CCTV Emerging Technologies

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Introduction

This paper is intended to provide an overview of the state of CCTV technology, and current trends of new technologies, specifically as they apply to the ITS industry.

In the 1990s, the ITS industry began deploying CCTV cameras for surveillance, primarily in point to point fiber optic systems. In some cases where fiber was not available, leased T1 lines were used. Most of these cameras are now termed traditional Pan-Tilts or non-dome cameras. In these systems, a receiver/driver was located in the CCTV cabinet. This receiver/driver accepted RS-232 or RS-422 commands and in-turn sent 110V up individual pan and tilt wires to a heavy duty pan tilt unit.

In the late 1990s and throughout the 2000s, a large focus moved to dome cameras that had an integrated receiver/driver inside the dome housing, moving the communications from the cabinet to inside the dome camera. Also in the early 2000s we saw the emergence of MPEG1 and MPEG2 video encoders for transmitting the video and control data over the emerging IP markets. This move was highly facilitated with the advent of hardened Ethernet switches. The analog dome cameras of today are still highly similar to their predecessors, with the largest advancements being additional optical zoom and day-night operation. (Note: there are some traditional style pan-tilt units offered with integral receiver/driver and integral IP).

While analog cameras with external encoders are still preferable to some for reasons to be discussed herein, there is a significant shift to IP cameras in all markets, which is beginning to move to the ITS arena. With an IP camera, dome or traditional, the video and control data is all handled via Ethernet direct to the camera. In essence, the external video encoder is now located inside the dome camera – similar to how the receiver/drivers were moved inside the dome cameras many years ago. A lot of this technology shift was heralded by the security recording systems, where DVRs (Digital Video Recorders with analog inputs) are being replaced by NVRs (Network Video Recorders), where the recording system can grab the video streams directly off the network.

MPEG2 technology was not suitable for recording due to its very large bandwidth requirements, so the markets were stuck with DVRs. With the advent of MPEG-4 (Type 2), the recording systems were able to utilize these streams, sometimes native but mostly proprietary with hybrid compression. With the introduction of H.264 (MPEG2 Type 10), the IP camera industry really accelerated.

Additionally, following the technology trends that we see every day in flatscreen TVs, technology is moving from 35x day-night cameras, to 720p cameras, to 1080p cameras, to MegaPixel cameras, etc. All of these have their advantages, disadvantages and applications as related to different markets. With HD and MegaPixel technology, there is no analog signal available – it is all digital due to the bandwidth requirements. (This is the same as TV Networks converting to all digital). So therefore, the camera must be an IP camera.
External Encoders vs. Internal Encoders

We have already identified that the latest technologies, HD and MegaPixel, require an IP interface to the camera. But what about our typical, most common surveillance cameras – the 18x to 36x optical zoom, day-night cameras that are used throughout the country?

It is evident that at some future point almost all cameras will be IP. But there are many things to consider about having an IP dome versus an analog dome with an external encoder, especially as it relates to the ITS market.

**Cost:**

For the most part, there will be a capital cost savings of a traditional IP cameras over an analog camera with external encoder. This is one of the biggest considerations for IP cameras.

**Maintenance:**

While some will argue that the IP dome is simpler, others will offer that it has higher maintenance and repair costs. In ITS systems, unless the system is wireless/solar, we typically have a CCTV cabinet located somewhere near or on the CCTV pole. This cabinet already houses an Ethernet switch, so having an encoder in the cabinet is no big deal. If the encoder goes down, replacement is fast and simple. However, if the encoder in an IP camera goes down, the entire camera assembly has to be taken down and sent back for repair. Typically more tech time and shipping costs.

**Lowering Device implications:**

The vast majority of lowering devices sold over the past 12 years are wired for analog cameras. The cabling has coax, two twisted pairs for data and power wires. In these systems, the conductors are permanently molded or sealed into the connector system and/or the connector has changed for IP operation, so to change to an IP camera will require the lowering device to be removed and sent to the factory for rework (or a new lowering device purchased).

