AUTOMATED CRASH NOTIFICATION

Preliminary Findings and Future Trends

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Although prevention remains the national goal, early notification of a crash and the ability to estimate its severity and the extent of any injuries can have a significant impact on the provision of prehospital care and treatment. Early crash notification is especially important in rural areas. Significantly fewer miles are driven in such areas as compared with urban travel, but a much higher percentage of rural crashes result in fatalities. Factors responsible for these higher fatality rates include longer notification and response times. Also contributing are the greater speeds involved; lower levels of hospital and prehospital care in rural areas; and a larger number of crashes involving single-vehicle, unwitnessed road departures.

Each year roadside crashes account for a third of all highway fatalities and cost society more than $80 billion. Rollover crashes are the most severe, resulting in 25 percent of roadside fatalities, and 75 percent of rollovers occur on rural roadways. This fact has been recognized by the Federal Highway Administration's Technology Deployment Initiatives and Partnership Program (TDIPP), which has as a goal reducing the human cost of run-off-the-road crashes and related injuries. The program is designed to significantly accelerate the adoption of innovative technologies, including systems that can enhance postcrash services, such as emergency vehicle response or specific medical services, thereby mitigating trauma.

Crash Notification Effort in New York State

One effort addressing the above TDIPP goal was initiated by the National Highway Traffic Safety Administration and a number of public and private partners in western New York State in October 1995. Two systems were developed and are currently being tested under this effort: an automated collision notification (ACN) system and a crash event timer (CET) device.

The ACN system includes an in-vehicle module (IVM) that automatically senses and characterizes a crash and transmits information about the crash to a 911 dispatch center via wireless (cellular) communications. At the 911 center, a computer console displays a detailed roadmap showing the crash location and other data, including the change in velocity experienced by the vehicle during the impact; whether the crash was a frontal, side, or rear impact; whether rollover occurred; the make, model, and year of the vehicle; and the probable occupants of the vehicle.

One of the major requirements for the IVM was platform independence so that the module could be used by a wide range of private vehicle owners, and the system could be installed efficiently without involving other vehicle (safety) systems. As a result, crash threshold would need to be based on injury risk, not crashworthiness characteristics of the

Early crash notification is especially important in rural areas, which have a much higher percentage of fatalities than urban areas, in part because of road departures and rollover crashes.

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FIGURE 1 Internal and external views of in-vehicle module of automated collision notification system, which automatically detects a crash and transmits information to a 911 dispatch center via wireless communications.

vehicle, such as mass or stiffness. Furthermore, the unit had to be capable of recording multiple crash events, since the first event may not be the most serious in terms of producing injury.

Unlike other vehicle electronic systems, the IVM also needed to survive the crash itself. The module used for the operational test (see Figure 1) is packaged in a rugged housing and contains a high-performance digital signal processor, three orthogonally mounted micromachined accelerometers, a single-chip modem, a Rockwell Jupiter 12-channel Global Positioning System (GPS) unit, and a nonvolatile flash memory to store crash events. A device-activation algorithm based on injury data from the National Automotive Sampling System for the years 1994–1996 and weighted to represent the national condition was developed. The ACN is triggered on the basis of change in velocity, principal direction of force, and acceleration.

The CET is a simple sensor that is triggered by the same level of crash forces as the ACN. The device is designed to provide an essential piece of crash information not presently available—the precise time of the crash. The CET has no communications capabilities, however, so its data must be manually downloaded after a crash. Police officers in the test area have been trained to notify the study team when a crash involves a vehicle with a CET.

Operational Test

An operational test of the above devices is being carried out. This operational test has two major thrusts. The first addresses the real-world performance of the ACN system. Approximately 1,000 privately owned vehicles with the systems are being used to evaluate the performance of the in-vehicle equipment, emergency messaging infrastructure, and emergency service providers. Data are also being collected by CETs installed in some 4,000 vehicles. These data will be used to generate reliable postcrash timelines, which will provide a basis for evaluating the efficacy of the ACN system.

The operational test is being conducted in western New York State, principally in Erie County and with focus on rural areas. The primary goal of the test is to quantify the reduction in crash notification times attributable to the ACN system. Secondary goals include assessing acceptance of the system among users, including emergency medical services (EMS) dispatchers, responders, and drivers of the test vehicles; investigating any institutional and legal issues that may inhibit national deployment of the ACN capability; assessing the survivability and performance of the sensors and instrumentation; and documenting costs associated with deploying the system.

Most of the in-vehicle ACN test article equipment has been installed in the test vehicles and in the emergency message equipment operational at the Erie County Sheriff's cellular public safety answering post (PSAP) and Erie County Medical Center's secondary PSAP. The test has been ongoing for about 15 months for the ACN equipment and about 25 months for the CETs. More than 75 crashes have been documented, 26 of which have been above threshold (i.e., involving enough acceleration to initiate reporting of a crash). Table 1 provides a summary of the current status of the operational test. The remainder of the ACN units are to be installed during 1999, and the test will continue until September.

