A comparison of high definition (HD), megapixel and standard definition (SD) surveillance technologies

- The basics
- HD – becoming the standard
- HD throughout the surveillance chain
- HD applications
- Megapixel – making light of the details
- Megapixel applications
- SD – effective surveillance
- SD applications
- Conclusion
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‘HD’ has become a household term due to the appearance of high-definition televisions in the home. Just as HD TV is being increasingly accepted by consumers, the demand for HD systems in the network (IP) surveillance marketplace is also growing. In the surveillance market, another high resolution option is offered by ‘megapixel’ solutions – such as Bosch Megapixel cameras. These often supplement SD cameras in an SD system. Last but certainly not least, SD systems are well established and can be found in most current surveillance applications.

The Bosch portfolio includes all HD, megapixel and SD technologies, and covers the entire surveillance chain from the camera and lens all the way to the monitor. Deciding which is best for your network system can be a challenge. This paper aims to help you choose the system that’s right for you. We outline some of the differences between the three technologies, highlight their key benefits and look at suitable application areas for each one.

The basics

HD images contain either 720 or 1080 rows of pixels making up a 16:9 format image. Megapixel, while also being high resolution, follows non-standard image guidelines and is in 4:3 format. SD comprises 576 rows of pixels for PAL and 480 rows of pixels for NTSC in a 4:3 format image.

HD images can be created using either progressive scan or interlacing techniques, denoted as 1080p or 1080i. Progressive scan is better, as it processes images twice as fast as interlacing, reducing motion artifacts and jagged edges, and generally giving a clearer image. Bosch HD systems use 720p (equivalent to 1 megapixel) and 1080p (equivalent to 2 megapixel) resolution.

The 2 megapixels of a HD video in 16:9 format offers more usable image content than the respective 2 megapixels in 4:3 format.

HD – becoming the standard

Two key factors differentiate HD from SD – highly detailed images and a 16:9 aspect ratio.

Detailed images allow operators to better distinguish individuals or small features in the scene. Similarly, a single HD camera can cover a much larger scene than an SD camera, at a comparable resolution.

A ‘vision-friendly’ 16:9 ratio image is compatible with today’s widescreen monitors. It also matches human eyesight more closely, as we tend to see more from left-to-right than up-and-down. Perhaps most importantly for video surveillance, however, is the increase in ‘useable’ image content. For instance in many locations 4:3 format images can capture a lot of empty sky or ground. 16:9 pictures reduce the amount of background scenery and increase the field of view across the scene.

Bosch Intelligent Video Analysis (IVA) can also benefit from HD quality. The higher resolution and different aspect ratio of an HD image means that the Bosch HD-optimized IVA provides better detection capability.
Compared to megapixel solutions (which also render high definition images), HD systems offer:
- Better dynamic range to reveal greater detail in scenes covering both shaded and bright zones simultaneously
- More sensitivity to provide excellent detail as long as scenes are moderately well lit
- Compliance with industry standards to ensure excellent color reproduction, full frame rate and 16:9 format.

**HD throughout the surveillance chain**

To get the full benefits of HD it is vital the entire surveillance chain aligns with HD requirements – an HD camera alone is not enough. Can the lens also handle high resolutions? Does the camera look through a curved glass bubble, as with dome cameras? Can the storage capacity support HD quality?

Bosch HD solutions ensure true HD capability, with components designed specifically for HD technology. For example, our Dinion HD camera features a special lens to ensure the best image possible is captured by the camera.

**HD applications**

Primary applications for HD are new installations that want to take advantage of the latest technology, from scene to screen. In particular, applications requiring the highest detailed images will demand HD. They include:
- City centers
- Airports
- Finance and banking
- Traffic monitoring (air, land and sea)
- Casinos and gaming
- Government
- Passport control

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**Megapixel – making light of the details**

Megapixel cameras boast ultra high definition digital imaging in a 4:3 format images instead of 16:9 format. Composed of up to several million pixels, megapixel images allow operators to pick out the smallest details in a scene and to zoom in on particular areas while retaining image integrity.

As with HD cameras, for a given resolution, a single multi-megapixel digital camera can view a far larger area than a typical SD camera. Multiple video streaming capability allows you to view the entire scene while enlarging small sections of the scene simultaneously. This enables your video surveillance system to cover the same with fewer cameras.

The main limitation of megapixel cameras is that sensitivity decreases as the number of pixels increases. Scenes must be well lit to get the best level of detail. Also, megapixel images usually have a lower dynamic range than true HD and therefore will be less effective in high contrast scenes where detail is required in both the light and shaded areas of the scene.

Having the same 4:3 format as SD, megapixel cameras often replace or supplement SD cameras, being installed in well lit locations where high detail is of particular importance.

**Megapixel applications**

Able to capture extreme detail, megapixel applications include those involving long viewing distances, e.g. perimeter fences, or where recognition of very small objects is needed, e.g. jewellers. Other possibilities include crowd surveillance, and banking and finance applications.
**SD – effective surveillance**

SD uses 704 x 576 (PAL) or 704 x 480 (NTSC) pixels, which is equal to 4CIF resolution and sufficient to meet the demands of many surveillance applications. This resolution cuts down on the amount of video information in the signal compared to HD or megapixel, saving on bandwidth as well as reducing video storage needs.

Having evolved over many years, today’s SD solutions – such as Bosch Dinion 2X IP and FlexiDome 2X IP cameras – can deliver exceptional images, in some cases even clearer than megapixel solutions. This is because SD delivers the widest dynamic range and best sensitivity of any technology. Modern, advanced SD cameras offer the optimum balance between resolution, dynamic range and sensitivity.

Their wide dynamic range makes SD systems great for high contrast scenes, revealing details in both bright and shaded areas simultaneously. One example is having the camera mounted inside a tunnel, looking towards the tunnel’s entrance – objects and activity can be observed both inside the darkened tunnel and outside in daylight simultaneously.

Extended light sensitivity means SD cameras operate very well in difficult, low light situations. This makes them ideal in locations that experience variable lighting conditions, as they maximize image usability.

**SD applications**

There’s a very wide range of applications suitable for SD. SD systems have been the standard until recently and are still widely used. Typical applications for SD systems include:

- Prisons and correctional facilities
- Educational facilities
- Hotels, bars and nightclubs
- Commercial and government buildings

**Conclusion**

Without doubt, HD delivers a number of benefits for IP security systems as long as the entire system supports HD. For new installations, HD is the better choice unless the application has specific features, such as difficult or low lighting, where SD cameras may maximize image usability. Indeed many installations will be best served by using a mix of SD and HD cameras.

SD still fulfils a valuable role, offering its own advantages in many applications. Megapixel solutions also have a place in today’s video surveillance systems, especially in supplementing SD cameras where capturing extra detail in scenes is required.