Cross-Cutting Study of Advanced Rural Transportation System ITS Field Operational Tests

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INTRODUCTION

USDOT has funded seven Advanced Rural Transportation System (ARTS) projects focused on traveler safety under the ITS Field Operational Test Program. Booz-Allen & Hamilton was contracted to oversee the evaluation of these (as well as 50+ other) field operational tests funded by FHWA. As the tests have advanced towards completion, Booz-Allen & Hamilton has studied groups of similar tests, identifying common issues and comparing findings. A significant component of this effort is a program of outreach to share these results, as well as lessons learned in implementing the projects, so that other ARTS deployments continue to build on the success established by these early projects. This paper describes the cross-cutting study of these seven tests:

- Advanced Rural Transportation Information and Coordination (ARTIC)
- Herald En-Route Driver Advisory System Via AM Sub Carrier, Phase II
- Idaho Storm Warning System
- Oregon Green Light Commercial Vehicle Operations Test
- San Diego Smart Call Box
- TransCal Interregional Traveler Information System
- Travel Aid.

DESCRIPTION OF THE TESTS

Advanced Rural Transportation Information and Coordination (ARTIC)

Introduction

The ARTIC ITS Field Operational Test combines the communications dispatch operations of four public service agencies into a single communications center that serves a remote area in the Arrowhead region of northeastern Minnesota. The ARTIC partnership crosses state agency jurisdictions and functions, and fosters cooperation between highway and transit interests. This cooperation is critical in remote, rural regions where resources are limited and pooling of assets is necessary to satisfy the operational requirements of multiple agencies.

The goals of the project are to coordinate and pool resources to reduce duplication, improve transportation system efficiency, and improve user and driver safety. ARTIC responds to the challenges of providing transportation services in a remote area with low population density, a harsh winter climate, an aging population, and the inefficient use of existing transportation resources.

The testing phase began in October 1997 and is continuing. Evaluation of the project focuses on user acceptance and satisfaction, system technical and functional performance, system efficiency and effectiveness, system costs, and legal and institutional issues.

Project Description

The test operation commenced in October 1997. Figure 1 illustrates the test area. A consolidated center located in Virginia, Minnesota, houses the emergency response functions and communications equipment for both the State Patrol and the Minnesota Department of Transportation (MnDOT). The center also houses the fleet management operations for Virginia Dial-a-Ride and Arrowhead Transit. Automatic Vehicle Location (AVL) devices and Mobile Data Terminal (MDT) equipment have been installed in 4 State Patrol cruisers, 15 MnDOT plow trucks, 12 Arrowhead Transit buses, and 3 Virginia Dial-a-Ride buses. This equipment provides operations personnel with the following features:

- Up-to-date information on vehicle location and availability
- Improved communications capability during emergencies.

The test implemented a computer-assisted transit scheduling system. The test also deployed a computer-aided dispatch (CAD) system to automate State Patrol call taking, communications, and records management functions. This deployment is part of a statewide program to expand the CAD system currently under development in the Twin Cities metro area to all Patrol districts outside the metro area.

The evaluation of the project focuses on:

- User acceptance and satisfaction
- System technical and functional performance
- System efficiency and effectiveness
- System costs

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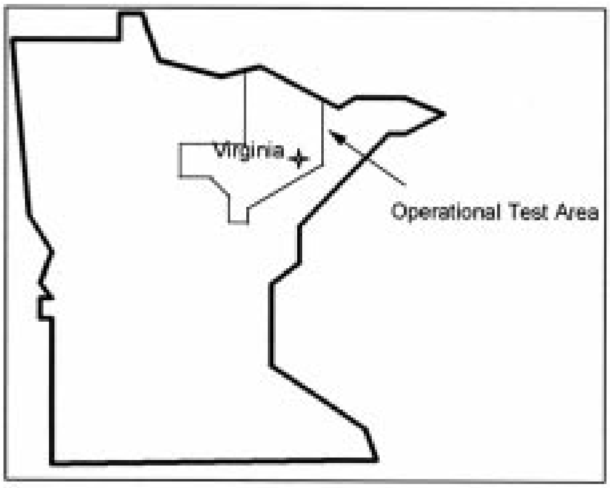

FIGURE 1 ARTIC operational test area in northeast Minnesota.

