

CARS (Condition Acquisition Reporting System) and the CARS Group

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ABSTRACT

Throughout the 1990s and beyond, transportation agencies in the U.S. and Canada identified a need for condition reporting systems, both for internal traffic management and for sharing real-time information with the public, and in 1997, four states in the U.S. pooled their resources to build a first-generation condition reporting system, reducing the cost to each individual agency while also offering the opportunity to collaborate on the requirements and design for the new system. The result of this multi-agency effort was CARS (Condition Acquisition Reporting System), which is an ITS standards-based system that allows authorized agency users to enter, view, and share critical road, travel, weather and traffic information. CARS has subsequently been deployed by 17 agencies in the U.S. and Canada, including state departments of transportation, cities/municipalities, and toll authorities - and the group continues to grow. This paper discusses the history of the CARS Group and its developments, while also discussing opportunities for expanding it to transportation agencies in other parts of the world.

KEYWORDS: computer applications, traffic management, organizations, public services, computer-aided operation,

1. Introduction

Throughout the 1990s and beyond, transportation agencies in the U.S. and Canada identified a common need for condition reporting systems, both for internal traffic management and for sharing real-time information about the transportation network with members of the public. In 1997, four states in the U.S. decided to pool their resources and to seek additional federal support to build a first-generation condition reporting system together, thus reducing the cost to each individual agency while also offering the opportunity to collaborate on the requirements and design definition for the new system.

The end result of this multi-agency effort was CARS (Condition Acquisition Reporting System). CARS is an ITS standards-based condition reporting system that allows authorized agency users to enter, view, and share critical road, travel, weather and traffic information. Authorized CARS users can access the system from any location using a standard web browser, allowing data entry from any computer with Internet connectivity. CARS has subsequently been deployed by 17 agencies in the U.S. and Canada, including state departments of transportation, cities/municipalities, and toll authorities—and the group continues to grow. Members of the “CARS Group” drive the ongoing development, extension, maintenance, and operation of the system based on their current needs and budgets.

This paper will discuss the history of the CARS group and its developments, while also discussing opportunities for expanding it to transportation agencies in other parts of the world.

2. The CARS Group

The CARS software was initially developed by Castle Rock on behalf of the Washington State, Minnesota, Missouri, and Iowa Departments of Transportation (DOTs). Since its initial deployment, the CARS group has grown from four states to seventeen public agencies spread throughout North America. The fundamental objective of the group is to use shared resources to create modular, configurable software solutions to ITS problems. Whereas an individual state may not have the funding or other resources to deploy a major software solution, the CARS program presents an alternative.

Beyond resource sharing, the CARS group also provides members with an iterative approach to software solution development. Typically, the initial sponsors of a project establish a working prototype of a software module. Other members then contribute improvements and additional features over time as they deploy the module. The focus is on quickly deploying software that works, and then improving that software over time. CARS member agencies benefit enormously from the iterative approach, and learn from observing the deployment activities of their colleagues.

Generally, the development process follows two models: joint development of a new module by several states, or iterative development of a module over time. In both cases, individual states are able to obtain substantial cost savings (and more robust software) versus developing such software alone.

2.1. Joint development

Often, new CARS software modules are developed at the request of several CARS Group members. The CARS-AMBER module was developed for 8 CARS states (including Alaska, Iowa, Kentucky, Maine, Minnesota, New Hampshire, New Mexico and Vermont). In this case, the objective was to establish an automated and efficient process for the dissemination of AMBER alert (abducted child) information through various media operated by DOTs, including 511 phone systems, web sites, Dynamic Message Signs (DMS), Highway Advisory Radio (HAR), email, and cellular phone Short Message Service (SMS) messages. The envisioned system was considerably complex, and involved several tasks including coordination with law enforcement, establishing operational

procedures, researching data standards, software development (both user interface and various equipment interfaces), as well as configuration, testing and final deployment.

The estimated budget for this project was well over \$1 million. Developing this software would have been beyond the limits of a single agency's budget. However, in the case of CARS-AMBER, eight CARS agencies pooled together funds (including \$125,000 each in federal funds) to share the development costs. The end result was a robust application with several "extra" features, such as the capability to extend the messaging components of CARS-AMBER. The resulting messaging service, CARS-Messenger, is described later in this paper.

2.2. Iterative development

in some cases, a single CARS Group member agency needs to develop a new software module for a specific purpose, but the agency's limited budget necessitates constraints on the scope of the development work. In these cases, it has been the Group's approach to build an initial software module that satisfies only core requirements for the funding agency but leaves room for future expansion. Thus, when other agencies contribute funding to the module, its feature set can easily be expanded. The CARS-Group often follows this iterative software development model, producing software modules that evolve over time, with (typically) frequent iterations. When other agencies subsequently deploy the module, their contributed funds are applied toward both the deployment itself and to software enhancements—to satisfy agency-specific needs and to adapt the module to overall changing circumstances and technologies.

