REMOTE CONTROL

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In Redding, California, Caltrans (the California Department of Transportation) is using a combination of technologies to notify drivers in the local mountains of hazardous curves and to provide incident managers, both in the TMC and on call, with timely information.

At the California Department of Transportation (Caltrans) District 2 TMC in the foothills at nearby Redding, an innovative new tool has been installed which allows the incident manager to better accomplish this - an advanced curve warning and traffic monitoring system. By warning motorists and truckers of their high speeds approaching a curve, the system seeks to prevent accidents. When traffic slows and backs up after an accident, the system quickly notifies key personnel by pager who can view conditions over a telephone line to help plan an appropriate response to the incident. This proactive and reactive strategy helps solve a difficult rural traffic problem.

Mountain challenges

Interstate Highway 5 (I5) traverses the northern California mountains past Shasta Lake and around Mount Shasta into southern Oregon. The rugged terrain constrains the highway to a narrow path between small rural communities, challenging many motorists and truckers to negotiate a steep and winding road through mountainous country. Unfortunately, many vehicles exceed the safe advisory speeds around curves. The resulting accidents, especially those involving trucks, can block the highway for hours at a time.

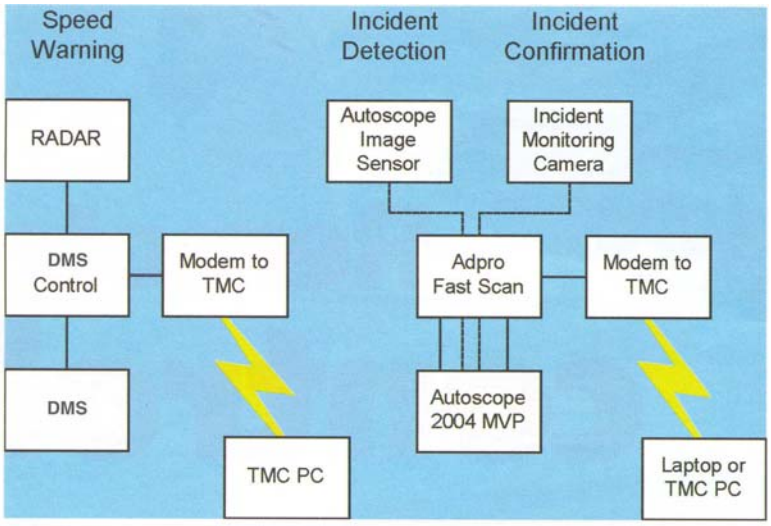

Figure 1: *An advanced curve warning and traffic monitoring system*

Traffic professionals also face the challenges common to mountain regions. Even with quick mobilization, it takes time to reach a rural location. Simply learning about an incident can be a drawn-out affair - for example, the mountains can block cell phone signals in remote areas between towns and weather is always a trying factor. Getting information to the TMC for the incident manager requires new tools and techniques.

Figure 2: *A typical installation. The cameras are mounted on the pole to the left of the DMS*

The TMC in Redding is now undergoing a major expansion which will allow more space for new tools and communications capabilities. The TMC will combine dispatch and traffic management functions, operating round the clock during inclement weather. Certain staff and computers, previously confined in a very small area, are moving to a much larger space and the TMC will have two 84in (210cm) and six 21in (55cm) video monitors, satellite communications, and a geographical information system (GIS) map showing alarm highlights.

Another new tool, which combines a number of ITS technologies, provides speed warnings to motorists and automated incident detection and verification for traffic professionals. The advanced curve warning and traffic monitoring system consists of: radar units, dynamic message signs (DMS), Autoscope™ video detection systems, incident monitoring cameras, Adpro video compression systems, and telephone communications to the TMC.

The field equipment for the system shown in Figure 1 divides into three subsystems according to function:

- Speed Warning: Provides active warning to drivers (radar and DMS);
- Incident Detection: Autoscope video detection system and automatic TMC alert;
- Incident Confirmation: Incident monitoring camera to view down stream accidents.

The TMC staff and field managers alike now receive a page whenever the new system detects a potential incident. Using a laptop computer, the incident manager can call in via telephone to visually assess the extent of the incident, even while on call at home. Likewise, an alarm at the TMC alerts staff to a problem. Once again, a telephone call to the field brings video and traffic data back to the TMC. This automatic system supplements other means, like calls from the public, to quickly notify incident managers of an accident.

The initial deployment (Figures 2 and 3 show a typical site) placed speed and incident detection sensors at the five most troublesome curves along the IS, about 60 miles (100km) north of Redding.

To actively warn drivers of their excessive speed, the DMS displays both the vehicle's speed and the recommended speed for the approaching curve. If the motorist is traveling slower than the advisory speed, the DMS simply displays the standard advisory speed. TMC personnel in Redding can also change DMS messages remotely.

To quickly alert incident managers of a potential accident, the Autoscope wide-area video vehicle detection system (see Figure 4) provides incident detection alarms. The Autoscope system measures the speed of vehicles at each site. When an alarm occurs, the Adpro Fast Scan video transmission system pages incident managers and phones another Fast Scan unit at the TMC. Incident managers can view video, traffic data and the operation log from the Autoscope system to determine the cause of the alarm, observe any congestion within sight of a camera, and plan the proper response to the incident.

