LAW ENFORCEMENT STRATEGIES TO BENEFIT FUTURE INTELLIGENT COLLISION-MITIGATION SYSTEMS

Article

By

Assistant Chief Teresa Becher
California Highway Patrol

Command College Class XXXVI

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Ah, the pleasure of that drive through the foothills, with the allure of fall colors on the leaves and mountain roads that bring out the best in driving. The driver pushes the new car to the limit so it hugs the road (just like the commercial said…). Suddenly, the on-board navigation system sounds a brief warning and an electronic voice advises the car is approaching the next curve too fast. How does that darn thing work, anyway? Promising to read the owner's manual later and confident the system has a "fudge factor" built in, the driver is sure the car is under complete control. "Now what does the car want?" The wheels are on gravel, and it's blurting out something about the car having left the main traveled portion of the roadway. "Slow down! Turn the wheel, hard!"

The snap turn has pushed the car beyond its limits. The vehicle starts to roll over; the stability control system kicks in and applies independent braking to the wheels to correct the problem. The car stays upright but continues to slide off-road and collides head-on with a tree. Just prior to the impact, the in-vehicle radar sensors recognize the impending collision, tighten the seatbelt and activate the airbag. Automatically, the front bumper extends an additional six inches to help absorb the impact.

Thankfully, the driver survives the impact; however, he sinks into unconsciousness before he can call for help. Luckily, the same sensors that recognized the impending crash immediately assess damage to the vehicle and activate the telematic collision notification and locator system. Separate sensors in the driver seat are able to take basic vital signs and a camera turns on so the telematics service provider can see the

interior of the vehicle. Information about the crash is transmitted from the vehicle to the service provider to a law enforcement dispatch center within seconds.

Responding medics have vital information about the severity of the crash, damage to the vehicle and injuries to the occupants before arriving on scene. Global Positioning Systems (GPS) provide the exact location information, and the dispatch center can tell the vehicle's damage level and starts a tow truck to the scene. Officers arriving on-scene use specialized equipment to determine the cause of the collision and clear the scene quickly with their completed report.

When the crash first occurred, infrastructure sensors in the vicinity activated to monitor traffic backup at the incident site and send information to other telematics service providers and local media. Occupants of other vehicles are notified of the collision within minutes and their vehicle systems provide them with alternate routes of travel. There is minimal traffic backup associated with this incident.

Does the scenario outlined above sound far-fetched or too futuristic to happen in the next ten years? Perhaps, but consider that most of the technology needed to fulfill this vision already exists today through intelligent in-vehicle and infrastructure sensors, communication systems, electronic vehicle control technologies and Traffic Management Centers (TMCs). In fact, the main reasons these intelligent collision-mitigation systems (CMS) are not fully developed and mass-installed on all vehicles are cost, reliability, and a lack of consumer awareness and acceptance.

What intelligent CMS currently exists and where will it be by 2013? What are the issues and who are the main players? How can development and implementation of these systems positively impact law enforcement? Why should law enforcement see this as an

important futures issue and plan for the impacts? The willingness of law enforcement to take on a leadership role to address these questions will help others understand the need, and will ultimately save lives and enhance traffic safety in ways we can still barely imagine. The first step, though, is to plan for the future we want.

Intelligent Collision-Mitigation Systems Now and the Future

Intelligent collision-mitigation systems are already moderately advanced and in use on many high-end and commercial vehicles. Many of them, in fact, are in use in cars sitting on sales lots today. GPS that track the vehicle's movements, General Motors' OnStar emergency communications option, electric steering, power brakes and independent wheel control are all examples of CMS in demand by today's sophisticated buyer. In commercial vehicles, black box technology, GPS tracking of fleets, sensors that watch blind spots and collision warning systems are also already in limited use.

Similarly, research and development for this technology is moving forward at a rapid pace. It is only a matter of time before highly refined sensor nets (laser, radar, video and impact control technologies) become commonplace on the car of tomorrow. CMS systems now in place, or in active development, include:

- Black Box Technology – is currently used to record basic vehicle speed, throttle position and seatbelt use in the 5 seconds immediately preceding a collision. Advanced Black Boxes will provide more detailed information from in-vehicle computer systems in formats more easily downloaded.
- Crash Notification Systems – can currently provide mapping and vehicle location information to the telematics provider when a collision has occurred. The provider then calls law enforcement and the emergency

medical authority, as appropriate. The service provider can also currently remotely locate, lock or unlock the vehicle and shut it down. Future On-Board GPS Systems will act as a total communications system for the driver detecting collision scenarios and providing information about speed limits and other vehicles to the driver. The system will also be tied to the in-vehicle sensors and automatically notify the telematics service provider when a collision has occurred. Service provider systems will be tied electronically to police and/or emergency medical dispatch centers to more efficiently transmit vital information.