- Legal and institutional issues.

Herald En-Route Driver Advisory System Via AM Sub Carrier, Phase II

Introduction

The Herald En-Route Driver Advisory System Via AM Sub Carrier, Phase II (Herald II) ITS Field Operational Test evaluates the utility of providing traveler information in rural areas. The Herald II system employs a subcarrier on a commercial AM radio broadcasting to remote areas in Colorado and Iowa. The project proposes to test the feasibility of generating, transmitting, and receiving messages over a large geographic area. The test assesses the use of AM subcarriers as a reliable, low-cost medium to communicate traffic messages in the challenging terrain of Colorado and the potentially interfering environmental conditions of Iowa.

Phase I of the test occurred from October 1995 to December 1995. Phase II began operation in 1996. A final report is expected in the second quarter of 1998.

Project Description

The Herald project is being conducted in two phases. Phase I of the test consisted of a communication technology feasibility study funded entirely by the ENTERPRISE group. (See the Test Partners section for a description of the members of this group.) Activities in Phase I included a literature search to help determine the design approach, the development of specifications, data requirements, and simulation models, the development of a prototype system, and the performance of pilot tests.

Phase II is the actual field test and evaluation and is supported by the Federal Highway Administration. This Phase consists of developing the prototype mobile receivers, modifying and installing the transmitter sites, developing message formats, and collecting, analyzing, and evaluating data. The project will assess the performance of an AM subcarrier as a basic data communication channel. The project will also assess the impact of the AM subcarrier's channel characteristics on the channel's ability to disseminate traffic messages reliably and efficiently.

The project will provide two types of services: en-route driver information and traveler services information.

Herald consists of components that will address message generation, transmission, and reception. Figure 2 shows these components. The message generation component formats the traveler information. The message transmission component translates the formatted messages for transmission. The message reception component (in the vehicle) receives, decodes, translates, and presents the data in a format useful to the traveler.

To test the system in the field, test personnel are setting up the transmitters and installing receivers and measurement systems in test vehicles. These measurement systems will assess the AM subcarrier performance. The testing proceeds incrementally, gathering a small data sample and analyzing it before collecting more data. Test personnel start sampling the transmission at points close to the transmitters. As the test continues, testing will occur at greater distances from the transmitters and at varying times of day. While messages are being broadcast, test personnel will measure the signal strength according to standard criteria. Test measurements will eventually be taken in all planned terrain types and times of day.

The evaluation of the project will address two significant research questions about AM subcarrier modulation technology:

- Can it provide adequate signal coverage in a rural or rugged terrain?
- Can it provide accurate traveler information?

Idaho Storm Warning System

Introduction

The Idaho Storm Warning System ITS Field Operational Test is an Advanced Rural Transportation System test that is evaluating a system to warn motorists about adverse weather conditions. The system consists of a group of sensor systems that provide visibility and weather data coupled to a set of variable message signs (VMS) located along the highway. The system operates along a stretch of Interstate 84 in Idaho and northern Utah. The primary goal of the system is to reduce the number and severity of visibility-related multiple-vehicle accidents along this section of I-84.

Testing of the system components began in 1994. Due to a lack of visibility events in the early winters of the test and because of equipment operation problems, the data collection period was extended until March 1998.

Project Description

The project consists of two phases. The first phase tested three visibility sensors incorporating two weather information systems The purpose of the first phase was to determine the suitability of the sensors and weather systems for use in Phase II. The first phase also established the baseline information regarding driver behavior on the test section of Interstate 84 in southern Idaho. The second

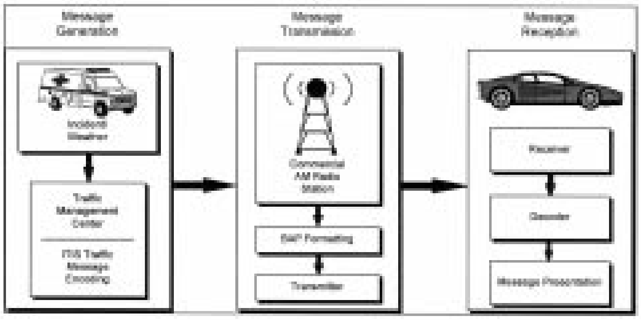

FIGURE 2 Components of Herald design concept.

phase is integrating the sensing technologies and a set of variable message signs (VMS) into an alarm and warning system to advise motorists of adverse visibility conditions.