The Autoscope system along I5 looks for slow-moving or stopping vehicles. In this case, Caltrans defined an incident as an average speed below 35mph for the last five vehicles. The Autoscope system can also look for stopped vehicles in the road or along the shoulder, vehicle queues, congestion, slow traffic, wrong-way vehicles, vehicle types like high-speed trucks, or the shockwave from an incident outside the view of the Autoscope sensor. It can also look for various logical conditions specific to the site. The Autoscope video detection system can meet the unique requirements of almost any incident management system.

Figure 3: *The same installation, showing the location of the control cabinet*

The Autoscope system also collects traffic data continuously. This data includes volume counts, vehicle classifications, average speeds, average occupancy, average headways, level of service, density and average flow rates. Traffic professionals at the TMC can periodically call each unit to download traffic data for analysis.

Detection and confirmation

The incident detection and incident confirmation portion of the new system consists of off-the-shelf equipment: the Autoscope 2004 machine vision processor (MVP), two Autoscope image sensors, the Adpro Fast Scan video transmission system, and a modem. Interface panels terminate the wiring to the cameras and convert the contact closure output of the Autoscope MVP to the alarm input of the Adpro Fast Scan unit.

When the Autoscope video detection system detects an incident, an alarm output causes the Adpro Fast Scan unit to dial several pagers in sequence and then call another Fast Scan unit at the TMC. The pagers receive a coded message of an incident alarm at the site. At the TMC, an alarm sounds and video from the site is available for display.

At the TMC, a PC, a central Adpro Fast Scan unit and a modem can connect to any of the field sites over a standard PSTN phone line. Once connected, the remote Adpro Fast Scan unit compresses the video and updates only the changes in the scene, yielding several frames per second. It also provides a full-duplex communications channel to the Autoscope MVP.

The Autoscope Supervisor Toolkit software on the PC in the TMC can modify the detector layout, retrieve the operations log and interval traffic data, switch between video sources, and view live detector actuations on the high-quality video from the field. Away from the TMC, a laptop computer with a modem can also dial the remote site. The on-call incident manager, using Adpro Video Central Gold software, can select either detection video or incident monitoring video for display on the laptop's screen.

In the mountains along I5, the incident detection design objective was to detect an accident typically resulting from trucks losing control on a curve. The application here is not very different from another truck rollover application in the eastern USA where the Autoscope video detection system looks for high-speed trucks and activates a flashing warning sign. It is also similar to enforcement applications where the Autoscope system detects trucks bypassing a weigh station.

Initial results

During installation, several issues arose because of the remoteness of the sites. Modem communications over the rural telephone lines was intermittent at first. The team solved this problem by upgrading the modems to better handle noise on the lines. An Acceptance Test in the third quarter of last year included staging mock incidents. Several vehicles traveled slowly through the detection areas to trigger incident alarms. The test vehicle drivers received pages after passing through the test site.

Figure 4: *Inside the control cabinet. The Autoscope 2004 is the lower, blue box. The Adpro Fast Scan is the upper black box and keypad*

The main concern is unnecessary pages. False alarms impede the operational use of any automated incident detection system. Some of the causes of false alarms are:

- Sensor anomalies and power failures;
- Weather effects on traffic;
- Short duration, unreported incidents;
- 'Near miss' incidents that result in a short traffic slowdown;
- 'Gawker slowdown' – including sightseers;
- Recurrent congestion;
- Compression waves;
- Bottlenecks or merging zones around construction sites (for example).

The Autoscope video detection system provides several ways to confirm an incident. The incident manager can inspect both the detection video and the incident monitoring video. The Autoscope MVP's operations log also shows local power failures that cause an alarm once power resumes.

The Autoscope video detection system provides a log of past incident alarms for comparison with other records and as a measure of effectiveness (MOE).

As part of on-going system maintenance, the traffic professional can modify his or her definition of an incident or adjust detector placement. For example, the Autoscope MVP's
Incident Detector can also test for an incident at some sites.

One of the primary benefits of the Autoscope video, detection system is visually verifying detection performance from the TMC. Using the PC in the TMC, traffic professionals can quickly make changes to the

system - system maintenance merely requires a telephone call.

Conclusion

Caltrans District 2's new advanced curve warning and traffic monitoring system in the mountains north of Redding, California, is an excellent example of the innovative application of several ITS technologies in a rural setting.

By pro actively warning motorists and truckers of their high speed approaching a curve, the DMS subsystem seeks to prevent accidents, especially those involving trucks. As traffic slows and backs up after an accident, the Autoscope subsystem quickly reacts to alert TMC staff of a potential accident and then helps confirm the severity of the incident. By visually verifying performance, the traffic professional can easily adjust the video detection system to the traffic behavior and conditions at each site, minimizing both time to detect and false alarms.

Although the system helps solve a rural traffic problem, the approach applies to urban traffic safety problems as well. An active warning to drivers can help prevent truck rollovers and other accidents on freeway transition roads, at off-ramps, on bridges and in tunnels.