Incident Management: Analysis, Modeling and Design
for Traffic Incident Management Systems

April 30, 2009

For Submittal to:
Nevada Urban Transportation Center
University of Nevada, Las Vegas
Attn: Ken Peck, Ph.D.
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1 General Information

1.1 Introduction and purpose

This report describes the technical progress made on the Incident Management project from January 1, 2009 through March 31, 2009.

Project description

The aim of the project is to enhance the incident management process in the Las Vegas area by developing mathematical models, analyzing the models, performing simulations and then applying those to assist decision support system for the incident management team in the Las Vegas area. The project includes analyzing the current situation of incident management process in Las Vegas area, identifying the availability of ITS infrastructure, roles of various organizations involved etc.

Traffic incidents cause secondary incidents which requires the response from same agencies already engaged in the primary incident. These secondary incidents accounts for 20 percent of all incidents and 18 percent of all deaths. Reducing these incidents will have significant decrease in overall incidents. Thus a model will be developed to identify and reduce these secondary incidents.

Research related to the project is being conducted in x major task components, as follows:

1. Literature Review: Currently, the literature review is carried out in three fields
   (a) Incident Management
   (b) Secondary Incidents
   (c) UTAH’s Computer Aided Dispatch(CAD) system

2. Identify ITS Infrastructure: ITS is already in place in Las Vegas area. Different
agencies collaborated and formed a FAST centre to provide and manage ITS system in Las Vegas area.

3. **Evaluate Communications**: Meeting and interviewing different officials of emergency responding agencies to get the detailed information on their roles, responsibilities, intra-agency communications, inter-agency communications, softwares used etc.

4. **ITS for Communications**: Gathered information about present usage of ITS for communications such as HAR’s, VMS etc.

### 1.2 NUTC Account Number/Name of Recipient

UNLV Account #
Recipient: Name & Affiliation
Las Vegas, NV 89154

### 1.3 Project Title/Name of Project and Principal Investigator

Project Title: Incident Management: Analysis, Modeling and Design for Traffic Incident Management Systems
Principal Investigators: Pushkin Kachroo, Ph.D, P.E.
Vinod Vasudevan Ph.D, P.E.

### 1.4 Date of Report/Period Covered by Report

Report Date: April 30, 2009
Period Covered by Report: January 1, 2009 - March 31, 2009
2 Progress Towards Goals

Progress for this quarter continued as planned from 2008 Q4 until just past mid February. From the latter part of February to mid March we transitioned from performing new research work, to wrapping up current initiatives, and then to focusing primarily on final report preparation. A task specific progress report follows below.

2.1 Accomplishments and Major Activities

Task 1: Literature Review:

1. Incident Management: Publications on incident management from FHWA, NDOT, RTC and various local agencies are used for literature review. Incident management refers to the coordinated approach in managing incidents that occur on the highway. Various studies have estimated that 75 billion dollars of lost productivity and 8.4 billion gallons of wasted fuel due to congestion. These statistics shows need of effective incident management plan and the fig 1 shows the impact of incident management process on congestion.

2. Secondary Incidents: Secondary incidents are the incidents occurred due to the occurrence of primary incident. Recent studies suggest that 20% of all deaths and 18% of all deaths are caused due to secondary incidents. From the past couple of years, research on this topic has been increased and due to the lack of necessary data to distinguish the secondary incidents, authors are presenting different methods to identify the secondary incidents. A temporal and spatial analysis are used to identify the secondary incidents from the crash data. Based on the local traffic characteristics different spatial and temporal parameters are considered. Figure 2 shows the temporal and spatial parameters.

3. Utah’s CAD system: Utah’s traffic operations center CAD systems are integrated with
five other emergency responding agencies. The emergency responders being UDOT, Utah Department of Public Safety, Salt Lake City Police and Fire Departments, Valley Emergency Commuter Center and Utah Transit System. This is one of the two states to which FHWA awarded grants to evaluate the effectiveness of the system.

Integration of systems will enhance the speed, quality and sharing of data between different emergency responders. In this CAD systems, incident data is shared between all the CAD systems based on the data is entered in one of the CAD system.

Detailed report on above topics are included in the appendix and the sources of the reports and various other developments can be seen in the project website.
Task 2: Identify ITS infrastructure:

To get the detailed information about the incident management process in the Las Vegas area, the project team is interviewing the officials from different emergency responding agencies. Project team has interviewed officials from LVMPD dispatch and LVMPD fatality departments till now. Simultaneously, the information on the incident management process is gathered from different publications and websites of local emergency responders.