The project need and purpose arose because of the history of accidents on a 100-mile long section of I-84 (see Figure 3). Certain areas in the test location are subject to low visibility conditions caused by blowing snow during winter and dust during spring. This section of I-84 also functions as a passenger and commercial vehicle travel route between Boise, Idaho, and Salt Lake City, Utah. From 1988 to 1991, this area experienced 18 major visibility related accidents, according to Idaho Transportation Department statistics. The percentage of trucks involved in these accidents (44 percent) exceeds their proportional representation (33 percent) in the traffic stream.

The project intended to reduce the number and severity of accidents on the subject section of I-84. The purposes of Phase I include evaluating the capability of three sensor systems to provide weather and visibility information and establishing baseline information about vehicle speeds before the installation of VMSs. In Phase II of the project, test partners are installing and integrating the VMSs. They are also evaluating the capability and suitability of the entire system in providing weather and visibility information to motorists.

Phase I of the test installed and evaluated three sensing systems: SCAN, Handar, and LIDAR. The SCAN system incorporates two separate visibility sensors, one using visible light and the other using infrared light. This system also includes four weather measurement sensors for wind speed and direction, air temperature, relative humidity, and type and amount of precipitation. The Handar system includes weather sensors similar to the SCAN system and a point detection visibility sensor similar to the visible light sensor of the SCAN system. The Light Detection And Ranging (LIDAR) system is a single visibility sensor using advanced laser technology. The LIDAR system operates similar to radar systems and can provide visibility measurements over a larger area than the other two technologies. During this phase, test personnel also used a video camera system to provide real-time verification of the conditions at the test site. Information from all these systems was transmitted to a master data collection computer at the Cotterell Port of Entry (POE) facility. The computer collected and analyzed sensor data every five minutes and alerted POE personnel if visibility fell below a predetermined threshold. If a visibility event occurred, system operators at the Cotterell POE confirmed the event using the video system. In Phase II when the operators confirm a low visibility event, they will manually activate the VMSs to advise motorists.

Oregon Green Light Commercial Vehicle Operations Test

Introduction

The Oregon Green Light ITS Field Operational Test is an evaluation of three major technical components intended to enhance commercial vehicle operations throughout Oregon. An electronic preclearance system employs transponders and weigh-in-motion (WIM) devices to reduce required stops by commercial vehicles at 22 weigh stations. The Downhill Speed Information Systems (DSIS), located at Emigrant Hill and Siskiyou Summit, calculates and displays a safe downhill speed for each passing truck. Of interest to this paper is the Road Weather Information Systems (RWIS), installed at Ladd Canyon, Columbia Gorge, and Siskiyou Summit, which collects weather data, processes it, and automatically informs motorists of abruptly changing weather conditions.

Systems are being installed and data collection began in fall 1997.

Project Description

The project is testing systems to make commercial vehicle operations safer, more efficient, and less expensive to both operators and the general public.

The purpose of the RWIS is to reduce the application of environmentally harmful abrasives. The project installed the RWIS in locations of rapidly changing weather patterns. A sensor package measures air and pavement temperatures, dew point, wind speed, visibility and precipitation. An on-site remote processing unit (RPU) autonomously detects hazardous conditions and displays a warning message on variable message signs. The RPU communicates with a central processing unit (CPU) in Salem, which displays all alerts on a website as well as on kiosks installed in major truck stops. From the CPU a system operator can also override the RPU and display other messages.

San Diego Smart Call Box

Introduction

The San Diego Smart Call Box ITS Field Operational Test evaluated the feasibility and cost effectiveness of using enhanced roadside call boxes for data collection, processing, and transmission. Smart Call Boxes are an improved version of devices used as emergency call boxes in California. The test examined using the smart boxes for traffic census data collection, incident detection, hazardous weather reporting, changeable message sign (CMS) control, and video (CCTV) surveillance. The evaluation focused on cost effectiveness compared to other methods.

