
# Compendium of ENTERPRISE Projects

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## INTRODUCTION

The ENTERPRISE program is a multi-state pooled fund study group comprised of Transportation agencies from North America and the Dutch Department of Transportation, as the European liaison. The focus of the ENTERPRISE program is to develop, implement and deploy low-cost Intelligent Transportation Systems (ITS) designed for rural and small urban application. Since the inception of the program in 1991 ENTERPRISE has developed a multitude of projects that address needs surrounding areas of safety, traveler information, data sharing and national standards efforts. The ENTERPRISE program efforts adhere to and remain consistent with the National ITS Architecture, allowing member states to accelerate their ITS programs.

This document serves as a synopsis of completed ENTERPRISE projects from 1995 to 2002 and provides an overview of the high-level project goals and objectives, current status and the project contact for those interested in receiving more detailed information on specific projects. This synopsis covers projects in the following user service areas of the National ITS Architecture:

- Travel and Traffic Management;
- Public Transportation;
- Electronic Payment;
- Emergency Management;
- Advanced Vehicle Safety Systems; and
- Information Management.

Further information on completed projects as well as general information on the ENTERPRISE program can be found by visiting the ENTERPRISE web-site www.enterprise.prog.org.

# Herald Operational Test

## Overview

Information dissemination is difficult to achieve due to a lack of basic communications infrastructure capable of reaching the great expanses and mountainous terrain that characterize the rural environment. The Herald Operational Test addresses the need to provide important safety information to travelers in rural areas.

The Herald project tested the utility of employing a sub-carrier on an AM broadcast station to provide traveler information in rural areas with the following tasks:

- Tested an AM sub-carrier as a reliable, low-cost medium for transmitting traffic messages over wide geographic areas;
- Examined the institutional issues and barriers in utilizing AM commercial radio stations for broadcasting traffic messages over sub-carriers; and
- Tested the suitability of the ITIS BIF (Bearer Independent Format) and AM BAP (Bearer Application Protocol) documents developed by ENTERPRISE.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| | | | | | | |

## Current Status

Initial testing was completed using an HAR tower on loan from Colorado Department of Transportation (CDOT) installed at the Castle Rock Consultants Boulder, CO office. Final testing was conducted using a radio station in Denver, CO. The Herald project proved the potential for AM sub-carriers. Evaluation results and data were shared with a private firm (Mikros) who were intending to use venture capital funds to develop a nationwide AM broadcast of traveler information (accompanied by information such as stock quotes, headlines and other news). To date, this company has not followed through on these plans.

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# Simple Solutions

**Overview**

The "Simple Solutions" project identified and described proven, cost effective, "low tech" solutions for rural transportation-related problems or needs. The projects referred to as "Simple Solutions," focused on practical applications of technologies that could serve as precursors to future applications of more advanced systems or ITS.

More then 50 solutions have been identified and documented and then categorized according to the seven Critical Program Areas (CPAs) defined with the U.S. Department of Transportation's Advanced Rural Transportation Systems (ARTS) Strategic Plan. The CPAs are as follows:

- Traveler safety and security;
- Emergency services;
- Tourism and travel information services;
- Public traveler services/public mobility services;
- Infrastructure operation and maintenance;
- Fleet operation and maintenance; and
- Commercial vehicle operations.

**Time Frame**

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| | | | | | | |

**Current Status**

The solutions were documented and released as an FHWA document, and circulation went to thousands of local agencies. The information on the solutions were updated in the Inform project, and now appear on the Inform web-site www.inform.enterprise.prog.org.

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# Inform

## Overview

Informing transportation professionals of the capabilities of ITS applications is the first step towards gaining their acceptance and participation. Once educated in these issues, professionals become advocates of ITS, playing a crucial role in promoting widespread deployment.

The Inform project focused on extending the ITS marketplace to the local levels. The project emphasis is on introducing local transportation professionals to potential ITS applications within their local areas. Local level professionals can then become project champions, promoting ITS deployment. Focus groups in representative ENTERPRISE states asked local participants to identify transportation needs within their area. A set of ITS applications were then defined and presented as solutions to the specific needs of the target audience. Presentations of these applications serve as marketing tools, demonstrating that ITS offers viable solutions to local level problems.