Detailed summary of the meetings are provided in appendix

Task 3: Evaluate communications:

Evaluating the communications from the above interviews held and the documents procured from the websites.
Task 4: ITS for Communications:

3 Schedule Status

3.1 Milestones

4 Changes in Approach

5 Problems or Delays

6 Changes to Key Personnel

6.1 Principal Investigators

6.2 Researchers

6.3 Graduate Students

7 Technical Advisory Committee Meetings

8 Products Produced/Technology Transfer Activities

9 Cost Status

9.1 Actual Costs Incurred
10 Appendix

10.1 Literature Review on Incident Management

“Incident” refers to an event that degrades safety and slows down the traffic. An event may include disabled vehicles, crashes, maintenance activities, adverse weather conditions and debris on the roadway. Incident-related traffic congestion (including secondary impacts) detrimentally affects public safety, the environment, and the local economy. It is estimated that this congestion will cost the U.S. public $75 billion in lost productivity and 8.4 billion gallons of wasted fuel in the year 2005 (Lindley, 1989).

Traffic incident related delays are estimated to cause 50 to 60 percent of the total congestion delay. In small urban or rural areas it can account for significantly higher percentages. (FHWA, Freeway Management Operations Handbook, Chapter 10, Draft 2003) and according to the Federal Highway Administration (FHWA), nearly 800 fatalities and 37,000 serious injuries occur annually from vehicle accidents in work zones. These incidents pose a risk of secondary incidents which accounts to 20% of all the incidents and 18% of total deaths. These secondary incidents also increases traveler delay, increased fuel consumption, reduced air quality and when combined with work zones, delays and costs to the construction project.

“Incident management” is a coordinated approach in managing incidents that occur on the highway. It is the systematic, planned, and coordinated use of human, institutional, mechanical, and technical resources to reduce the duration and impact of incidents, and improve the safety of motorists, crashvictims, and incident responders. Effectively using these resources can also increase the operating efficiency, safety, and mobility of the highway. (FHWA, Freeway Management Operations Handbook, Chapter 10, Draft 2003).

Incident management involves a series of activities, which can be carried out by personnel from a variety of response agencies and organizations. The program includes
1. Incident Detection: A process by which an incident is brought to the attention of traffic incident management team. This can happen in many ways such as

- Calls from motorists
- CCTV cameras
- Motorist aid telephones or call boxes
- Police patrols
- Automatic vehicle identification (AVI) combined with detection software
- Electronic traffic measuring devices (e.g., video imaging, loop or radar detectors) and algorithms that detect traffic abnormalities
- Department of transportation or public works crews reporting via two-way radio
- Aerial surveillance
- Traffic reporting services
- Fleet vehicles (transit and trucking)
- Roaming service patrols

2. Incident Verification: It is the process of confirming that the incident has taken place, getting the exact location and obtaining as many primary details as possible about the incident. Usually arrival of the first responder on the scene confirms the incident. This can also be accomplished in many ways such as

- CCTV cameras
- Dispatch field units (police or service patrols) to the incident site
- Communications with aircraft operated by the police, the media, or an information service provider
- Calls from multiple motorists
3. Motorist Information: This involves creating the awareness about the incident to the public which helps them to take the alternate routes. The following technologies are used to disseminate the information

- Commercial radio broadcasts
- Variable message signs (VMS)
- Highway advisory radio (HAR)
- Telephone information systems
- In-vehicle or personal data assistant information or route guidance systems
- Commercial and public television traffic reports
- Internet/on-line services

4. Response: This is the most important activity in the incident management process which involves dispatching appropriate equipment, personnel, and activating the required communication links. Effective response involves preparedness by a number of agencies (i.e., planned cooperatively) involved in the traffic incident management team.

5. Site Management: This involves managing resources on site in real-time following proper pre-determined protocols and policies. Site management ensures the safety of responders, incident victims and the oncoming traffic. It usually involves following a formal command system, incident command system (ICS). An ICS sets the guidelines for planned and organized approach by the variety of emergency responders to incident and emergency management.

6. Traffic Management: This involves coming up with alternate routes, dispatching personnel at the incident for traffic management if necessary and then managing traffic control devices to alleviate congestion on site.

7. Clearance: This involves removal of any objects that might impede normal traffic flow at the site.
Traffic Incident management coalition group

According to the reports, Nevada ranks among the top ten states with highest crash rates in the nation. In 2003 calendar year there was a total of 63,582 traffic crashes with an estimated loss of $1,309,466,700. With no specific incident management team, the local emergency management and transportation agencies clear 15,000 incidents every year on freeways. The above statistics shows the need of incident management program in Nevada state.

