Wide Dynamic Range (WDR) in IP Surveillance Cameras

Introduction

What is Wide Dynamic Range?

“Dynamic range” means the difference between the largest and the smallest usable signal level. This term is commonly used in audio, electronics, photography and various other fields. In video, like with the human eye, it refers to the limited light range that can be seen in one scene. A lit room will appear dark after spending time in the summer sun; similarly, the outside can be blinding white after spending time in a dark room. Wide Dynamic Range (WDR) provides a broader spectrum of coverage for visibility in both a dark room and outdoor daylight at the same time.

By applying this concept to a camera, Wide Dynamic Range means that it can sense and capture both dim and bright light scene details in a single image.

This white paper discusses how cameras achieve wide dynamic range image capture, where to use cameras with WDR technology, and how WDR cameras are configured in FortiRecorder. It also provides sample snapshots of WDR pictures from FortiCamera models.

Why Use WDR Cameras?

Have you ever taken a family portrait with the camera facing into the sunlight? The result is disappointing with dark faces and little detail. While photographers can rearrange the scene and use a flashlight or reflector to brighten up the subjects, this is not an option for video surveillance cameras. Finding an optimal position for lighting and exposure can make surveillance installations a hassle. WDR technology was adapted to resolve this issue.

Where to Use WDR Cameras?

Complicated light situations are a concern for many surveillance installations. If the background is too bright, the subject in front of the camera will appear dark rendering the captured video useless. Cameras equipped with WDR improve the image quality of any high contrast lighting scene (the monitored area with portions of bright light and portions of dim light). WDR function enables cameras to capture image detail from both poorly and richly illuminated areas.
**Indoor**
The most common place for WDR cameras is monitoring entrance doors or against windows where there is intense backlight. Regardless if it is a store, bank, restaurant, or hospital—every facility must have entrance doors that can introduce bright light compared to the interior space. WDR cameras can compensate for the overly bright or overly dim area and provide a snapshot or video with clarity.

**Garage**
Cars often enter a parking garage where bright headlights often contrast a very dimly lit interior. A WDR camera will be able to better capture a clear and readable license plate.

**Outdoor**
The sun constantly changes position throughout the day. Outdoor surveillance cameras are frequently required to face strong sunlight in contrast to the shadow of the building or a covered porch at some points during each day. A WDR camera can compensate for this illuminance difference.

**Objects emitting bright light**
An opposite example of a bright backlight would be a dim background and a vehicle with bright headlights driving toward the camera. WDR cameras can do a better job of capturing a license plate image in this high-contrast scenario than a non-WDR surveillance camera.

**IR illumination**
Infrared (IR) illumination of an area sometimes provides overly strong illumination to close by objects. WDR helps compensate for this effect and prevents overexposure.

**What are Shutter and Digital WDR?**

**Shutter WDR** is a hardware-based sensor technology. **Digital WDR** uses a software algorithm to optimize the image quality of the dark areas by adjusting the gamma value. Shutter WDR provides better images with higher contrast of light and dark areas of the images.

All FortiCamera models support WDR.

- **Shutter WDR** FortiCamera models: FD40 / MB40 >120dB, OB30 > 100dB, SD20 > 96dB
- **Digital WDR** FortiCamera models: FD20 / MD20 / CB20 / AP214B

**What is the Unit dB Used in WDR Cameras?**

In the FortiCamera datasheet, you will find that cameras with Shutter WDR use a dB value to represent the capability of the camera to display a high contrast scene. Generally, the higher the dB value, the greater ability a camera has to capture high contrast scenes. Decibel (dB) measures the ratio of the brightest and darkest area in the picture that can be captured by the camera sensor. For example, if the ratio of the brightest to darkest is 10,000 : 1, the dB value is 80. If the ratio is 10 times higher, 100,000 : 1 the dB value is 100. Certain FortiCamera models can support greater than 120dB (a ratio of 1,000,000 : 1).

**How Does WDR Work?**

As previously mentioned, digital WDR is an image processing step that changes the gradient of the image histogram in a way that stretches the darker parts and assigns more grey steps to these areas. The effect is a fill light appearance that reveals more details in the darker areas.

Shutter WDR works differently. Basic photography teaches us that if the aperture remains the same, the longer the shutter exposure time, the more light that will be exposed on the sensor or film. Conversely, the shorter the shutter time, the less light that will be exposed. Shutter WDR actually double-exposes the same image. It captures one image with shorter exposure time (for the brighter area of the picture) as well as another longer exposure (to capture the darker area of the picture). The Digital Signal Processor (DSP) then uses an algorithm to combine the two images with different exposure times together into one frame to balance the brightness and sharpness of the entire image. The result is a clear, well-lit, and balanced image.
The above illustrations show how WDR imagery combines the over-exposed image and under-exposed image to create a well-balanced image. The balanced image shows clear detail in the dark areas as well as in the entrance with bright light.

**WDR Image**

In this typical scene with a bright back light, the camera with WDR Off shows objects appearing dark and not clearly identifiable.

The camera with WDR On can compensate for the bright back light; the subject is clearly identifiable.
How to Configure WDR Function in FortiRecorder

1. Login to FortiRecorder and click on Camera – Configuration.
2. Select the camera model that you would like to configure for WDR (for example, FortiCam-CB20).
3. Under the Video/Audio tab, you will find the WDR drop down menu.
4. Depending on the camera model, you will see up to three different WDR settings.
5. If your camera is capturing a high-contrast scene, the difference will be immediate and obvious after switching WDR on or off.

Summary

Many typical surveillance situations introduce a great variation of lighting conditions where a camera with Wide Dynamic Range improves the overall picture readability. Selecting a camera model that features WDR is one of the specifications that is worth paying close attention to if complicated light conditions are expected within the installation.