The objective of this project was to promote the development and deployment of ITS at the local level in ENTERPRISE states and provinces.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
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## Current Status

The results of the Inform project show the Inform web-site serves as an effective search mechanism for learning about the Simple Solutions and reaching the target audience. Given this, efforts were directed towards development of the site, that can be found by visiting the following link:
http://inform.enterprise.prog.org. Later projects (Inform Next Steps) combined these solutions with other rural ITS projects identified by FHWA, with the intent being that FHWA house these together with the other rural ITS portions of the FHWA web-site that can now be found by visiting http://www.its.dot.gov/rural_its.htm

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# International Traveler Information Interchange Standards (ITIS)

**Overview**

A key element of the success of Advanced Traveler Information Systems (ATIS) is the ability to exchange traveler information between in-vehicle systems, traffic, transit information providers, traffic control centers, police and fire departments, and transit authorities. The ability to exchange information is becoming increasingly important as fully integrated ITS systems are deployed.

Effective standards help promote compatible ATIS products and the rapid development of the ITS industry. When compatibility between vendors is encouraged by standards, more choices are available to the consumer. The traveler is able to buy products from a wide range of products that can communicate with other travelers who may be using a wide variety of products.

The ITIS efforts of the ENTERPRISE Program have been underway since the early 1990s. These efforts initially translated the similar standards that had been developed in Europe, where standardized data exchange had been used prior to its use in the United States. An ITIS Committee inside ENTERPRISE worked to translate these standards and develop draft standards for the American ITS industry by talking with member states to understand their needs. Early projects such as Trilogy in Minnesota benefited from these standards, and still use the ITIS codes today. Once developed, these standards were offered to the standards development agencies working on National standards within the United States. These have tremendously influenced what has now come out of the standards agencies.

**Time Frame**

| 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|
| ▨ | ▨ | ▨ | ▨ | ▨ | | |

**Current Status**

ENTERPRISE ITIS efforts have translated towards supporting the ENTERPRISE states by representing their needs towards the National Standards development. The current ITIS Eye project has focussed on this effort.

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# Colorado Mayday

## Overview

The Colorado Mayday Field Operational Test was intended to develop and test an in-vehicle device that could be manually triggered in an accident or emergency and would report the vehicle location along with other vehicle-specific information. The project was proposed to the Federal Highway Administration (FHWA) in January 1994, and testing commenced in early 1995. Three phases were planned, of which two were completed. The first phase assessed the design and technical performance of the Mayday system through limited testing. The second phase tested the system in real-world conditions on a small scale basis. The final phase was to be a full-scale test involving 2000 motorists that would use the system in actual emergencies.

Other elements of the project included evaluating the system's fit within the National ITS Architecture, the feasibility of marketing a low-cost system, and expanding the program to a nationwide program.

The low-cost Mayday system is comprised of three principal elements, defined as follows:

***Mayday in-vehicle unit***
The in-vehicle unit housed the low-cost location device which provided the GPS data from which the vehicle position could be derived; the button box used to operate the system and request assistance; and the interface equipment used to control the communications system.

***Communications system***
A two-way communications link transmitted, request information to the control center and receive confirmation messages from the control center.

***Mayday control center***
The control center received all emergency assistance requests originating from the in-vehicle units. The requests were processed, identifying the vehicle location and type of assistance required. The control center then routed the request to the appropriate response agency and notified the motorist of the action taken and the anticipated response time.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
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## Current Status

The results of the Colorado Mayday project proved the concept, and established a series of functional requirements for how such a system would need to operate on a national

level. The Colorado Department of Transportation (CDOT) Mayday Project Manager, Neil Lacey, participated in the Multi-jurisdictional Mayday Group, in order to share these lessons learned with private sector Mayday products and services.