The other option which has not been field tested may be to use a Balun to send the Ethernet from the top of the pole down the coax. And if the balun is powered, use the data wires to provide power to the Balun. This has not been tested, nor has the suitability of such devices to be installed inside the lowering system junction box.

**Distance Limitations:**

Cat5e/Cat6 cabling has a specified distance limitation of 100m (330ft.). Within ITS systems, there are many instances where the CCTV Cabinet is in excess of this from the camera pole. And most Ethernet extender devices available do require power.
Existing System Integration Questions

If starting a new CCTV system from scratch, it is a no-brainer to go with the latest technology. But what about when you are integrating new technology elements into your existing system, without the funds to do an entire overhaul?

Is my head end display system capable of handling H.264 and RTSP?

Many older wall screen systems like Jupiter and Barco do not handle H.264. Most of these systems implemented H.264 within the past 3 years, whereas a lot of existing systems have older processors.

Can my displays show both 4:3 and 16:9 aspect ratio? Simultaneously?

While H.264 does not define aspect ratio, where a regular H.264 encoder will have a 4:3 aspect ratio, the HD and Mega-Pixel cameras will have a 16:9 aspect ratio. You could have black lines around the image.

Does my head end software support RTSP requests and does it decode H.264?

Many legacy control systems may not have RTSP protocol implemented, which is required for H.264. It is a very different URL structure than older UDP systems.

Does my network have the capacity for bandwidth on HD and Mega-Pixel cameras?

Some network infrastructures may not accommodate the potentially large bandwidth of newer cameras. 1 MP, 2MP, 6MP cameras are on the market. Will my existing network be overloaded with this bandwidth?

What Do I Really Need?

Sometimes the best way to approach the new technology is to determine what is really needed to accomplish the task at hand, rather than getting caught up in the buzzword du jour.

The standard 18x – 35x optical analog or IP cameras are the most common device used within ITS. The newer HD (720p and 1080p) currently have lower optical zoom, but higher digital zoom. However, keep in mind that the sensitivity of a camera is based upon how much light hits the imager, so super long zooms may not provide adequate lighting for a crisp, vibrant picture.
If the goal is to display video on monitors or within wall-screen windows of relatively small size, HD and Megapixel cameras may not be worth the added expense. There is only so much resolution that some monitors can display.

The fact of the matter is that most of the new technology is being driven by consumer products (TVs, cameras, smart phones, etc.) and also by the requirements of security systems. And in ITS, we tend not to record our video. Let’s take a look at the traditional use of mega-pixel cameras.

In deploying Mega-Pixel cameras, (offered by all major CCTV vendors), the user watching live video is seeing a regular image – most likely identical to 35x, 720P or 1080P, or at least close enough the human eye cannot discern any difference. These cameras are typically used in security systems that are recording video. Take a look at any Wal-Mart. You will usually see a candelabra with 3 or 4 cameras mounted on each corner and in the center, recording video of the entire parking lot. Let’s replace all of those with one mega-pixel camera with wide view angle lens per mounting location. If an incident occurs in the parking lot, security staff can replay the video, stop on any frame and then zoom in and pant and tilt around the video with amazing clarity. Very similar to the use and feel of most commercially available map programs.

There is a very famous mega-pixel image taken of President Obama’s inauguration. It can be found at the following link. This will truly show the intent and usage of Mega-Pixel cameras.

http://digg.com/newsbar/topnews/David_Bergman_1_474_Megapixel_Pic_of_Obama_s_Inauguration

**Conclusion**

The CCTV industry has changed rapidly over the past several years with advent of MPEG2 (Digital TV, DVD, etc.) and H.264 (Hi-Def TV, Blu-Ray DVD, etc.). With H.264, we are now seeing the migration to IP cameras, and even more so High Def IP cameras. These technological advances are the result of engineering advancements in consumer television and cameras.

We need to understand and follow technology, yet not get too caught up in the hype and buzzwords. We need to make sure we understand our own requirements and expectations, understand the limitations and ramifications of new technology on existing infrastructure, and apply the new technology that best fits our needs.