- Collision Warning Systems for Passenger Vehicles and Heavy Trucks – currently can provide audible and visual warnings when collisions may occur. Advanced monitoring systems in development include laser, radar, video cameras and GPS, which will form a collective safety net 360 degrees for the vehicle monitoring the interior and exterior environment. Pre-crash systems in development can control safety equipment and vehicle control systems.
- Front/Rear-End Warning Systems – this specific type of collision warning system currently notifies the driver when a collision may occur. Systems in development can retract the seatbelts, deploy the airbag, assist in braking, extend the front/rear bumper to absorb greater impact and intentionally dip the front end of the vehicle, if necessary, so unavoidable collisions will be bumper to bumper.

- Lane Departure Warning Systems – currently, a specific collision warning system that warns when a driver is crossing a lane line if a turn signal has not been activated. Advanced systems being developed will also be able to warn drivers when they are about to drift off the road and crash or when they are approaching a curve too fast.
- Backup Warning Systems – another type of warning systems that uses video cameras and radar to warn when an obstruction is in the vehicle's path of travel while backing. Some systems even show the driver what is behind them. Advanced systems will assist in braking and deploy safety systems to mitigate the impact.
- Night/Fog Vision Systems – currently enhance vision by projecting the road scene onto the windshield as a heads-up image using infrared technology. Advanced systems will adjust the headlights to follow the vehicle path of travel and tie to in-vehicle and infrastructure sensors to locate and display other vehicles on the roadway.
- Stability Control Systems – can currently notify the driver when tire pressure is too low and/or apply brakes independently when steering does not match the vehicle path of travel (e.g., hydroplaning). Rollover systems in development will warn drivers they are about to roll over, retracting seatbelts and/or implementing stability control intervention by the vehicle.
- Adaptive Cruise Control (ACC) – senses when the vehicle is overtaking another in its path while in cruise mode and brakes automatically to

compensate. Then, the system accelerates the vehicle back to the cruise control setting when the path is clear. This system is currently marketed only as a convenience system and not as a collision-mitigation system.

- Intersection Collision Avoidance – (in development only) will warn drivers they are about to crash into a vehicle crossing their path (either running a red light or at a left turn). In the future, these systems will also assist in braking to avoid or lessen the impact of the collision.
- Pedestrian-Protection Devices – (in development only) will specifically recognize humans in the path of a vehicle and provide driver warnings and vehicle impact control measures.

Stakeholders and Issues

These systems are magical technological marvels to most of us, but there are groups working diligently to move the development of intelligent CMS in a positive direction. These key stakeholders include auto manufacturers, vendors, the U.S. Department of Transportation, state and local departments of transportation, law enforcement agencies, the health care system, the commercial and insurance industries, community based traffic safety groups, legal groups, the public, the media, taxpayer groups and environmental advocates. Each of these groups is concerned with different issues, but input from all of them is necessary to make intelligent collision-mitigation systems an acceptable technology of the future.

The main issues of concern for CMS technology include funding, reliability, human factors, privacy issues, liability concerns, standardization, and system security/tampering. Transportation funding is a priority issue for private and

governmental stakeholders involved in research and development of intelligent CMS technology. Funding is also an issue for taxpayer groups and transportation entities that want to prioritize installation of the technology in costly roadway infrastructure construction or retrofit.

Reliability is also a major factor for all stakeholders. Intelligent CMS must match its human counterpart (the driver) as closely as possible in its ability to sense, think and react to a driving situation. If the systems cannot match human capacity, they will never be accepted by the driving population as a safety solution.

Human factors, such as a person's ability to multi-task using complex vehicle technology, are critical to successful application of intelligent CMS. This issue is especially problematic for the nation's booming older driver population. Many older drivers do not react as quickly as do younger drivers and the technology may well be more of a hindrance than a help if they become distracted by intelligent CMS. Other opponents of the technology argue that drivers will become over-reliant on the systems and fail to drive defensively, causing more crashes.

Privacy issues are a major concern in development of the technology. Privacy advocates fear law enforcement or other entities will retrieve and abuse the information from black boxes and GPS systems without safeguarding the personal freedom of drivers. This issue will mainly impact public acceptance of the technology; law enforcement use (or abuse) of the systems will play a primary role in that debate.

The litigious nature of American society will also have a direct impact on the auto manufacturers' and vendors' willingness to move forward with introduction of intelligent CMS. A driver using intelligent CMS may try to hold the system, the vendor and the

vehicle manufacturer responsible for a collision regardless of other factors. Too many frivolous lawsuits focused against intelligent CMS technology may hamper development and introduction of the systems for years to come. Moreover, a major failure of an intelligent CMS technology that causes crashes will also have a significant detrimental impact.

Development of standards will be critical to consistency in the technology. CMS systems use a variety of complex algorithms to calculate when the vehicle should warn or intervene in an impending collision. Additionally, vendors approach human interaction with a CMS device in a variety of ways (e.g., warning light versus buzzer, voice activated versus push button, et cetera). While standards will be critical to systematic development of CMS, federally mandated standards for these systems could slow advancement of the technologies as manufacturers and vendors have to adjust existing systems to comply.