Preliminary Test Results

In all 26 above-threshold crashes, the units worked as planned. Of the 7 above-threshold crashes involving vehicles equipped with ACN systems, 3 required emergency medical transport. In all 7 cases, the ACN crash message was received at the PSAP within 2 minutes of the crash.

TABLE 1 Status of Automated Collision Notification Operational Test[a]

Test Data	ACN	CET
Number of Units Installed	639	2,930
Total Days in Field	170,000	1,555,000
Total Crashes	29	54
Below Threshold	22	35
Above Threshold	7	19
Crashes Out of Study Area	2	4
Delayed Notification[b]	n/a	5

[a] As of January 1, 1999.

[b] Delayed notification refers to those CET crashes that were reported too late for time-of-crash data to be retrieved, since the CET operates for 3 weeks following a crash and then resets.

For crashes involving vehicles equipped with CETs, it is possible to generate accurate crash event timelines that can be compared with the timelines for the crashes involving ACN-equipped vehicles. When a sufficient number of crashes have been experienced, these data should make it possible to measure the differences in notification and response times attributable to the ACN system.

With the ACN and CET data sets, one can also measure the difference between the actual crash time and the time reported on the police accident report (PAR). This time difference is important because the latter time is used extensively to characterize crash response timelines. Figure 2 provides a summary of the time differences noted to date. In most cases, the PAR crash time is later than the actual crash time. This error in crash time results in a timeline in which the notification and response times are shorter than the actual times.

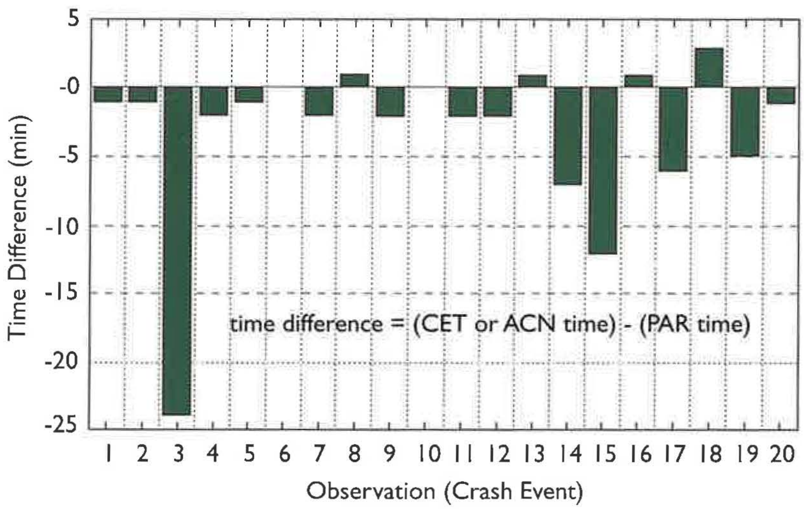

FIGURE 2 Difference between measured and reported crash occurrence times.

Operational and Institutional Issues

The New York State program is generating information that will be highly useful for evaluating the effectiveness of crash notification systems. In addition, the information provided by the program is assisting in the identification of system and infrastructure issues that must be successfully addressed if automated mayday systems are to become effective and ubiquitous. Among these issues are the reliability of the in-vehicle equipment, including the occurrence of false alarms and missed signals; the ability to identify personal injury crashes; and issues associated with the crash detection threshold, in particular the importance of not overwhelming EMS dispatchers with calls about minor crashes. Another infrastructure issue is the roaming problem that has prevented establishment of a cellular connection between the vehicle and the PSAP.

Several institutional issues have also emerged during the course of the operational test. The mechanisms for emergency notification that come into play after a vehicle crash involve multiple law enforcement agencies, the local fire department, local emergency medical responders, and the Erie County Medical Center. Their overlapping and varying response protocols are largely dependent on local and historical relationships and are difficult to standardize. Moreover, the interactions among these organizations are complex and varied and differ from case to case. These variations make it difficult to compare response times for a given incident or among cases.

Training of dispatchers, both police and EMS, has proven to be a problem as well. Test calls have been dropped and mistakenly routed as a result of misunderstanding of the system and confusion over which organization has primary responsibility. These problems affect the quality of the data being collected.

Some of the operational issues that arose during the ACN test in New York State are now being addressed in Rochester, Minnesota. Under the Mayday Plus program, sponsored by the Minnesota Department of Transportation in a cost-sharing arrangement with Veridian Engineering, Inc., and other private partners, a communications infrastructure capable of receiving and responding to voice and data messages from a variety of mayday providers is being built. The system is intended to be operational in fall 1999, and its use involves a cooperative effort with the Minnesota State Patrol and the Mayo Clinic. The Mayday Plus program is also helping to extend the Society of Automotive Engineers mayday standard to cover the message set associated with crash severity data.

Next Steps

Widespread deployment of automated crash notification technology is possible given the growth of wireless communications in the United States. Moreover, the number of licensed drivers has increased significantly in the last 25 years, as has the number of miles driven. As the cost of both in-vehicle crash notification elements and airtime decreases, these systems will become more affordable, and the mass market should open up.