The test had two goals:

- Evaluate the cost effectiveness of smart call boxes
- Document and discuss the institutional issues encountered.

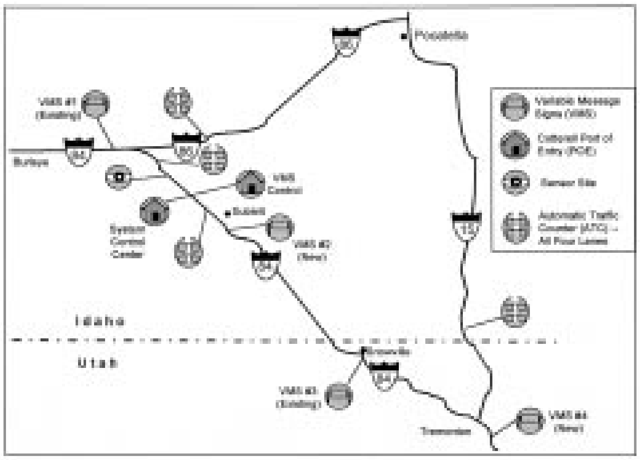

FIGURE 3 Map of project location.

The tests were conducted at numerous sites on the interstate and state highway system of San Diego County, California (see Figure 4). The test took place from September 1995 to June 1996.

Project Description

To improve motorist safety and emergency response, Caltrans (the California Department of Transportation) has installed an emergency phone system (call boxes) along many of the highways in the state. Motorists can use these phones, located at regular intervals, to connect directly to emergency dispatch centers. This Field Operational Test explored the possibility of using the established call box infrastructure to gather and transmit additional traffic and weather information.

The test planned to conduct five subtests, one for each data processing and transmission task. The project actually tested functional systems for traffic census data collection, hazardous weather reporting, and CCTV surveillance. Test partners canceled the changeable message sign subtest when the tested call box system proved incompatible with the California CMSs. The installed incident detection systems did not function properly.

The information collected by the call box installations was transmitted to the Caltrans District 11 Transportation Management Center.

The test had several objectives related to the project goals. Test evaluators attempted to determine the relative effectiveness of smart call boxes compared to a baseline system of conventional telephone lines and controllers. They also wanted to determine the projected life-cycle costs of the two systems and the tradeoffs between the systems. The ultimate objective was to determine which system is best for each task. The evaluators attempted to determine whether any institutional issues encountered have the potential for affecting the performance of similar systems.

TransCal Interregional Traveler Information System

Introduction

The TransCal ITS Field Operational Test evaluates an Interregional Traveler Information System (IRTIS). The IRTIS provides coverage for the Interstate 80 and US 50 corridor between San Francisco and Tahoe/Reno-Sparks area. The IRTIS proposed to disseminate customized traveler information via telephone, personal digital assistants (PDAs), and in-vehicle navigation devices (IVDs) as well as traditional broadcast media. The primary objective of TransCal is to disseminate comprehensive, accurate, and timely pre-trip and en route traveler information to help mitigate the impacts of congestion and incidents.

The Traveler Advisory Telephone System (TATS) component of the TransCal field operational test (FOT) became unofficially operational in March 1997 and will continue until September 1998. Testing of the PDAs and IVDs continued until March 1998. The Final Evaluation Report is expected in March 1999.

Project Description

TransCal implements a comprehensive interregional traveler information system that integrates road, traffic, transit, weather, and value-added traveler services from various sources. The project demonstrates the utility of an advanced traveler information system and showcases emerging capabilities in computing, communications, and consumer electronics. Figure 1 shows the area of IRTIS operation during the field operational test.

TransCal originally included two other components. These components were an emergency notification system to test a satellite-based two-way communication system, and a Tahoe transit frequent passenger program to increase transit use in the Lake Tahoe Basin. TransCal's Management Board, however, voted to eliminate these components from the project and redirected the funds in support of the IRTIS component.

The IRTIS operates from the TransCal Traveler Information Center in Sacramento, California. It receives real-time traveler related information from existing public and private interregional sources. It processes and fuses this data with existing static and periodic data and maintains a real-time traveler information database. The system disseminates the information to travelers via wireline and cellular telephones and FM subcarrier networks. The general public can access this information via telephone and traditional broadcast media. Test personnel are evaluating accessing the information using PDAs and IVDs. The paragraphs below briefly describe these devices.