Currently, intelligent CMS relies heavily on radar, video and GPS, all of which can be jammed or distorted. Additionally, future vehicle-to-vehicle and vehicle-to-infrastructure systems will rely on short-range radio communication to function. Short-range radio is also susceptible to tampering by overriding or blocking the signal. The success of CMS will hinge on the industry's ability to safeguard proprietary technology and law enforcement's ability to deter this new type of crime.

Technology Benefits to Law Enforcement

Overall, the impacts of intelligent CMS on law enforcement are beneficial if changes are planned for carefully in the present. The most prominent potential advantages of this technology include:

- A significant reduction in collisions and injuries and fatalities associated with collisions.
- A reduction in officers killed in the line of duty as a result of collisions.
- Advancements in the way traffic collisions are investigated and documented by using CMS information.
- A reduction in overall traffic congestion and/or congestion-related incidents.
- Positive changes in public perception and attitudes about driving.
- Development of new driver training and testing standards.
- Police personnel redirection from traffic issues to other priorities.
- An ability to use the technology to address other law enforcement issues (e.g., pursuit intervention and auto theft).
- Increased ability to provide other types of service to the public.
- Development of new high-tech units to focus on crimes related to intelligent CMS.
- Stakeholder agencies working more closely together on related issues.
- More community/public support for law enforcement.

Strategic Planning for Law Enforcement

The future described in the opening of this article was chosen as the *vision* for strategic planning for this issue, and offers an opportunity to design and implement strategies which would positively impact development of collision-mitigation systems. The broad goal for intelligent CMS strategic planning is to support the development and implementation of reliable intelligent CMS in roadway infrastructure and in all newer vehicles driven on the highway. Three primary objectives will serve to promote the achievement of this goal. These objectives are:

1. To support and promote adoption of uniform standards for intelligent CMS.
2. To promote dedicated funding for in-vehicle and infrastructure CMS technologies at the local, state and federal levels.
3. To encourage governmental and public acceptance of intelligent CMS technology.

No doubt, this slate of objectives will require the dedication and effort of a broad cross section of interests. Looking solely at the third objective, more than a dozen primary strategies could be developed for large traffic law enforcement agencies desiring to lead the work towards intelligent CMS. Those objectives are:

1. Track and participate in the development of both infrastructure and in-vehicle devices to gain input and develop expertise.
2. Ensure key stakeholders are included in research and development to gain appropriate buy-in from all groups.

3. Consider testing and using the devices in police vehicles or on police driving courses to help develop reliability and show benefits.
4. Encourage other law enforcement agencies to use caution in exploiting this technology for enforcement purposes, which may provoke privacy concerns and hamper future development of the systems.
5. Participate in setting the standards that permit the ultimate use of the technology for broader law enforcement purposes.
6. Encourage the development and use of in-vehicle devices with high public attraction (e.g., devices to detect fatigued drivers).
7. Work with the stakeholder groups, including the media, to implement public education and information strategies to benefit intelligent CMS.
8. Advocate for CMS technology at professional meetings and seminars with key stakeholders.
9. As technologies prove beneficial, stress their benefits at education and awareness meetings with the public.
10. Inform and educate stakeholder groups, including Congress.
11. Solicit participation from stakeholder groups in strategic planning for this issue.
12. Develop clear policies and procedures for CMS technologies that directly impact law enforcement protocols for collisions, etc.
13. Collect data during collision investigations documenting the role of intelligent CMS in mitigating the collision.

Conclusions and Recommendations

Intelligent collision-mitigation systems are here in basic form already and are moving forward rapidly. Technological advances in the systems will exponentially enhance their capabilities. The only reason they have not yet had a greater impact on traffic law enforcement is because they are not in mass-production – yet. Given that a blend of safety and profit motive will induce vehicle manufacturers to introduce more CMS measures in subsequent model years, it is imperative that law enforcement take the lead to ensure those advancements enhance driving safety for all, not just those who can afford it. Many police agencies are already looking at some of the initial technology like black boxes and may be trying to develop procedures or protocols to handle the information. By the time they get that strategy in place, the technology and public perceptions will have changed. A piecemeal approach to this issue will not work, and would only serve to place the police in a position of catch-up for years to come.

Traffic law enforcement stands to gain a great deal from the technology in terms of achieving its mission and goals to reduce fatalities and injuries associated with collisions. Law enforcement in general stands to gain from the technology relative to its other associated uses (e.g., pursuit termination and curtailing auto theft). In addition, law enforcement as a stakeholder has a lot to add to research, development and implementation of this technology. The best way to get involved now is through strategic planning and participation in process of creating the future. Using the steps and strategies outlined herein, any large law enforcement agency with a major traffic unit concerned with managing futures issues can become involved.

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