With the guidelines provided by FHWA almost every state has a local Traffic incident management group with different types of incident management programs. TIM is one such group formed in Las Vegas region for efficient Incident management. This team will discuss regional issues in traffic management and builds a regional consensus for clearance time goals, HAZMAT removal, TIM policies, best practices, technology improvements, communications, agreements and recommendations for a regional traffic incident management program that includes all first responding emergency and traffic agencies in Las Vegas region.

Roles and Responsibilities in Incident Management:

For effective Incident management, each and every agency participating in an Incident clearance should have specific roles and responsibilities. The existing roles and responsibilities of the emergency responders in the Las Vegas region are discussed below

Federal Highway Administration (FHWA):

It sets the standards, publishes “best practices for traffic incident management, provides planning guides and training options for partners involved in traffic incident management. FHWA helps in operating Highways.
Federal Emergency Management Administration (FEMA):

It mainly manages national emergencies and hazards. It provides federal response and recovery efforts, trains first responders, manages the National Flood Insurance police, and the U.S. Fire Administration.

Department of Safety - Nevada Highway Patrol (NHP):

NHP is the primary first responding agency for incident management. It serves as incident command in most incidents on the freeway/highway for the Las Vegas region with the responsibility of managing the incident, traffic diversions, clearance of the roadway and investigation of crash scenes on state highways and interstate freeways.

NHP serves as the Public Safety Answering Point (PSAP) taking 911 calls and when other 911 is contacted by travelers regarding freeway/highway incidents, those calls are forwarded to NHP. It interacts with all emergency agencies including corners office in case of fatalities and public information media regarding incidents and maintains dispatcher availability 24/7 from NHP-RTC FAST.

NHP posts DMS messages and monitors CCTV video feeds when FAST employees are not available (24/7 access is not available yet but is underway). Computer Aided Dispatch (CAD) system is used to locate and manage incident information (this system cannot currently communicate directly with other agencies systems). It primarily uses cell phones and radios for communication. NHP maintains secure information system inaccessible by others and provides security oversight of NHP-RTC FAST TMC agencies.

Nevada Department of Transportation District 1:

It provides staff assistants in providing traffic control, cleaning up debris, managing HAZMAT cleanup and repairing the roadway and receives incident feedback from NHP. It works
with NHP and other regional emergency responders to provide 511 information about the region traffic status for the statewide 511 system future. Uses newly provided hand held radios, cell phones and emails for communication. It operates and maintains four Highway Advisory Radios (HAR) in Southern Nevada and manages FAST agreement and provides funding for TMC Facilities Management position.

**Nevada Department of Transportation - HQ:**

It manages and funds Freeway Service Patrol (FSP) to assist drivers and NHP with traffic incident management. Manages 511 Statewide and Statewide Traffic Incident Management Team efforts. It reviews and makes policy on Traffic Incident Management, quick clearance and legislative recommendations for TIM development in the state of Nevada.

**Freeway Service Patrol:**

FSP offers roadside assistance who are in need. It assist in safety of drivers and individuals at incident scenes. It provides assistance to NHP with traffic control to prevent secondary incidents, rapid removal of vehicles and debris from travel lanes and paved shoulder.

**Nevada Department of Transportation Communications Department:**

It manages and oversees State NDOT radio systems, Oversees the statewide communications committee and helps in integration of communications systems whenever requested.

**Las Vegas Metropolitan Police Department (MPD):**

MPD serves as the Public Safety Answering Point (PSAP) taking 911 calls and when other 911 is contacted by travelers regarding freeway/highway incidents, those calls are forwarded to NHP. Along with NHP, MPD manages the incident on County roads, traffic diversions,
clearance of the roadway. Informs all emergency agencies and public information media regarding incidents via individual agency dispatchers. It owns and operates 700 MHz radio system.

**Law Enforcement:**

Conducts traffic incident management on arterial and local (and some freeway) systems.

**North Las Vegas Police Department (NLVPD):**

It serves as the Public Safety Answering Point (PSAP) taking 911 calls and when other 911 is contacted by travelers regarding freeway/highway incidents, those calls are forwarded to NHP. Operates AIMS system for traffic incident management on corridors in the NLVPD area and manages traffic for the Las Vegas Speedway. NLVPD communicates with other first response agencies via individual dispatchers and attends traffic incident management calls.

**Clark County Environmental and Risk Management:**

It works with NHP during incidents that involve large commercial vehicles. It manages HAZMAT contract for clearance of HAZMAT spills and/or removal of commercial vehicles from the Clark County right-of-way.