- Personal Digital Assistants (PDAs) - The PDAs are hand-held, portable devices that provide users with information contained in the IRTIS database. The PDAs receive dynamic information types through the FM subcarrier data broadcast system.
- In-Vehicle Devices (IVDs) - The IVDs provide interactive access to detailed maps and the use of an integrated GPS receiver to determine the vehicle's current location. The IVDs receive dynamic information types through the FM subcarrier data broadcast system.

The IRTIS uses three types of data definitions: static, periodic, and dynamic. Static data remains relatively constant over time and for the duration of the test. Periodic data remains relatively con-

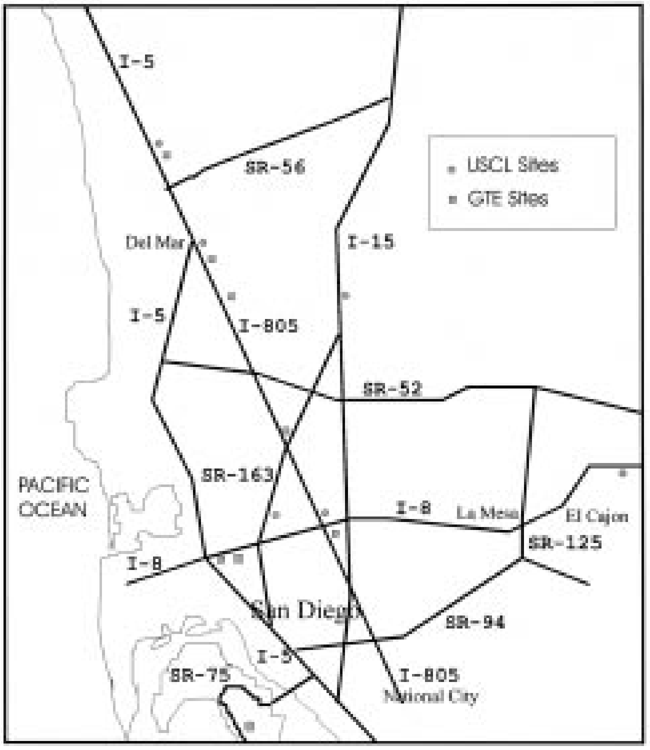

FIGURE 4 Smart call box field test sites.

stant for short periods of time - on the order of weeks. Dynamic data consists of current conditions obtained as they occur. Static data may reside in the IRTIS database or within the dissemination devices themselves. Periodic and dynamic data is processed and maintained by the IRTIS computer workstations in real-time. Table 1 provides a list of data types within each data category.

IRTIS consists of a data processing subsystem (IRTIS main database), a data dissemination system, and multiple end-user technologies designed to receive data from the IRTIS main database.

The data processing subsystem combines data from multiple sources to produce an integrated list of freeway and arterial incidents, emergency maintenance, planned event status, and regional weather status. The subsystem also determines the initial status of new traffic incidents and updates the current incident list as appropriate. The data processing done by the IRTIS uses the TRW Trans View advanced traveler information software. This software supports the collection, processing, and dissemination of real-time traffic and transit information. The data processing subsystem consists of computer workstations and servers on a local area network that is scaleable in size to accommodate any number of inputs and outputs. The network connects to a wide range of traveler services and products. A separate computer server acquires, processes, maintains, and disseminates the information.

The IRTIS automates the data collection process as much as possible. An IRTIS operator, however, must manually input data from some data sources. An IRTIS operator is also responsible for keeping traveler information accessible via public telephone through a voice processing system called the Traveler Advisory Telephone System. The operator makes a voice recording of any changes in traveler information based on reported changes of the current traveler information database. Travelers can access this information by calling a single telephone number.

The evaluation goals of the TransCal project include:

- Assess user acceptance from the perspective of the end-users, public partners, and private partners
- Assess benefits and costs of IRTIS
- Assess system performance of IRTIS as an integrated system and by system component
- Assess IRTIS impact on travel behavior
- Assess institutional and legal issues.