As was evident in the recruiting for the operational test program in New York State, lack of awareness of automated crash notification is a major obstacle to its widespread use. That situation can be expected to change. General Motors is in the process of launching a campaign to demonstrate the features and benefits of its OnSTAR service—whereby the OnSTAR service center is automatically contacted if a frontal crash occurs and the airbag is deployed—in an effort to create consumer demand. The ACN, with its ability to transmit crash severity data and interface directly to the PSAP, represents a significant advance over the crash notification features of OnSTAR. The ACN effort has received attention in the national media, and ITS America has broadcast messages about the capability on 618 radio stations in 50 states with an audience of more than 15 million listeners. Public awareness is expected to generate demand, particularly as the cost of the service decreases. Packaging of mayday systems with other services, such as navigation, driver assistance, and traveler information, might also increase consumer demand for crash detection technology.

Other stakeholders, including insurers and vehicle manufacturers, could derive benefit from automated crash notification technology. For example, a "black box" could record information that would assist in the reconstruction of accidents or assessment of driver behavior.

Assuming that demand supports the widespread deployment of in-vehicle crash notification systems, the integration of these systems with public safety and medical response services nationwide will be the next major challenge. To achieve such an end-to-end system, issues such as availability of standard mayday messaging and display equipment at all PSAPs, with established protocols and training for dispatchers, will need to be addressed. Requirements for automated crash and injury severity estimates, triage, and EMS dispatch and routing will need to be explored as well. Some or all of these efforts might be funded by the ComCARE legislation introduced by the House Commerce Committee in 1998, which provides states with block grants to begin implementing automated crash notification systems. Regional or key corridor deployment might be needed early to provide sufficient data beyond the operational tests described here with which to evaluate effectiveness and establish system benefits.

Web Sites Related to Highway Safety

Each of the following Internet sites is a rich information resource, offering the full text of documents, electronic journals, and newsletters, as well as links to related sites. The multidisciplinary nature of traffic safety is reflected in the wide range of subjects to be found. Links were active as of February 26, 1999.

U.S. SITES

Federal Agencies

National Highway Traffic Safety Administration: *http://www.nhtsa.dot.gov/*
NHTSA develops, promotes, and implements educational, engineering, and enforcement programs directed at preventing motor vehicle crashes and reducing safety-related economic costs associated with vehicle use and highway travel. Of particular note on the NHTSA Web site are the Auto Safety Hotline, the Traffic Safety Materials Catalog, and NHTSA's Kids' Page.

National Center for Statistics and Analysis, National Highway Safety Administration: *http://www.nhtsa.dot.gov/people/ncsa/*
NCSA is responsible for providing a wide range of analytical and statistical support to NHTSA and the traffic safety community. The NCSA Web site provides statistical information on U.S. traffic accidents, from brief fact sheets to the full text of research reports.

Turner-Fairbank Highway Research Center, Federal Highway Administration: *http://www.tfhrc.gov/safety/hsis/*
Information on research sponsored by FHWA at the Center is provided. This research is focused on the development of highway safety information systems, improvements to traffic control devices and methods, studies of driver and vehicle interactions with the highway, improvements to pedestrian and bicycle facilities, and the creation of better predictive models through crash analysis.

Private Organizations

Insurance Institute for Highway Safety: *http://www.hwysafety.org/*
The Insurance Institute for Highway Safety is an independent, nonprofit research and communications organization, whose efforts are directed at reducing deaths, injuries, and economic losses due to highway crashes. The Web site includes easy-to-understand crashworthiness evaluations for U.S. passenger vehicles, information on state traffic laws, and the *Status Report* newsletter.

American Automobile Association Foundation for Traffic Safety: *http://www.aaafts.org/*
The AAA Foundation for Traffic Safety focuses its efforts on preventing highway crashes. Among topics covered on this Web site are crash data, aggressive driving, drowsy driving, teen driver safety, driver education, school bus safety, and bicycle and pedestrian safety.

NON-U.S. SITES

Transport Canada: *http://www.tc.gc.ca/roadsafety/rslink_e.htm*
A worldwide listing of Internet sites related to highway safety is provided.

Netherlands Organization for Applied Scientific Research (TNO): *http://www.tno.nl/homepage.html*
TNO is a Dutch organization that performs basic research in many areas, including traffic safety. Information on the organization's current research activities is presented.

Australian Federal Office of Road Safety (FORS): *http://www.dot.gov.au/programs/fors/forshome.htm*
FORS guides the development of measures aimed at reducing the incidence and severity of highway crashes. Web site highlights include the full text of some recent FORS reports, brief research monographs, and news releases.

Swedish National Road and Transport Research Institute (VTI): *http://www.vti.se/welcome.htm*
VTI is a national research institute whose traffic safety research efforts address traffic engineering; environmental aspects of transport systems; road user behavior; vehicle engineering; human factors; collision safety; and the planning, design, construction, maintenance, and operations of highways. The Web site includes the electronic version of *Nordic Road and Transport Research*, an English-language journal that highlights the latest research of six public research organizations in Denmark, Finland, Iceland, Norway, and Sweden.

Information on Web sites related to highway safety compiled by Mary Ellen Tucker, Librarian, University of North Carolina Highway Safety Research Center.