**Clark County Coroners Office:**

Along with NHP, Coroners office participates in clearing and investigating the incidents involving deaths. It assist in leadership efforts at the TIM to develop policies and support regional quick clearance agreement.
Clark County Office of Emergency Management and Homeland Security:

It participates in emergency management, focusing on policy decision making, identification of resource capabilities (ingress / egress), public information and rumor control. It has no direct operational responsibilities in incident management and clearance.

Clark County Fire Department (CCFD):

CCFD is the primary emergency responder or incident command agency for fire incidents, hazardous material spills, rescue, and extraction of trapped crash victims for Clark County. It helps the incident management team in clearing incidents and contacts a towing agency to tow the vehicle once the situation is stabilized. It keeps the data of the past incidents.

Clark County Public Works (Maintenance):

This department is responsible for managing incidents and clearance of incidents on CC-215. It closes and reopens roadways for use whenever necessary and generates a report of the incident. Clark County traffic signals and roadside equipment maintenance on County right-of-way are taken care by this department. Communicates Metropolitan Police Department (MPD) and North Las Vegas Police Department (NLVPD) using a dedicated radio channel during incidents.

Clark County Regional Flood Control District (RFCD):

It acts only when flash flood events occur. It collects data and shares with other agencies such as FAST for analysis. FAST video feeds may be helpful for surveillance and verification of water on roadway instances.
City of Henderson Police Department (CHPD):

As NL VPD and MPD, it serves as the Public Safety Answering Point (PSAP) taking 911 calls for Henderson. It plays an important role in reporting incidents, preserving evidence, reopening roadways for use and generating report of the incident in Henderson area, Communicates with MPD and NLVDP using a dedicated radio channel and CAD technology to aid communication with NLVDP.

RTC Freeway Arterial Transportation System (FAST):

It operates RTC FAST center and performs traffic monitoring and control via CCTV, detectors, DMS, ramp meters and FMS software. RTC has full access to most signal controllers in the Valley which can alter the signal timings accordingly during incident clearance. Communicates face-to-face during incidents with NHP,RTC FAST TMC and helps NHP and NDOT in incident management by providing data and tools to identify incidents and assisting with remote monitoring of the incident scene. It provides trailblazer signs to utilize and assist diverted motorists with detour route information during incidents. Support the Traffic Incident Management (TIM) Coalition by working with NDOT to support meetings and provide video taping of incidents in a quality that can be utilized for debriefing incidents at the TIM.

Citizens Area Transit (CAT):

It has contracts for vehicle removal, debris clean up, and Hazmat clean up for a crash involving a transit vehicle. Determines transit bus detour routes.It Shares incident information with law enforcement agencies and Office of Homeland Security when requested.
American Medical Response (AMR) Ambulance:

AMR is the primary source of providing first-aid at the incident site and thereafter transporting patient from incident to hospital. This service will be requested by 911 or NHP.

Towing and Recovery Operators:

Removes wrecked or disabled vehicles and debris from incident scenes. They work with TIM partners to accomplish regional quick clearance agreement.

HazMat Contractors:

Helps TIM in cleaning and disposing the toxic or hazardous materials at the incident site.

10.2 Utah’s Computer Aided Dispatch

Major metropolitan areas in the United States depend on advanced traffic management system(s) (ATMS) to manage mobility, congestion, and incident clearance. As a part of ATMS, an extensive infrastructure of remote cameras, loop detectors, and other ITS applications that provide traffic management services are installed. These systems are operated from centralized TMCs, where traffic-related information is received, processed and appropriate remedial actions are deployed and coordinated. However, there is no effective way to share this data with other responding agencies. Transportation, law enforcement, fire, and emergency medical personnel are improving the public safety operations significantly. These operations can be made even more effective when information is shared across organizations and jurisdictions. Equipment and personnel can be more efficiently deployed, incidents can be cleared faster, can provide safer work zone for responders at the scene and to the traveling public. To date there has been little effort to integrate highway traffic management with
public safety systems. The integration of different systems requires a great effort because of the existing CAD systems are proprietary and not equipped to easily share information with systems with dissimilar interfaces and integration includes various data, message formats and different standards used by public safety agencies and transportation agencies. Nevertheless, CAD and ATMS systems can be integrated and data can be shared, provided that a number of related institutional and technical issues are addressed.

