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Which Format for Which Application?

NTSC, 720p, 1080p or Mega-Pixel

With all of the different formats available in security cameras these days, it can be difficult to decide which format offers the best performance for a given application, especially since application requirements can vary so greatly. The requirements for outdoor applications are considerably different from those of indoor applications. Understanding the tradeoffs involved in basic camera characteristics such as resolution, sensitivity and zoom capabilities will make selecting the right product for your application a less challenging task.

Resolution – The first characteristic that most people look at to compare cameras is resolution. The resolution of the camera, specified in lines or pixels, is a good indicator of how "crisp" and detailed the video image will look under optimum lighting conditions. It can be a little bit difficult to compare conventional NTSC analog type cameras with the newer HD and Mega-Pixel cameras, due to the differences in how the resolution is sometimes specified. Analog cameras are traditionally specified in "lines of TV resolution" which specifies how many discernable alternating black and white lines can be placed in the field of view before the lines just blur into a gray field. High Definition (HD) and Mega-Pixel cameras are more commonly specified by the number of horizontal and vertical pixels in the actual image sensor. These numbers are not directly comparable. The number of TV lines of resolution is roughly equal to 70% of the number of horizontal pixels. The chart below lists some values for cameras that are typical of the different types of formats.

Format	H Pixels	V Pixels	TV Lines
NTSC	768	494	540
720p	1280	720	900
1080p	1920	1080	1350
5 Mega-Pixel	2596	1944	1825

Sensitivity – This is the one characteristic of high resolution cameras that is NOT usually emphasized in the promotional literature. Sensitivity is a measure of how much light is required to provide an acceptable signal to noise ratio in the video image. The major tradeoff involved with increasing the number of pixels in an image sensor is that it makes each of the pixels smaller, and lowering the size of the pixel means that it cannot capture as many photons, which makes the electrical signal in the pixel smaller. Since the noise inherent in the silicon sensor does not decrease as quickly as the signal when the pixel gets smaller, the noise gets much more noticeable, and causing the image to appear very "grainy". Increasing the number of pixels from about 400,000 which is typical of NTSC

analog ¼" CCD sensor cameras to 5 Mega-Pixels would result in a more than 11dB decrease in the signal to noise ratio, if a larger sensor size is not used. Even if the sensor size is increased to ½", the signal to noise ratio is still degraded by 5dB. This is not necessarily a major issue for indoor applications, where the lighting can usually be controlled, but it is a serious issue for outdoor applications under night time conditions, where the amount of available light may be very low. This can be especially problematic when analytics are used for motion detection. The noise can be so severe at night that the motion detection will be triggered continuously, or need to be set to such a high threshold that it is not really useful. The chart below shows approximately how much signal to noise penalty increasing the number of pixels creates, for the same sized sensor, compared to the 768x494 pixel NTSC camera used in the WTI Sidewinder PTZ camera.

Format	H Pixels	V Pixels	Total Pixels	S/N Penalty
NTSC	768	494	379392	-
720p	1280	720	921600	3.9dB
1080p	1920	1080	2073600	7.4dB
5 Mega-Pixel	2596	1944	5046624	11.2dB

Note: S/N ratio is approximately proportional to the square-root of the pixel size.

Zoom Capabilities – Many of the new Mega-Pixel cameras are promoted as having "virtual" pan, tilt and zoom capabilities, due to their ability to display either the full sensor image or only a portion of the entire sensor image on the display. But, how does this virtual "zoom" feature stack up against a real optical zoom lens? If we "zoom" a 2596Hx1944V 5 Mega-Pixel camera to a width of 768 pixels (our NTSC analog camera in the chart above), we have created a virtual "zoom" magnification on our display of 2596/768 or a factor of 3.4 to 1. While this may be useful for some limited indoor applications, where distances are small, this would be inadequate for most outdoor applications where distances tend to be much longer, up to several miles sometimes. Even relatively low cost analog PTZ cameras typically include at least a 10 times optical zoom capability, with 20 times or even 35 times being available. It would require a 464 Mega-Pixel camera with virtual zoom to create the same apparent magnification as a 35 times optical zoom on an analog PTZ camera.

Matching Your Application – Taking into consideration the issues discussed above should help narrow the choices when you are trying to select the appropriate resolution for the application that you are developing. Here are some general guidelines:

Outdoor and Day/Night Surveillance – The combination of a large pixel, high sensitivity sensor and high magnification optical zoom lens makes a PTZ camera with NTSC resolution like the Sidewinder ideally suited to outdoor applications that involve very low night time illumination levels and long outdoor distances of up to several miles.

Daytime or Indoor High Definition Imaging – The increased resolution of 720p and 1080p formats can provide beautifully clear images, and when equipped with an optical zoom lens like the Sidewinder HD PTZ camera, can provide outstanding performance. However, care must be taken to ensure adequate lighting levels to prevent excessive noise in the image. Illumination levels will typically need to be 5 to 10 times higher for these cameras (for the same signal to noise ratio) as compared to available NTSC cameras.

Motion Detection and Analytics – These types of applications are usually very sensitive to noise in the image, as the analytics are comparing one frame with the next to determine changes in the scene, which is very difficult to do if all of the pixels have a constantly changing value due to noise in the video signal. The signal to noise ratio of the camera should be the guiding factor when choosing cameras for these types of applications, not resolution.

Indoor Surveillance – Under controlled lighting conditions, and at short to moderate distances, Mega-Pixel cameras with their "virtual" pan, tilt and zoom capabilities, and analytics capabilities offer an attractive set of features.

~Dale Roche, Director of Engineering

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