Mayday: Concept or Reality?

HAU L. TO, JANELLE L. MONETTE, AND FARIDEH AMIRI

Oftentimes intelligent transportation systems (ITS) is perceived as cutting-edge technology that will become fully realized in the near future. One aspect of ITS, mayday technologies, has already arrived. From commercial products backed by large automobile manufacturers (such as GM OnStar™ and Ford Rescu™ to aftermarket products (such as CERES™ and AutoGuard™), these technologies are being equipped in consumer vehicles across the nation. In an effort to determine the impact of emergency calls from such systems, the Minnesota Department of Transportation (Mn/DOT), Minnesota State Patrol 2100 (MSP), and Mayo Emergency Communications Center (MEC) have teamed up with Veridian Engineering to develop an emergency communications infrastructure capable of directly accepting mayday calls and intelligent enough to accurately route calls to the proper authority depending on the geographic location and the nature of the incident. The Mayday Plus system consists of the in-vehicle module (IVM), dispatcher interface and communications gateway. The IVM consists of cellular and global positioning systems (GPS) technologies and is capable of transmitting voice, location, and crash severity data. An example of crash severity data includes the change in velocity of the vehicle upon impact. The dispatcher interface is a personal computer that displays data received from the vehicle or other dispatch centers interconnected to the Mayday Plus system. The communications gateway is the key to the Mayday Plus system. The gateway automatically and logically routes data and voice based on the geographic location and the nature of the incident. The Mayday Plus equipment has been installed in test vehicles in the Rochester, Minnesota area. This paper reports the findings of the six-month Mayday Plus operational test.

OVERVIEW OF MAYDAY TECHNOLOGIES

The emergence of wireless technologies has revolutionized emergency response. The combination of cellular and global positioning systems (GPS) has allowed for access to valuable incident location information. This is commonly known as Mayday technologies. Several initiatives from around the country in recent years have focused on testing the operational feasibility of such technologies. States that have provided test beds for Mayday include: Washington, Colorado, New York, and Minnesota. The New York and Minnesota initiatives remain the only ongoing tests. While Minnesota's operational test (Mayday Plus) shares similarities with prior initiatives, the project centers more on creating an emergency infrastructure capable of receiving calls not only from Mayday Plus devices, but from a variety of commercial products as well.

H. To and J. Monette, Castle Rock Consultants, 2600 Eagan Woods Drive, Suite 260, Eagan, Minnesota 55121-2800. F. Amiri, Minnesota Department of Transportation, 117 University Avenue, MS320, St. Paul, Minnesota 55155.

THE MAYDAY PLUS PROJECT AND COMPONENTS

The Mayday Plus project is spearheaded by the Minnesota Department of Transportation (Mn/DOT) in partnership with the Minnesota State Patrol (MSP) District 2100 and the Mayo Emergency Communications Center (MEC). Veridian Engineering and their proposed team were retained for system development and Castle Rock Consultants was selected as the independent evaluator.

The three primary components of the Mayday Plus system include the in-vehicle module (IVM), dispatcher interface stations, and Gateway.

In-Vehicle Module (IVM)

The IVM is composed of a cellular handset and antennae, GPS receiver and antennae, and Veridian's "black box". It automatically transmits crash data when preset thresholds are exceeded. The black box collects and transmits valuable crash severity data, such as indication of rollover, change in velocity upon impact, principle direction of force, and heading direction of the vehicle. Additionally, the data stream associated with each IVM includes telephone call-back number, driver, and vehicle information. MSP and MEC desired the additional information, since it was perceived as valuable in enhancing emergency response. In addition to automatic crash notification, the IVM allows users to manually send three types of distress signals: emergency, roadside assistance, and Good Samaritan. The intent of the Good Samaritan feature is to allow third-party witnesses to report a roadside incident.

Dispatcher Interface

The dispatcher interface allows emergency dispatchers to view and manipulate data sent from IVMs. Dispatcher interfaces have been installed at MSP 2100, MEC, and Rural Metro (a nationwide, private, third-party response center.) In addition to the data mentioned earlier, the location of the vehicle is also sent in the message string. The interface provides the dispatcher with a map of the vehicle location and allows forwarding of calls and faxing of data. It was developed in a Windows-based environment to increase usability as a result of most dispatchers' familiarity with using Windows-based systems.

Mayday Plus Gateway

The Mayday Plus Gateway is a unique feature of the system. Cellular 911 call handling protocols for the state of Minnesota are quite

specific. While the State Patrol initially handles all cellular 911 calls, incidents occurring on county or city roads are forwarded to the appropriate local law enforcement center (LEC) according to the location of the event. Additionally, MEC provides different medical response services according to predetermined boundaries. MEC emergency services are not always dispatched to the scene of an incident. They operate according to primary, secondary, and air flight boundaries.