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# Vehicles as Probes

## Overview

Automatic vehicle identification (AVI) systems are becoming increasingly popular. Example applications include electronic toll collection and automatic vehicle location. AVI data is viewed as a potential source of traffic surveillance for emerging Advanced Traffic Management Systems (ATMS). AVI systems can relay information about conditions of the traffic stream in real-time. Recent reports on the effectiveness of several AVI systems for incident detection have been very encouraging. This is particularly important as incidents cause over 65% of the total traffic congestion in urban areas. It is possible that through the use of AVI equipment, a vehicle probe system may prove to be more cost effective than other types of surveillance systems in collecting information to support ATMS projects

This project examined the percentage of probe vehicles required to provide data which are representative of general roadway conditions. As part of the investigation, a detailed benefit/cost analysis was conducted to evaluate the cost effectiveness of this approach relative to alternative surveillance systems.

The objective of this project was to devise a new more cost-effective way to perform freeway and arterial surveillance including lane occupancies, route speeds and possibly incident detection by using traffic probes. Specific goals of the project were to determine the minimum sample size of vehicle probes necessary for reliable traffic data and to evaluate the cost effectiveness of this approach.

It is important to note that this project did not seek to develop or evaluate AVI systems.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| | | | | | | |

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# Video Imaging

## Overview

As Freeway work-zones become more and more dangerous for roadway construction crews, new ways are needed to keep the speed of traffic in the work-zones below the posted maximum. The Dutch Ministry of Transportation (Rijkswaterstaat), along with Pulnix, are evaluating the effectiveness of utilizing video imaging as a method for measuring vehicle travel time, calculating travel speed and automatically reading license plates of offenders.

The effort validates a video imaging system in the real-world environment at various locations. It is important that testing occurs both in Europe and in North America to ensure the concept's validity. The system utilizes license plate recognition, without actual reading, for tracking vehicles and then measures travel times between sequential locations at various test sites. From travel time values average speed values can be calculated. This gives a speed of travel over the whole work-zone section and not just a spot speed. The system can read the license plate of offenders. On site citing by police officers is possible. As an alternative, the information can be processed off line and ticketing can be handled fully automatically. The accuracy of the system was tested and approved by the Dutch counterpart of the Bureau of Weights and Measures.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| | | | | | | |

## Current Status

Testing has occurred in both Rijkswaterstaat and within Iowa. The results have been positive and further implementations are planned.

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# VRC Application Identifier Protocol

**Overview**

The VRC (Vehicle to Roadside Communications also referred to as Dedicated Short Range Communications or DSRC) Application Identifier Protocol project reviewed current and planned North American and European developments and projects involving multiple applications of VRC equipment. The project was accomplished under the guidance of a project steering committee and resulted in a comprehensive list of VRC application identifiers.

The objective of this project was to gain a broad understanding of current VRC application communications protocols and identifier methods in North America and Europe with the ultimate goal of standardization.

**Time Frame**

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
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**Current Status**

As of June of 1996 new Type 3 transponders would be available which are compatible with both Mark IV and Hughes transponders. Around the Pearson Airport in Toronto Canada there are now 800 deployed vehicles in the operational test, all with Type 2 transponders. The vehicles that run most often will be upgraded to Type 3 transponders. Also, now that 800 vehicles are running, it will be possible to perform a vehicles as probes operational test.

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# Weather and Road Information Coordination (WRIC)

## Overview

The integration of weather information collection and dissemination facilities, based on open, non-proprietary communications standards, was a logical step towards deployment of better systems for cost-effective highway maintenance and improved traveler information.

This project developed common specifications and promoted practical solutions for integrating weather information from Road and Weather Information Stations (RWIS) monitors, aviation weather sensors and other available sources. Standard formats are utilized for information exchange, making information available to users via existing and emerging traveler information systems. The objectives of the project helped to address and resolve institutional issues which constitute barriers to the creation of the necessary public-public and public-private partnerships.

Specifically, the results of WRIC were as follows:

- Organized, support and follow-up on a user needs and partnering workshop which provided input to all the ENTERPRISE states' programs;
- Coordinated with and built on related work in other states;
- Examined the quantity and quality of weather information provided by R/WIS and aviation weather systems, either installed or scheduled to be throughout Iowa, Colorado and Arizona;
- Assessed the transferability of data produced by these systems to highway maintenance and traveler information applications;
- Reviewed institutional issues among public and private agencies regarding the operation and dissemination of data from these systems;
- Worked with participating states in resolving issues and moving forward with compatible, integrated solutions; and
- Contributed to and supported the development and acceptance of protocol(s) for transmitting weather information between sensors and data fusion points, and between multiple collection and dissemination centers.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
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## Current Status

The WRIC project supported the state of Minnesota's needs for procuring R/WIS vendors. In addition, standards development agencies were invited to participate, and the results were fed to the standards agencies actively working on standards development.

