White Paper

What Is Wide Dynamic Range and Why Should Camera Specifiers Care?

A guide for Integrators and Installers on how to work with wide dynamic range cameras and the benefits they bring for getting better evidence from video surveillance solutions.

It's always been the Achilles' heel of video surveillance, with analog or digital cameras, those nasty shadows, glares, reflections and direct sunlight that turn captured images into darkness or wash them into a brilliant, undetectable white. Higher resolution cameras simply exacerbate the problem.

The introduction of megapixel and high definition cameras gives the promise of better images from a surveillance system. That's why more and more end users are selecting them. However, many end users become very disappointed when the system goes live. Because of varying lighting within the scene, they seem to be no better off than when they deployed their standard definition analog or IP cameras. The entrance to the facility is overexposed because of glare, destroying the possibility of identifying who has come in. However, just to the left, shadows in the scene wipe out any possibility of seeing interactions between check-out clerks and customers. All that money invested in high resolution cameras seems to have been for naught.

This white paper is a guide for Integrators and Installers on how to avoid these problems by working with wide dynamic range cameras and the benefits they bring for getting better evidence from video surveillance solutions.

Related White Papers from Infinova

Infinova has a series of white papers aimed at helping Integrators, CSOs and senior security management to make the technical and business decisions needed to manage security and surveillance installations. The previous five cover:
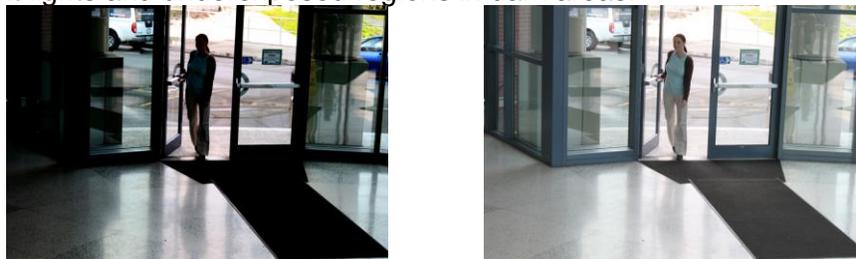
- Coexistence strategy at the heart of a cost-effective move from analog to digital security video.
- Selecting cameras – analog to IP-based as well as megapixel and high definition.
- Fiber optics enhances the operation and business bottom line of surveillance solutions.
- Storage options and ways to determine which are the best for the needs of the enterprise.
- How to conduct a security site survey leading to a risk and vulnerability matrix.

These previous white papers are available for download at www.infinova.com

Wouldn't it be nice if the lobby camera clearly showed people coming through the glass door along with the cars and objects in the parking lot behind them, even if reflections or bright sunlight are shining right into the camera? Banks would cheer if the camera at the outdoor ATM could compensate for shadows and sunlight to identify facial features and other details. In retail applications with storefront windows, reflections and glare would no longer render foreground objects undistinguishable.

Problem Defined and Solved

In traditional CCD cameras, all the pixels in the array have the exact same shutter speed. They capture the entire image as a whole. Conventional image processing – exposure, contrast, color, etc. – is done as an average for the entire image. There is no image processing done at the individual pixel level. Overexposure and underexposure are handled on a limited basis after the image is captured. In challenging lighting conditions, the resulting image will show normal exposure with blown-out highlights, dark shadows or both. The viewer sees overexposed regions in bright lights and underexposed regions in dark areas.

Contrarily, an all-digital technology can provide Wide Dynamic Range (WDR) in which each of the hundreds of thousands of pixels acts like an individual, self-adjusting camera. Wide Dynamic Range (WDR) is the ratio of the brightest pixel that can be captured by the imaging system to the darkest pixel that can be captured. With high resolution cameras especially, users need a WDR of 17 bits, > 100db.

The catalyst for WDR is the inclusion of an analog-to-digital converter (ADC) within each pixel of the image sensor. The ADC translates the light signal into a digital value at the immediate point of capture, thus minimizing signal degradation and cross-talk – pixel images overlapping each other, resulting in ghosting – in the array and allowing for greater noise reduction methods. Once the data is captured in a digital format, a variety of digital signal processing techniques are used for optimal image reproduction.

Each Pixel is Adjusted to Handle its Unique Lighting Conditions

Because each pixel has its own analog-to-digital converter and the information generated is captured and processed independently, each pixel in effect acts as its own camera. The exposure time for each pixel is adjusted to handle the unique lighting conditions at that pixel location in the image sensor array. Thus, the unit essentially has hundreds of thousands of individual cameras, each of which produces the best image possible.