In order to develop a system that would consider these jurisdictional issues, Mayday Plus call routing procedures required in-depth scrutiny. The Gateway serves as the brains behind the automatic routing of Mayday calls according to the location of an incident. For example, an emergency call data transmitted from an IVM located on a county road within the MSP 2100 district and MEC primary service area will be forwarded to both MSP 2100 and MEC call centers. MSP 2100 will initially receive the voice and forward it onto the LEC. MSP 2100 can also send any relevant data to the LEC via fax. The following diagram (Figure 1) summarizes the call routing procedures set up by the Mayday Plus system.

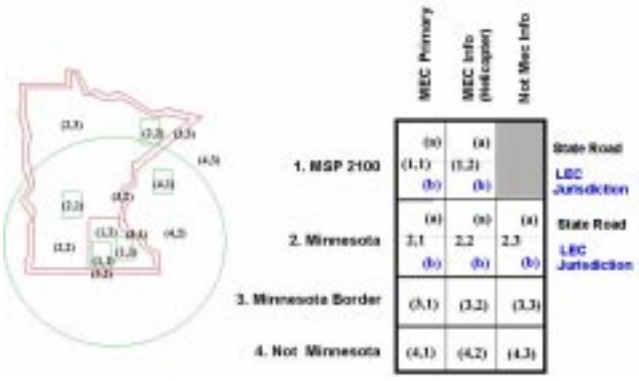

FIGURE 1 Routing of calls (diagram provided by Veridian Engineering)

Additionally, the Gateway automatically routes calls to the proper authority depending on the type of call (emergency, automatic collision, roadside assistance, or Good Samaritan). For example, if a roadside assistance call is transmitted from a location within MSP 2100, the data will be sent to MSP, but Rural Metro will receive the voice connection and will transfer the "voice" to the appropriate response center. Within the operational test, Rural Metro transfers the voice and sends a fax to AAA, a local roadside assistance company.

THE MAYDAY PLUS OPERATIONAL TEST

The operational test, scheduled for six months (24 weeks), began August 16, 1999 and runs through January 30, 2000. During this period, the independent evaluation will be performed. The evaluation consists of seven detailed test plans covering several areas of interest. The test plans pertain to:

- expandability and transferability of the Mayday Plus system;
- evaluating the impacts of system implementation;
- evaluating the impacts on the dispatch operations;
- evaluating the impacts on the quality of responses;
- performance and reliability of the functional components of Mayday Plus;
- evaluating the perceptions of Mayday Plus; and
- market feasibility of Mayday Plus.

During the project definition stages, there were only a few commercial Mayday products available on the market. However, after an in-depth analysis of the market situation, it was determined that there were over a dozen different devices available. A decision to eliminate the last detailed test plan was made based upon these findings. The following sections outline some of the findings resulting from the test plans.

System Functionality

Multiple functions of the system were evaluated during the operational test. When the operational test began in August, initial interaction with the system showed that not all of the desired and previously agreed functions were fully operational. While this did not prevent actual operation of the system, it detracted from the perceived usefulness of the system by dispatchers. The Mayday Plus system received upgrades during October and November to resolve the majority of the preliminary technical issues identified by dispatch supervisors at MSP 2100 and MEC, Mn/DOT and the independent evaluator. For example, at the initiation of the operational test, incoming Mayday Plus calls appeared at the bottom of the call list, making it difficult to discern the most recently received call. This was resolved in the November upgrades. As of one month prior to the end of the operational test, the following issues remain outstanding:

- the data for archived calls cannot be fully retrieved. For example, a user cannot retrieve the map or address of the location associated with an individual call. Archived data can only be viewed in a tabular format and cannot be viewed individually. A fully operational system would need this functionality.
- the location of an incident is only archived when a fax of the call is sent. Archived information is accessed by dispatchers for reports and follow up to incidents. Location information is necessary for these reports.
- the date of information-only calls is not recorded in the archived data. This limits the users' ability to easily retrieve call information from the system. Calls are difficult to distinguish from one another without this critical piece of information.

In addition to the issues noted above, a fully operational Mayday Plus infrastructure will need improved safeguards. For example, during a scheduled testing period on November 30, the system was "down" at Rural Metro. The driver performing test calls as well as MSP 2100 and MEC dispatch centers had no indication of the problem. When the driver activated the IVM during the period the system was experiencing technical difficulties, the IVM did not alert the driver of any complications. Furthermore, the IVM did not direct the driver to manually dial 911 or present the driver with alternatives. The problem was discovered when the driver performing the test calls manually contacted MSP and MEC about difficulties connecting to the dispatch centers. During this incident, it was difficult to contact technical help.

Usability

The Mayday Plus system was analyzed for usability of the IVM and dispatcher interface. The IVM consists of a handset similar to a

cellular telephone equipped with six additional buttons dedicated to various functions of the Mayday Plus system. The system is set up so that a user presses a button for a desired service. For example, if a driver ran out of gas on the freeway, the "ROAD" button could be pressed to connect the driver with a roadside assistance provider. The participants using the system did not experience any difficulties operating the IVM during the operational test.

