

High-Definition Video over IP: Enhancing Visual Information for Improved Traffic Flow and Incident Response

By Craig Beal, Engineer, Cohu Inc., in conjunction with Theresa Myers, Editor, Activu Corporation

Modern Traffic Management Centers (TMC's) are typically using HD IP video cameras for incident management and adaptive signal control. Incident management systems are used primarily to detect a traffic incident, verify and assess the problem, and respond to the incident. The response can range from notifying designated authorities by phone or email, securing emergency personnel or simply relaying that information to appropriate organizations. Adaptive signal control systems utilize video cameras to detect the critical details that enable operators to react quickly to road conditions. Recently, Activu spoke with Cohu Electronics to better understand how IP video is being used in TMC's and how the latest advances in High-Definition (HD) IP video are enhancing these systems.

How are TMCs using IP Video?

Most TMCs today are using roadway sensors for traffic counting as a means for determining traffic speed and conditions. However, these sensors provide limited information because they can only display the speed of traffic, which can be a symptom of a bigger problem. TMCs rely on IP video cameras to provide the diagnosis to those symptoms. In incident management systems, cameras allow operators to see the true cause of the traffic backup. With this visual information, TMC operators can provide feedback to the public via real-time traffic GPS systems, changeable message signs, television, or on the Internet (i.e. web portal, Twitter, Facebook) and they can pass along this information to other government agencies for use in incident response. Advanced use of these traffic surveillance systems includes the use of camera presets. These pre-defined "presets" can allow the application software to direct the camera to automatically look at a specific section of roadway, when a certain action triggers this "preset". For example, when traffic reaches below a predefined speed threshold, traffic sensors can alert the application software to redirect the camera to view an alternate angle. Based on what the operators can see, they have the ability to make changes to traffic signals, etc.

On city streets, IP video cameras are primarily used for adaptive signal control systems in which TMC operators can monitor certain corridors and coordinate traffic signals in order to keep traffic flowing along critical traffic corridors. They can make certain lights turn green or red based on real-time traffic conditions. This type of functionality is especially valuable during high-traffic events such as a sporting event or natural disaster.

How has the market changed in the past 3 years as it relates to TMC technology implementation?

Within the last 3 years, TMC's have begun implementing the latest IP technology into their video systems. The main reason for this is that the IP networks can be used to support a variety of different pieces of traffic management equipment on a single communications channel. The associated equipment used in traffic counting sensors, video monitoring, and changeable message signs, and traffic signal controllers can be configured and managed over the IP network instead of each piece of

equipment requiring its own communication lines or several shared lines. They don't have to install separate communication lines for the cameras, roadway sensors, and all the other different pieces, like they've had to do in the past. The consolidation of network equipment means that now, TMCs only have to install an Ethernet network. This helps them reduce their labor and equipment expenses while realizing true ROI. Another reason for the increased migration towards IP systems is the fact that IP video is easily shared amongst individuals and organizations. With IP video a network can be configured to allow users, with the proper credentials, to view a video feed from anywhere that has internet access.

What are some of the most important attributes of IP cameras that TMCs are looking for?

First, TMC's have been moving away from the use of analog cameras that rely on external encoders for producing IP video and moving towards cameras that integrate the video encoder directly into the camera itself. This reduces the equipment footprint and the total cost of ownership by removing the cost for the additional encoder and reducing the space required in traffic signal cabinets.

Second, a fully functional video system using analog cameras requires a complicated network of video encoders and decoders, matrix switchers, and camera control receivers to allow for full control and display of the cameras. IP cameras with external encoders provide IP video right out of the camera that is useable at the TMC without any additional encoding or decoding.

Third, IP cameras are even more powerful when combined with a dynamic suite of video management software. With the combination of video management software such as Activu and Cohu IP video cameras, all or most of this analog equipment can be eliminated from the project design.

Finally, the transition from an analog camera system to a full IP system can be a bumpy one. Cameras that output both analog and IP video can help ease this transition. These types of cameras can be installed into an analog system with the IP video functions available as soon as the TMC is able to put the required network in place. This allows TMC's to buy cameras featuring the latest technology without introducing complications into systems already going through the analog to IP transition. Once the IP network is in place TMC operators would just need to change the camera configuration in order to output IP video. Maintenance crews do not have to be dispatched, lane closures do not need to be coordinated, and new cabling doesn't necessarily need to be installed. It's an easy way for the TMCs to make the switch to IP.

Cohu's new line of HD products offers several important advantages for TMC's. HD cameras provide drastically improved real time images. The breakthrough here is the addition of an 18x optical zoom lens; this translates into increased resolution, at increased distances. "In the beta trials of our HD cameras, a single 3960HD pan/tilt/zoom (PTZ) camera could accomplish the adaptive signal control tasks at more than a half mile away simply because of the increased resolution and optical zoom lens," said Craig Beal, Engineer, Cohu Inc. "In addition, HD cameras can output both analog and IP video which is perfect for TMC's in the transition from analog to IP. During a beta trial for the City of Santa Ana, California, they were able to look at an intersection in all four directions and get a clear visual of up to two intersections away, allowing operators to identify potential problems and make necessary adjustments to the lights to keep traffic flowing at a steady pace."