Travel Aid

Introduction

The Travel Aid ITS Field Operational Test intends to improve safety and reduce accidents for travelers crossing the Snoqualmie Pass along Interstate 90 north of Seattle, Washington. The test will achieve this goal by transmitting suggested speed limits and traveler advisory messages to variable message signs (VMS). The Travel Aid system broadcasts advisories throughout the 40-mile length of freeway included in the Travel Aid test.

Field testing is currently underway. A final evaluation report is expected in September 1998.

Project Description

Accident data has shown that the accident rate on I-90 across Snoqualmie Pass in January is 12 accidents per 100,000 vehicles; during July the rate is 1 accident per 100,000 vehicles. During winter, snow, ice, fog and other weather extremes make driving more difficult than at other times. The traffic mix over the Pass in winter months includes recreational travelers traveling to and from the various wintertime recreation destinations, as well as a significant number of tractor-trailers. The trucks must proceed at reduced speeds when climbing or descending the Pass. During inclement weather, snow removal equipment is out in force to maintain the roadway. The Washington State Patrol and Washington State Department of Transportation maintenance staff have indicated that many accidents are caused by drivers traveling too fast for the prevailing weather and traffic conditions. The result is a very high winter season accident rate.

The goal of the Travel Aid test is to reduce the frequency and severity of accidents on Snoqualmie Pass. The test focuses on the winter weather season, but is applicable to any time of year, since weather and driving conditions are unpredictable and can be severe due simply to the elevation of the Pass.

Travel Aid transmits speed limit information and traveler advisory messages to variable message signs (VMS) (State police have issued citations to motorists exceeding the speed limit posted on the VMS.) The Travel Aid system provides three types of information to a software-based algorithm that generates suggested speed limits for vehicles. Radar detectors gather average vehicle speed data. Sensors embedded in the pavement determine pavement conditions. Weather stations record information including wind speed, temperature and precipitation. Figure 5 presents the design overview of the system.

TABLE 1 IRTIS Data Definitions

Static Data Definition	Periodic Data Definition	Dynamic Data Definition
Freeway segment definitions	Transit schedule	Freeway incidents
Arterial segment definitions	Transit fares	Arterial incidents
Transit segment definitions	Planned lane closures	Transit incidents
Transit stop locations	Planned detours	Transit schedule change
Major points of interest	Planned events	Emergency maintenance
Transit route definitions	Airline phone numbers	Planned event status
		Regional weather status

This information is synthesized and processed in the central Travel Aid file and communications server at the operations center in Hyak. The computer algorithm suggests a speed limit and the Travel Aid operator reviews it. If the operator concurs with the limit, he transmits traveler advisory messages to the variable message signs (VMSs) and in-vehicle units. This transmission occurs via radio and microwave.

TEST STATUS AND RESULTS TO DATE

Advanced Rural Transportation Information and Coordination (ARTIC)

Test Status

The project began operations in October 1997. Data collection will continue until September 1998. The Final Evaluation Report is anticipated in December 1998.

Results

Although system operations have just begun, the use of the communications facility is already yielding benefits. Anecdotal evidence exists that describes rapid responses to emergencies, particularly in winter conditions, that would not have been possible prior to system deployment. In one case, a MnDOT snowplow responded to a vehicle accident location in a fraction of the time that it would have taken for other law enforcement assets to respond. The snow plow operator was able to relay critical information to help resolve the accident situation.

All of the participating agencies are very enthusiastic about the project. The agencies look on the project more as an actual deployment than as a test. The transit agencies in the project have begun specifying that their vehicles be equipped with AVL technology as part of the original purchase. State agencies are already planning to include continuing operation funding in their respective budgets. In short, the participating stakeholders already consider the test a success.

Herald En-Route Driver Advisory System Via AM Sub Carrier, Phase II

Test Status

Test personnel are currently analyzing the initial data collected. Additional data collection is tentatively scheduled for six weeks, starting in April 1998. The evaluator will analyze the data in parallel with its collection.

Results

No interim results are available.

Idaho Storm Warning System

Test Status

Phase I of the test is continuing in parallel with Phase II, which began in November of 1996. Due to equipment operation problems and the lack of visibility events in winter 1996/1997, data collection was extended until March 1998.