It increases exposures in darker areas and decreases exposure in brighter areas. Each pixel is processed while the image is captured, sampling multiple times per second. If an individual pixel senses that it is overexposed, it will close and quit gathering light while pixels capturing shadowed, dark and potentially underexposed image areas continue to gather light. These images are then combined to create a high quality video frame or picture. As a result, details otherwise lost are simultaneously captured vividly with more clarity and color vibrancy regardless of lighting conditions.

Traditional vs. WDR Cameras

That's why traditional CCD cameras can't "see" well in varying, non-optimal lighting conditions. For instance, since they generalize pixel settings, they can't capture true color. They cannot provide noise-free images without vertical smearing, pixel blooming or camera blindness. It's why images used as evidence from traditional cameras can be suspect and create problems in a court of law.

With a WDR solution, the user obtains accurate color, skin tone and facial features in the darkest and lightest area of a scene simultaneously. Viewers can detect the age and color of the suspect easily, quickly determine if an employee is swapping a stack of dollar bills for 20's or see other sleight-of-hand cheats regardless of the lighting conditions. An all-digital solution eliminates image-degrading noise and glare so images are always clear. All-digital solutions also minimize noise that can go undetected, such as random artifacts (irregular variations), speckles and edge jitter.

All-digital solutions also maximize disk space, a very important consideration when one migrates from analog to high resolution (the more pixels, the more storage). Remember, noise not only compromises image quality but eats up valuable disk space. Without an all-digital WDR camera, sampling and conversion noise can often increase DVR video storage 3-times (3X) over an all-digital WDR solution.

What to Look for in the Specifications

Don't pass over the specifications sheet when deciding on a camera. Dig into the specifications and look for the term "designated DPS (Digital Pixel System)." You also want to see that the definition of high resolution is a minimum 540 HTVL x 460 VTVL. Make sure the new camera uses a Pixim chip set and supports both NTSC and PAL video formats.

To illustrate, a data sheet might read, "Infinova' s V5413-A3 series indoor WDR color fixed minidome camera, based on DPS (Digital Pixel System), features 120dB super wide dynamic range. In addition, the WDR camera has decisive superiority over CCD cameras, providing higher S/N Ratio, improved color rendering and better image quality." In the listing of specifications, one will find terms such as "Effective Pixels – 720 x 540" and "S/N Ratio: > 52 dB (AGC OFF)."

Lastly, verify the GB of storage per 24 hours of video captured. Look at the difference between CCD and an all-digital solution –
• Medium Resolution CCD   52 GB
• High Resolution CCD   38 GB
• All-Digital   31 GB
The all-digital solution uses 18 percent less disk space than high resolution CCD and 40% less space than medium resolution CCD.

Remember, effective resolution is the best indicator for video security professionals of how effective a CCTV camera is really going to be in terms of capturing detail in an image that might have to be used as actionable evidence. WDR via an all-digital solution is key to getting the best resolution.

By helping channel partners provide their customers with complete, affordable, best-in-class, large and small video surveillance solutions, Infinova helps integrators generate more business more profitably. Leveraging a manufacturing process certified to ISO 9001:2000 standards and over 250 engineers with a list of video industry firsts, Infinova channel partners provide their end-users with industry-acknowledged product reliability and technical leadership.

So that Infinova channel partners can create complete solutions, Infinova provides IP surveillance cameras and components, CCTV analog cameras, DVRs and components, camera accessories, monitors, power supplies and fiber optics communications devices. Infinova also has the technical ability and manufacturing flexibility to let integrators propose customized solutions. In addition, Infinova will partner with other manufacturers making other surveillance equipment and software to help its channel partners create turnkey solutions. Contrary to most other companies, Infinova will back-up their partners' products as well as its own to assure both the integrator and its customers that one call – to Infinova only – takes care of everything.

Infinova works diligently to assure its channel partners can provide cost-conscious solutions. With Infinova's hybrid systems, channel partners can propose systems that protect a customer's investment in its already-installed analog surveillance system but that also put them on a dynamic migration pathway to IP systems.

Infinova is lauded for its exceptional maintenance programs. A major highlight is the company's 24-hour advanced replacement policy in which a substitute product is shipped immediately upon notice of a problem.

With such customer focus, Infinova is often referred to as "the integrators' manufacturer."

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