The dispatcher interface went through an evolutionary process during the operational testing of the Mayday Plus system. One month prior to the end on the operational test the interface is still undergoing enhancements. Dispatchers have commented on the ease of use and simplicity of navigating through the system. Additionally, they have expressed that the system was easy to learn.

Impacts on Public Agencies

An issue that originally spurred the interest of the Minnesota State Patrol to participate in the Mayday Plus operational test was the proliferation of cellular 911 calls. As more and more consumers purchase cellular telephones, the number of cellular 911 calls handled by MSP escalates. What is perceived as a safety feature by the general public has proven to be a nuisance by Public Safety Answering Points (PSAPs). For any one vehicular emergency (according to a preliminary analysis of 250 cellular 911 calls) there may be up to a dozen Good Samaritan cellular 911 calls. Even after emergency personnel have appeared on the scene, drivers will continue to report the incident. This detracts from MSP's ability to respond efficiently to other emergencies that may arise immediately thereafter. While public education is required to teach citizens when to responsibly make cellular 911 calls, a Mayday emergency infrastructure may quell some of the other concerns.

In addition to the cellular 911 concern, emergency response agencies have discussed the importance of the "golden hour" which is defined as the first 60 minutes after trauma occurs, in which the lives of a majority of critically injured patients can be saved if appropriate emergency response is provided. When dealing with rural traffic incidents, identifying accurate location information can consume precious golden hour minutes, which limits the amount of time trauma physicians have to save a victim's life. One concern is the lack of accurate location information sent with cellular 911 calls. Preliminary results have indicated that the Mayday Plus system decreases response time to severe crashes. Additionally, dispatchers have stated that the system is especially useful in situations where the vehicle driver is unconscious or unsure of their location.

From a transportation agency standpoint, the safety of the traveling public is of utmost concern. In a study performed by Mn/DOT in 1994 (where rural travelers were asked to prioritize travel-related concerns with ITS solutions), Mayday technologies ranked high. The results of that study initiated the Mayday Plus Operational Test. Furthermore, interagency cooperation, particularly between MSP and Mn/DOT, is significant. Not only are these agencies typically located in the same building, MSP provides dispatching of maintenance vehicles. In addition, MSP dispatchers also input pavement condition reports into a Mn/DOT system for use by patrol and DOT personnel. An additional benefit of the Mayday Plus system to Mn/DOT is the ability to promptly handle incidents alleviating traffic flow problems associated with highway incidents.

User Perceptions

Castle Rock surveyed all of the public participants as well as the dispatchers involved in the operational test, and the overall perception was that Mayday technologies are beneficial. Generally public participants perceive the benefit of Mayday technologies as the ability to provide "peace of mind" while traveling. Also, 100% of the individuals surveyed stated that they would purchase a system like Mayday Plus if it were affordable. Although not every participant surveyed worried about getting assistance in case of an incident, 100% of the participants believed that the Mayday Plus system will allow faster emergency response. In addition, an in-vehicle Mayday device will make them feel safer and be simple to use.

Institutional Issues

The Mayday Plus project attempted to closely match actual emergency protocols and procedures. As a result, interagency cooperation between the Mn/DOT, MSP, emergency responders, and PSAPs were required. Institutional issues that were faced during the operational tested included: resolving varying agency concerns, the effect of reduced management involvement and staff turnover, procedural impacts, and improved coordination among interagency departments

MAYDAY PLUS: CONCEPT OR REALITY?

Mayday Plus is a concept progressing rapidly towards reality. Early operational test results have conveyed widespread user acceptance. The location information of successful test calls has proven to be accurate to a degree that is acceptable to its system users. While the system has proven to be a fully-operational stand-alone system, widespread deployment regionally and nationwide will require consideration and resolution of several key issues including:

- successful interoperability of commercial Mayday products. The Mayday Plus project has proven the successfulness of sending important crash data to emergency dispatch centers. Commercial Mayday products, while they function in a similar manner as IVMs, they do not provide a direct data link to emergency dispatch centers.
- cooperation from private national message centers and commercial product providers. National message centers and commercial product providers currently use databases that provide non-priority numbers into PSAPs. In the case of a life-threatening vehicular emergency, key emergency providers need to be notified immediately to provide optimal care.

· facilitating the integration of technology at smaller PSAPs. Technology comes at a price. A comprehensive, nationwide emergency infrastructure would need to integrate with PSAPs. While full integration of Mayday dispatching technologies may not be feasible in the short-term, the inclusion of PSAPs nationwide should be included in the vision of a comprehensive emergency infrastructure.

Although the project evaluated functionality, usability, impacts on public agencies, and user perceptions of the Mayday Plus system, it was unable to test the integration of the system with commercial Mayday devices. This is, in fact, the key to a fully operational and functional Mayday emergency infrastructure. Without the ability to interface with various types of Mayday devices, the comprehensive benefits of a Mayday emergency infrastructure cannot be reaped.