic of network bandwidth. The proprietary technology of Enhanced UVC, in view of the current trend of greater image demand, turns out to be an indicative resolver, with the most advanced algorism empowered by firm R&D forces, for actively mitigating the side effects derived from the epoch of higher resolution.

Enhanced UVC, which is seamlessly compatible with the latest 8MP and 12MP devices by our company, largely broadens a wide range of scenarios of UHD resolutions for diversified surveillance applications, further proving its momentous role in both saving bit rate and enhancing image quality.

To strike a harmonious balance between crystal image quality and lighter bit rate capacity is never a simple task for every party involved, but with firmly commissioned to be a front-end pioneer, we proudly claims that you will find no answer but the Enhanced UVC presented by us to precisely yet comprehensively fulfil the ultimate achievements for the advent of 4K/8K UHD era in the coming future.