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# Multi-Jurisdictional Mayday (MJM)

## Overview

Mayday systems reduce the time it takes emergency service responders to reach crash victims via automated incident and accident reporting systems.

MJM successfully educated public agencies interested in the Mayday concept, and allowed vendors of Mayday products to receive feedback from such agencies. MJM allowed separate projects to benefit from collaboration with other emergency response systems. Most notably, the MJM group initiated a discussion with GM Onstar and Ford RESCU (Remote Emergency Satellite Cellular Unit) as their products were being developed. This discussion allowed for emergency response providers in Minnesota, New York, Colorado and Washington State, to interact with GM and Ford to share their needs from such systems. As a result of this, some states have formed relationships with Mayday responders.

The following tasks helped make the MJM project a success:

- Interacted and exchanged experience with Mayday activities through public-private partnerships;
- Influenced the scope and objectives of future Mayday activities, and raised the awareness of others through outreach;
- Contributed to the evolution of Mayday activities by providing input to standards and architecture development processes; and
- Shaped future private sector efforts based on public-initiated project experience.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
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## Current Status

The MJM activities were wrapped up in 1998. As a finale to the committee, a "roadshow" was conducted where the results of the group were presented to 9 different states in order to share the entire efforts of the group, and help initiate Mayday activities in the states.

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# Dedicated Short Range Communications (DSRC) Type 3 Transponders

## Overview

Type III transponders are a suitable means for two-way communication between vehicles and road infrastructure. The transponders are small and are mounted on the interior of the vehicle windshield. Currently they are used for parking management and for data exchange for commercial vehicle border crossings. Because of these existing uses, there is a large number of Type III transponders already in use in commercial vehicles, and the infrastructure for the two-way communications is in place. Additionally, because of their current uses, Type III transponders are available in production quantities at competitive prices.

This project developed and evaluated a system for providing real-time, in-vehicle safety warnings to travelers through the use of Type III transponders. The development and evaluation performed in this project lead to recommendations for a full operation test deployment.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
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## Current Status

The project identified the appropriate structure and format for safety warning transmission to Type III transponder equipped vehicles. The Bearer Application Protocol (BAP) form data transmission developed the safety warning message list. An interface and software program provides and displays in-vehicle safety warnings. Finally, the project made recommendations for a full test deployment.

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# Variable Speed Limit

## Overview

Trying to determine an appropriate driving speed under less than ideal conditions is a challenge for the motorist. It is equally difficult for law enforcement agencies to enforce and cite someone going too fast for poor conditions. The determination is difficult and subjective. In many cases drivers are cited for going too fast for conditions after an accident has happened. Currently no system is available in the U.S. to identify safe speed limits on a variable basis.

This project developed a variable speed limit system that utilizes fuzzy control technology to identify speed limits appropriate for differing environmental conditions. Fuzzy technology is proving to be effective in a broad cross-section of difficult control problems. In particular, fuzzy control concepts are well-suited to the control of complex non-linear systems where classical mathematical analysis is difficult and imprecision is inherent.

The project objectives were to develop a variable speed limit signing system for identifying speed limits that are more realistic and appropriate for environmental conditions than posted highway limits.

The goals were achieved through the following objectives:

- Developed a fuzzy control algorithm that uses environmental conditions to define speed limits;
- Built a test system for conveying variable speed limits;
- Tested and validate the system in a simulation environment; and
- Evaluated the potential for operational field testing of the system.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
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## Current Status

Final results of the variable speed limit operational test are pending. Further information on the project can be found by visiting the Arizona Department of Transportation variable speed limit web-page: http://www.azfms.com/About/ITSRD/a6.html.