Results

The results presented in this summary come from an interim report on Phase I dated January 1997 and a progress report for the winter of 1996/1997. The LIDAR system visibility sensor was not operational during the winter of 1995/1996 as reported in the Interim Report. The test defines a visibility event as one in which sight distance drops below 1,200 feet. According to available sensor information, there were no visibility events during the winter of 1996/1997. The LIDAR system did operate during this later period but the accuracy of the LIDAR data is subject to question because the system was still being calibrated. The Final Report is expected in August 1998.

The primary purpose of Phase I of the test was to determine whether the three sensor systems were capable of measuring visibility accurately. Test evaluators analyzed the visibility sensor effectiveness through three methods: POE personnel confirmation, video playback visibility comparison, and correspondence between the operating sensors.

The POE personnel confirmation and the video playback comparison were both subject to many problems that reduced their effectiveness as an accurate confirmation method. POE personnel confirmation problems included technical problems that caused the POE personnel to lose confidence in the system and the complicated and time-consuming nature of the method. Video playback problems included an ineffectiveness at determining precise visibility distances and several technical problems that resulted in limited availability of information. Considering the limited informa-

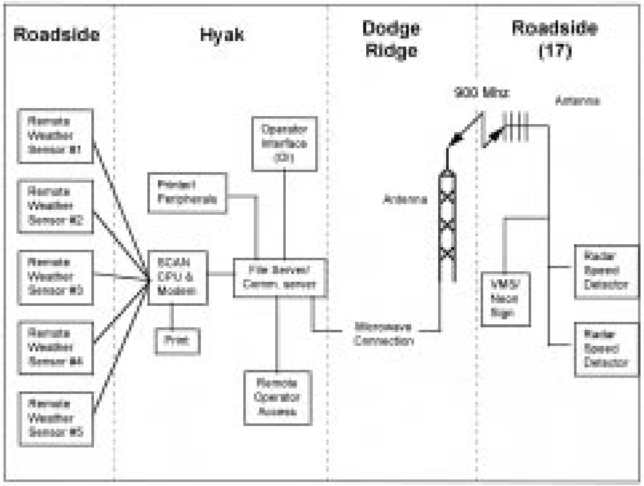

FIGURE 5 Travel aid system design overview.

tion available using POE personnel confirmation and video playback, this confirmation method shows general agreement between the observations of the personnel and the sensors' visibility during several event periods. Precise correlations, however, proved to be impractical due to differences in individual judgment and the POE personnel's busy schedule of other duties.

Despite the problems that reduced the effectiveness of the video playback confirmation method, the available Handar and SCAN data show a general agreement between the observed distances in the videos and the sensor distances.

The comparison of visibility readings from the Handar and SCAN sensing systems (involving three different sensors) showed that this comparison is unable to determine if the sensors provide accurate visibility distances. The sensors do, however, show a high correlation between themselves. Although they provide significantly different visibility readings, it was common to have correlation values of over 0.900 between different sensors. In particular, the infrared sensor tended to give lower visibility readings during snowy conditions but higher readings during foggy conditions compared to the two visible light sensors. In spite of these differences, the three sensors showed a strong, positive linear relationship. This means that when one sensor shows a decline in visibility, the other two also exhibit a decline. Conversely, when visibility improves according to one sensor, the others also show improvement.

The LIDAR information from the winter of 1996/1997 indicated more frequent low visibility readings than the other sensors. As noted earlier, however, the LIDAR system was still being calibrated. The LIDAR system shows the complexity of visibility measurements because it produces visibility estimates at one-quarter mile intervals for up to several miles away from the site. These discrete quarter-mile estimates show significant variations in visibility (as much as several thousand feet) from one interval to another. This implies that information from point sensors like Handar or SCAN is highly dependent on sensor location.

The information from Phase I indicates that the sensors have the potential to provide useful information regarding low visibility. The mixed results, however, mean that in Phase II it is important to have information from all three sensors to determine the nature of the message to be displayed on the VMSs.

Oregon Green Light Commercial Vehicle Operations Test

Test Status

Contractors completed installation and testing of the RWIS equipment in the third quarter of 1997.

In light of the large scale of both test and evaluation, the earliest results are expected in January 1998. The final report is due in April 2000.

Results

No interim results are available.