2.3. Summary

The CARS program promotes collaboration among transportation agencies in a way that would not otherwise be possible. States and agencies learn from each other's efforts and deployments. Members frequently communicate with others in the group and share success stories as well as difficulties. Even those CARS members who do not participate in the development process for particular software modules benefit from the Group's activities indirectly—each project establishes a body of knowledge that is available to all members. New CARS Group members whose ITS deployments are still in infancy gain the considerable advantage of having access to the body of knowledge collectively shared in the group, and existing members constantly benefit from new funding applied by other members toward new deployments.

3. CARS 4 software

The core CARS software module that nearly all CARS Group members have deployed is a standards-based condition reporting system (CRS) that allows authorized users to enter, view, and disseminate critical road, travel, weather, and traffic information. CARS users can access the system from any location using a standard web browser over a secure Internet connection. No local software is required other than a web browser such as Internet Explorer. The user interface presents traffic and travel events in both an event-list format and a map-view format, and also provides user-interface integration with additional CARS modules.

CARS 4 is the fourth major iteration of the CARS operator interface, and is slated to replace CARS 3 during 2009. CARS 4 is designed to be map-independent, with current agency deployments based on Google Maps. In the future, with funding from CARS agencies, CARS 4 may be extended to use Yahoo! Maps, ESRI ArcIMS Maps or other mapping technologies. The CARS map interface makes it easy for operators to view, edit or create travel events visually.

Event creation has been refined in CARS 4 to allow operators to create/edit event details while simultaneously viewing the map in a split-screen view. Operators can easily relocate the event they are editing, view nearby events, or zoom in and switch to satellite view to see the event area in greater detail (for example, to confirm interchange or intersection geometry). The CARS 4 event creation/edit screen is shown in the figure below. In addition to the map interface, CARS 4 also supports an enhanced event list interface. The event list allows operators to easily view, sort and filter events by a wide range of criteria including Route/location, Priority, Event type (e.g. Roadwork), Creator, and Start/end date and time. Operators can also create, edit and delete events from the event list, just as they can from the map view.

3.1. ITS standards-based interface

The CARS web-based condition reporting system functions as the local, regional or national database that drives multiple, modular, real-time travel information dissemination systems. CARS also supports automated, ITS standards-based import and export of events, which has been successfully used by agencies to import event data from traffic detectors, RWIS (Road Weather Information System), police CAD systems, GM OnStar, regional agencies, external weather conditions, bus and ferry AVL (Automatic Vehicle Location) systems, regional ATMS (Asset Tracking and Management System), neighboring state systems, and more. CARS manual and automated events are synchronized via a master system clock.

ITS standards also provide the basis of the CARS modular design for information distribution. Because data can be communicated easily between CARS and external systems, the base CARS system has been integrated with a wide range of information dissemination systems. A sampling of the many available add-on CARS modules are described in more detail in following sections of this document.

The modular standards-based information dissemination approach increases operator productivity because information needs to be entered once, only. In a traditional decentralized approach, a system operator might respond to an incident by posting information to a web site; recording a manual HAR (Highway Advisory Radio) message; recording a phone system message; and posting a display on various VMSs (Variable Message Signs). Operators are also often required to notify long lists of potentially affected agency personnel. The CARS software makes it possible for one operator to enter a single event report that will post information to multiple information systems. Posting information in this way is much more streamlined than dissemination via traditional “stovepipe” information systems, each of them requiring individual operator inputs.

In short, CARS is a powerful “hub” of information that can dynamically drive a region’s ITS infrastructure. A single point of data entry (e.g., a crash or roadwork “event”) supports information dissemination via multiple media.