How are these features used and how are TMCs benefiting?

With HD cameras TMC operators can more clearly identify the cause of slowed traffic. With the increased resolution and increased distance, they can zoom in and really see the details. Whether a vehicle has blown a tire, an accident has occurred, or other incident, the TMC operator can more clearly view the scene which results in better decision making and more complete information provided to other public agencies.

HD cameras are also expected to play an increasing role in traffic enforcement applications where resolution and frame rate are important factors. Typically in order to transmit video from a megapixel camera over an IP network, it has to be configured for a frame rate as low as 3 or 4 frames per second. Using the latest HD cameras TMCs are able utilize a full 30 frames per second thanks to the latest H.264 video compression standards. For example, with a megapixel camera you would only have 3-4 frames available (in one second) in order to catch license plate or other critical information. Cameras using the latest HD and H.264 technology in this same scenario are able to provide 30 frames (in a second) with increased resolution. Because there are 26 more frames with an increased amount of visual information, there is a much higher likelihood that the critical information will be able to be seen.

Are more TMCs migrating from analog to IP video cameras?

Yes. Many TMC are migrating from analog to IP video cameras due to the benefits we have talked about. First, IP video is no longer considered Closed-Circuit Television (CCTV). CCTV is your core video, it's inside your building and part of your internal security system. It's typically not shared with anyone outside of your building. But you are seeing more TMCs requiring the ability to share information with government and public agencies outside of their building. IP video is very easy to share with multiple users and can be monitored from any computer with access to the video network. Second, available IP network bandwidth is increasing and the associated costs are decreasing. As fiber optic cable has become more prevalent and copper wire technology has improved, the bandwidth available has increased. So video is able to grab a chunk of that bandwidth. Dropping costs are also a driver of the movement from analog to IP video systems. IP video technology has been around for a long time, but it has just recently become affordable for use in traffic management systems. It has become a more flexible and cost effective solution.

What are the advantages of HD H.264 video compression?

Moving from MPEG-4 to H.264 has drastically decreased the bandwidth that it takes to run network video over IP. The latest camera technology uses H.264 and uses only about 1/3 of the bandwidth that MPEG-4 did. So, for instance, if you have a 100Mbps switch running at 10MB per camera, you could have up to 10 cameras on that switch (without consideration for headroom). Adding any more cameras will drastically reduce the quality of video provided by all of the cameras. If you took those same cameras and used H.264 encoding, you are only going to use about 33MB, so you could conceivably triple the number of cameras to 30, but that's speaking about standard resolution cameras. Until H.264 came around, it wasn't practical to have HD video over the network. You could do it, but if you wanted to have a lot of HD cameras, you had to have a very capable IP network. Because H.264 is 1/3 the

bandwidth, now those HD cameras are running at slightly less the bandwidth than was required for standard resolution cameras under MPEG-4. So for instance, if you had 10 standard resolution cameras on a 100Mbps network, now you can have 10 HD cameras on that same system. Because of the H.264 video compression you can literally get better quality video within the same amount of bandwidth.

IT managers currently using IP video cameras with MPEG 4 can upgrade to HD cameras without having to upgrade their network, it's a very easy migration path and in the end, what you'll get is a much clearer solution. When an operator has to verify a particular incident, being able to determine details such as how many occupants are in a vehicle, license plate number, and color of the vehicle is much easier to accomplish when using an HD camera.

What do you see as the most significant advantage of using Cohu HD video cameras integrated with an IP-based visualization and collaboration solution from Activu?

In providing a HD quality image from a Cohu camera, displaying and controlling this image on an Activu visualization and collaboration solution provides operations personnel with visual advantages which assist in how they respond to an incident. Now, they have a better visual evaluation tool. Responding to a reported incident, assessing the problem and determining a response to the situation in a timely manner can not only reduce congestion and wait times for motorists, but can also assist in saving lives.

Activu enables today's Traffic Management Centers to effectively manage traffic incidents and reduce congestion for improved safety and response time. Monitoring traffic flow and density over a large geographical area requires extensive video surveillance. As a network-based solution, Activu overcomes the difficult limitations posed by cabling when connecting a large web of cameras and instruments to a control center. Activu's open architecture easily incorporates all types of devices and is capable of displaying an unlimited number of information feeds

Activu software is integrated with and can display any Cohu product, including the Helios HD product, Translinx encoders, i-linxII encoders as well as the 3940/3980 MPEG-4 product line. This offers a one source software support and control system for all of Cohu products.

About Cohu:

Cohu Electronics is a leader in the Intelligent Transportation Systems and Traffic Management markets, with video systems installed in many of the largest transportation districts throughout North America, and gaining acceptance worldwide. Typical ITS/traffic management applications include general highway surveillance, electronic toll collection verification, traffic responsive timing, wide area detection, and inspection checkpoints. For more information visit <http://www.cohu-cameras.com>

About Activu

Activu Corporation is an Information Technology and Services company delivering true end-to-end network solutions for mission-critical command and control environments. With a team of dedicated engineers, Activu has the unique ability to design, build, deploy and support full turnkey, net-centric software-based visual systems from desktops to data and video walls to help organizations improve collaborative information sharing and decision making. For more information visit www.activu.com/traffic