San Diego Smart Call Box

Test Status

The test has concluded.

Results

The evaluation found the smart call box concept to be feasible but not necessarily optimal. Smart call box systems will often be cheaper to deploy than hardwired systems. Smart call box systems, however, did not necessarily prove to be superior to other wireless systems.

The planned tests encountered problems. Most test equipment experienced varying periods of three conditions: operational, operational with problems, and non-operational. Test personnel were not able to control changeable message signs using the tested call box system because the CMSs used in California proved incompatible. Therefore, test personnel canceled the CMS subtest. Test personnel installed call box-based incident detection systems but these systems did not function properly. In the video (CCTV) subtest, the installed system could not remotely control the pan-tilt-zoom capabilities because of communication and system integration problems.

Test personnel encountered significant system integration problems. The design of portions of the system to be located at the TMC was considered to be outside the scope of the test. Therefore, test personnel made use of existing data collection components or used the simplest possible means. Problems also arose because the call boxes (owned and operated by the partners) ran software provided by the vendors. Evaluators were not sure if some data integration problems resulted from basic incompatibilities or from the project staff's lack of familiarity with the software. These problems led to reduced usefulness of some of the data or delays in integration of the field data with the TMC data.

For the three successful subtests, evaluators estimated cost savings. Evaluators noted that using Smart Call Boxes to control field devices in the three successful tests could result in substantial per site savings over other alternative control options. The possible capital cost savings ranged from about $1,500 to as much as $103,000.

Evaluators noted several institutional issues that need to be resolved prior to full-scale deployment of smart call box systems. Future systems must be rigorously tested and include design enhancements, improved reliability, and lower maintenance costs. Any agency considering deployment of such a system should prepare detailed deployment plans. The agency should also resolve other important issues, such as ownership, financing, and maintenance. Evaluators also cited inadequate involvement of the partner agencies and the potential users of the system in the development of system designs. The organizational structure of the test partnership and the cumbersome contracting procedures of the partners resulted in major delays that had a negative effect on the outcome of the subtests. Evaluators suggested that the project manager and the vendors be included as partners to overcome some of these problems.

Legacy

The results of this test led to a decision to prepare a proposal for pilot deployment of a small scale smart call box system in the San Diego area. The deployment would install systems to collect traffic census data, detect low visibility conditions, monitor wind speed, and verify CMS messages by CCTV. The deployment plan would provide for further testing and system development.

Other smart call box projects are currently in progress in California. In the San Bernadino-Riverside area, call box systems are monitoring traffic census data and weather conditions. In Sutter County, systems are collecting traffic census data and detecting low visibility conditions.

TransCal Interregional Traveler Information System

Test Status

After beginning operation of the TATS component, issues pertaining to the in-vehicle device performance and proposed kiosk database quality delayed a full conduct of the test. In February 1998, the test partners decided to end test operations. The partners will finish testing the PDAs and IVDs by the end of March 1998. The TATS will remain operational until September 1998 using state funds. The test will redirect the existing evaluation efforts to focus on capturing the institutional and technical lessons learned during the course of the test. The evaluator will prepare a final report by the end of March 1999.

Results

No interim results are available.

Travel Aid

Test Status

The test is underway and test personnel are collecting evaluation data.

Results

No interim results are available.

LESSONS LEARNED

Approach

Through published (where available), and regular contact with these seven projects, Booz-Allen & Hamilton developed summary lessons learned. These are grouped into three categories:

- Planning
- Procurement
- Development

Planning

- Do not be over ambitious, particularly for your initial deployment.
- Strong leadership is required at the implementing agency(ies), combined with multi-agency commitment to stay the course through deployment and operation/maintenance.
- Address resource and skill deficiencies, including training in agency personnel responsible for the systems.
- Consider range of communications media to find the most cost-effective and reliable.

Procurement

- Utilize appropriate procurement vehicles; ITS have many characteristics that make them different from truckloads of rock or tons of rebar.
- Make provisions for life-cycle support in the original project planning.

Development

- Realistic delivery timelines are essential.
- Systems integration in remote areas is an enormous challenge.
- Maximize the available deployment season.
- Timely maintenance procedures are required in order to gain expected benefits from the installed devices.