4. CARS modules

As noted above, CARS was built using a modular architecture. This has allowed the CARS agencies to develop specific modular functionality that some, most or all deploy based on their needs. At the same time, all agencies are able to use a shared base CARS system. Following is

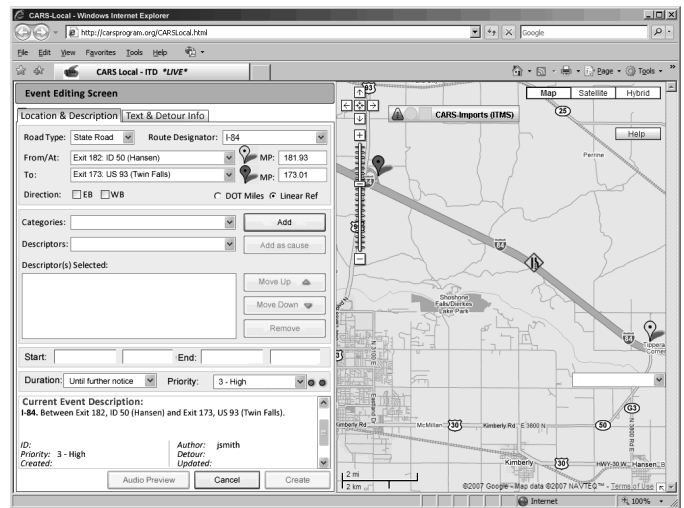


Fig.1. CARS 4 Event Creation/Edit Screen

a summary of a few of the most widely deployed add-on modules that have been added to CARS over the course of its eleven-year development.

4.1. CARS-511 phone system

In the United States (and more recently in Canada), the Federal Government has approved a universal phone number (511) for travel information. The vision is that callers can dial 5-1-1 from any location and receive real-time travel information over the phone. However, the detailed dialogues of this phone service are decided by state or provincial governments, so that each system meets the specific needs of its region.

CARS-511 is an automated voice response software module that receives current road condition information from CARS and formulates spoken reports for callers. Reports are presented using either spliced speech or text-to-speech (TTS). Because event descriptions are based on the TMDD (Traffic Management Data Dictionary) standard phrases, these can be pre-recorded and spliced together in real time. This would be impossible for a system that supported only free-text event descriptions.

4.2. CARS-messenger

CARS-Messenger supports the outbound “push” of travel information messages about traffic/travel events from the statewide CARS databases of participating agencies, via e-mail and SMS (cell phone text message). CARS-Messenger is a free, user-subscription based, fully automated notification engine that supports multiple distribution media—namely email, pager and SMS (Short Message Service).

CARS-Messenger allows subscribers to select the types of event alerts that they want to receive (e.g., delays,

roadwork, accidents), the geographic coverage (e.g., a designated city area, or selected stretches of specific routes), and the times of day during which alerts are desired (e.g., Monday-Friday, 06:00 to 09:00 and 16:00 to 18:00). CARS-Messenger monitors CARS updates and distributes traffic/travel event alerts in accordance with individual subscribers’ selection profiles.

Future enhancements to CARS-Messenger are expected to expand the concept to support customized web and 511 telephone user experiences based on detailed subscription settings, presentation of travel times, and transit-related alerts, among other things.

4.3. CARS-WEB

CARS-Web takes current traffic event information from CARS (e.g., construction, incident, road-weather and traffic data) and generates maps displays for public users on the Web. Reports are organized and presented both by incident type (e.g., construction, critical incidents, etc.) and by regional area (e.g., North, East, Metro areas, Province-wide). Agencies that have implemented CARS-Web—more than sixteen at this time—have their traffic/travel web pages customized to match the rest of their agency’s websites.

Once CARS-Web has been deployed for an agency, it runs automatically, generating updated web pages from CARS traffic-event data at regular intervals. Event information is presented graphically as a series of clickable maps on statewide, regional, and metropolitan levels. Users can access incident and condition information with one or two clicks of the mouse.

Publicly launched in November 2007, the second-generation CARS-Web software leverages the Google Maps API, providing real-time traffic, transit, and road condition information to the public received from CARS. CARS agencies incorporate Next-Gen Web’s dynamic features into their existing agency web sites. For a currently operational example—statewide in Vermont—visit <http://511.idaho.gov/> and select the “high bandwidth” option.

Users zoom and pan the maps using standard Google Maps controls. Users can also select the map, satellite, or hybrid image as a map background at multiple zoom levels, on top of which are rendered clickable icons and roadway coloring to represent traffic speeds or winter driving conditions. When a user mouses-over or clicks on an event or device icon, they see all public data related to that object. A Route Reports view allows users to generate a custom report for the route or routes they plan to travel.