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# Wireless Tower Siting Guide

## Overview

As wireless telecommunications expand their coverage and functionality, their role in transportation has become increasingly prevalent. In some instances, public agencies are installing towers for their own communications needs; in other instances, they are partnering with the private sector. Partnering can benefit transportation agencies and the public by:

- Increasing agency revenue for ITS procurement and other transportation needs;
- Supporting ITS deployment;
- Improving telecommunications coverage for the traveling public; and
- Enhancing rapid emergency/incident detection and response.

Regardless of whether wireless telecommunications infrastructure is developed along highway right-of-ways by the private sector through a shared resources arrangement or by the public sector for its own communication needs, there are numerous issues that needed to be considered and addressed to ensure the appropriate siting of wireless infrastructure. The reference guide that results from this research effort summarizes the important information in a practical, easy-to-use format.

This project allows decision-makers to effectively address wireless tower siting issues, including:

| | | |
|---|---|---|
| *Safety* | *Zoning* | *Collocation* |
| *Aesthetics* | *Jurisdiction* | *Tower/site* |
| | *Coordination* | *dimensions* |
| *Maintenance* | *Ownership* | *Interference* |
| *Lighting* | *RF emissions* | *Access* |
| *Liability* | *Legislation* | |

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| | | | | | | |

## Current Status

The wireless tower citing guidelines document is available on the ENTERPRISE web site and has received a high volume of request from agencies who are deploying wireless hardware.

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# Visibility Monitoring

## Overview

Preventing dust storms through environmental control strategies is a long-term solution that is not easy to implement. A more deployable safety measure is warning drivers in advance of a reduced visibility area. Traditional visibility warning systems that have been deployed to date are point sensors that must be very numerous and placed in precise locations to be effective. The ENTERPRISE Visibility Warning project helped to develop technology that addresses the problem at a much lower cost.

This project received ITS IDEA funding. The funds were used to develop the sensor technology that is the basis for a visibility monitoring system. Arizona conducted the project, with ENTERPRISE providing support and technical expertise as needed.

The following tasks helped make the project a success:

- Identified and evaluated current approaches and technologies for providing 511 traveler information to rural areas;
- Identified the most cost effective approaches to maximize use of available funding; and
- Addressed organizational issues, business models, and institutional barriers and developed standards common to all states.

## Time Frame

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| | | | | | | |

## Current Status

Project deliverables are being reviewed and will soon be posted to the web site. Furthermore this project facilitated the development of an ENTERPRISE project titled Dynamic Messaging for Low Visibility Events.

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# Dynamic Messaging For Low Visibility Events

**Overview**

Several ENTERPRISE members have installed, or are developing, fog or dust storm detection and warning systems. The ability to detect for or dust storm incidents is, or has been, the focus of other projects. However, the approach used to inform travelers of an upcoming weather incident has been less rigorously evaluated. Fog warning signs can become enveloped in fog and become unreadable. Dust storms can move across an area, perhaps requiring that the traveler information broadcast area move dynamically with the storm.

This ENTERPRISE project developed a guidance document on the deployment and operation of low-visibility warning systems. Research and evaluation was conducted on the effectiveness of the visibility detection hardware and methods of providing advanced warning of low visibility events to motorists. A workshop was held that convened transportation professional that have first hand knowledge of the operation on low visibility warning systems. The results and input gathered at the workshop as well as the research and evaluations of deployed systems, contributed to the development of the visibility warning systems guidance document.

**Time Frame**

| 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| | | | | | | |

**Current Status**

The report is available on the ENERPRISE web-site and has been circulated to board members as a reference and research tool.

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## CONCLUSION

The ENTERPRISE program continues to move forward with the development of several low-cost ITS solutions. There are over ten ENTERPRISE projects that are currently under development and nearing completion. The current projects address the following ITS areas:

- Integrating NTCIP Compliant Hardware;
- Low Power FM Traveler Information;
- 511 Traveler Information;
- Maintaining and Estimating Travel Times With-in work-zones;
- Rural Transit Technology; and
- ATIS Internet Guidelines.

Once again the current projects remain consistent with the National ITS Architecture and seek to further advance ENTERPRISE state's ITS programs in areas such as safety, traveler information, data sharing and standards efforts.