Complementing the Next-Generation CARS-Web software modules are the CARS-Web 3G and CARS-Web LB (low-bandwidth) modules. CARS-Web 3G is designed for use on small mobile web-enabled devices, providing

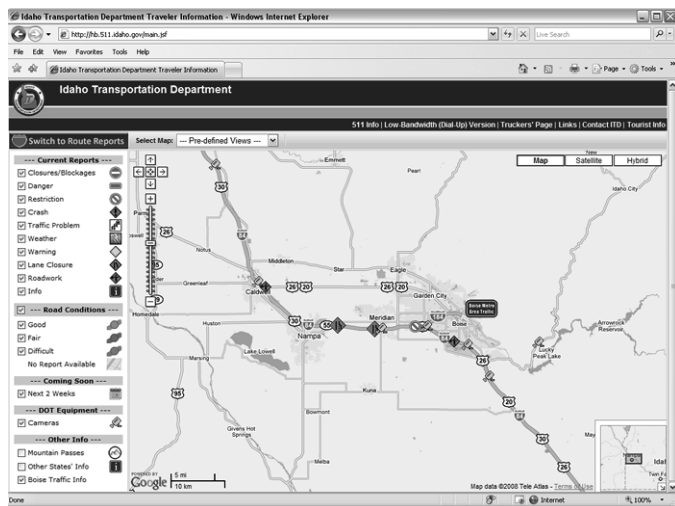


Fig.2. Next Generation CARS-Web (Idaho DOT)

convenient access to traffic information, traffic camera images, and road weather information. CARS-Web LB (currently under development) will provide a simplified version of the Next-Generation CARS-Web software that is more suitable for running on a low-bandwidth internet connection.

4.4. CARS-radio

CARS-Radio is an automated radio broadcast system that is operational in New York State, Iowa, and Vermont, supporting both AM (HAR) and FM (LPFM) stations. CARS-Radio technology takes information straight from the state CARS database without any manual operator action. Radio broadcasts are totally automated using pre-recorded spliced speech or Text-to-Speech (TTS) and are presented in a format similar to CARS-511 reports. Instead of dialing-up old-fashioned HAR stations and manually recording a separate message for each HAR station, CARS-Radio uses the Internet to select MP3 audio files immediately for every traffic information radio station in the state or region, based on local conditions.

4.5. CARS-signs

CARS-Signs unifies control of an agency's Variable Message Sign (VMS) devices under the standard CARS map-based data entry graphical user interface. CARS-Signs can support a range of VMS vendors' electronic signs. It also has the ability to share sign inventories and to set shared control privileges with other jurisdictions such as neighboring states or cities. Support for hybrid VMS networks that include signs from multiple vendors is possible because CARS-Signs uses ITS standards to communicate with VMS vendors' central software, using immediate-response SOAP push. In turn, the VMS vendor software controls the actual field devices. Sign message posting can be fully automated within the CARS operator interface. Both full- and semi-automation (i.e., operator decision support) are also supported by the software through an electronic version of traditional incident management plans, called VMS Plans.

5. Internationalization of CARS

The next release of CARS, CARS-4, extends the versatility and features of CARS by utilizing the Google Maps API for geographical display and management of events. This significant improvement over the previous system has generated interest from agencies outside the United States, thus increasing

the need for localization. CARS is capable of being fully language independent, currently supporting both English and French language web displays in Maine, with additional languages such as Spanish and German ready for follow-on. All translations between English, French, Spanish and German are totally automatic, using the predefined standard phrases. Thus operators can use the system in their native language, and, in theory, different operators could use the same CARS system in different languages. For example, a "Roadwork" event is recorded by the software using ITS standards-based codes. The event code for roadwork in a single system can thus be represented in multiple languages. CARS has also supported both metric and U.S. units since its earliest versions.

The progressive design and architecture of CARS, based on ITS standards, language independence, and map independence has made it increasingly attractive to local, regional or national agencies outside the U.S. and Canada. The relatively low-cost, iterative, modular and jointly funded approach used by the CARS group makes the software particularly well suited for developing nations that may not have the resources to develop their own systems from scratch.

6. Conclusion

With the rapid advancement in technologies that have enabled improved dissemination of travel information to the public, public transportation agencies are faced with the challenge of deploying new, modern information delivery systems that meet the needs of the public and fit within agency budgets. The CARS Group of transportation agencies represents a unique and cost-effective approach to this challenge, where group members leverage each others' capital investments and knowledge bases for the benefit of all. The Pooled Fund concept that the Group has pioneered has proven to be highly successful and beneficial to its members, and the group continues to grow. The core CARS Condition Reporting System "Hub" is now complemented by a large quite of software modules, addressing a wide range of agency needs including website information dissemination, interactive voice response (IVR) telephone systems, DMS, HAR, and subscription-based alerting. Many CARS modules have been designed and developed jointly by multiple group members, cooperatively, and the iterative software development approach that is commonly followed by the group has resulted in systems and software that have a high degree of adaptability, maturity, and robustness. As agencies in other countries face the same challenges that CARS Group members have set out to deal with, the opportunity exists for expansion of the CARS Group to include overseas members, and to build localization support into the system—allowing the CARS system to be deployed in any part of the world.