Study of UTAHs CAD System

The Utah Department of Transportation opened its UDOT Traffic Operations Center (TOC) on April 27, 1999 and officially launched Intelligent Transportation System program, otherwise known as CommuterLink. The UDOT TOC, through the CommuterLink, provides comprehensive traffic management and operational services and is currently fully integrated with all city and county transportation departments located within the Salt Lake Valley. Now CommuterLink is a leading force in managing, co-coordinating and disseminating the traffic and traffic related information. It is a consortium of State, county, and city transportation agencies working together with emergency management and private media organizations for traffic management and provides information related to incidents, emergencies, accidents, planned roadway closures, special events, homeland security, and disasters. Communication links are established to share and distribute the CommuterLink Closed Circuit Television (CCTV) images and traffic flow map displays with the University of Utah traffic lab; Salt Lake City police and fire dispatch centers; County Sheriff EOC; and the Valley Emergency Communication Center (VECC). As part of the CommuterLink program, UDOT and the Utah Highway Patrol (UHP) have made significant changes in integrating emergency response operations. UDOT integrated the Departments Incident Management Teams (IMT), which participate in police training and staff briefings, and are dispatched directly through the Department of Public Safety (DPS) Dispatch center. DPS is provided a rent-free space within the TOC in exchange for after-hours support of DOT functions. The relationship
between these four departments namely DOT operations, DPS, UHP, and IMT led to the improved resources sharing and better management. A summary of the current ATMS-EMS integration in Utah is shown in Table below.

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<th>Goal</th>
<th>Objective</th>
<th>Current Status</th>
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<td>TOC-DPS Integration</td>
<td>To provide a fully integrated communication system between the TOC and DPS with respect to telephone, radio, CAD, and ATMS for purposes of managing incidents, dispatches, and other routine activities in response to traffic and public safety-generated events.</td>
<td>Telephone hot lines established. Radio 800-MHz completed with talk channels assignments established for UDOT, DPS, VECC, SLC police and fire. CAD/ATMS Shared CAD completed. ATMS integration scheduled for summer 2003. Real-time ATMS and CAD information completed to Media (dedicated fiber) and public (<a href="http://www.commuterlink.utah.gov">www.commuterlink.utah.gov</a>. pager alert system and 511).</td>
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<td>CommuterLink properties for sharing video and data</td>
<td>The CommuterLink system shall support an electronic interface with other CAD systems to support interagency dispatching (electronic data interface, video).</td>
<td>Integration completed between UDOT/DPS CAD vendor (CIS), VECC (Spillman), SLC PD (Versaterm), SLC Fire (FDM).</td>
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Table 1: ATMS-EMS integration
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<th>Application enhancements</th>
<th>Enhance systems to interface with a geographic information system (GIS) and third party map display to show real-time status of incidents (incident ID, type, status, etc.); vehicle location and status; geo-referenced location-specific conditions; and other relevant geo-coded information.</th>
<th>GIS map and integration with ATMS is complete in the TOC. Distribution to other sites/media is in early stages of deployment.</th>
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<td>Field unit support</td>
<td>Provide support for routing planned and en-route guidance to dispatched vehicles. Ability to generate selected routes based on position information, incident location, and real-time roadway network status information. Ability of calculated estimated time of arrival information.</td>
<td>Field unit support pending completion of other tasks and identification of funding source.</td>
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<tr>
<td>In-vehicle navigation systems</td>
<td>Integrate communications and data transfers from the ATMS/CAD to field units via Mobile Data Terminals (MDTs) and Automated Vehicle Locations (AVLs) as follows. Utilize MDTs to support automatic central dispatching, self-dispatching, resource request, and State database access. Provide pre-arrival information on hazardous materials and other on-scene conditions, including video. Support MDTs deployed UHP, IMT, and some UDOT vehicles. Deployment to secondary units (i.e., snowplows, service patrols, structural engineers, etc.), pending additional funding. System enhancements to complete stated objectives pending additional funding.</td>
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Project Agencies

UDOT ITS Division

This division deploys the necessary ITS infrastructure needed to the state. It had started its operations in 1991, which now manages over 100 miles of freeway, arterial, and transit routes within the Salt Lake Valley. This infrastructure was designed, implemented, and is now shared with local transportation departments. Information and controlled device access is also provided to other partners, including local police, fire, and dispatch centers. The UDOT ITS Division is the lead agency for the CAD-TMC field operation test.

Utah Department of Public Safety (DPS)

DPS is the primary dispatch center for all highway patrol units throughout the state, and co-located at the TOC. It is one of Utah’s best advocates for the sharing of information not only between other public safety agencies, but also to the media and general public as well. DPS was the first agency in the State to have the complete access to CAD information. DPS is working on the possibilities of sharing the data to the public by filtered access to records on the Web in real time through commuterLink. DPS is also a key participant, since this agency represents the local interests of the police, highway patrol, and other dispatch centers. DPS hosts quarterly coordination and management meetings with these agencies at the TOC, and is largely responsible for encouraging and demonstrating the usefulness of coordinating with UDOT.

Valley Emergency Communications Center (VECC)

VECC is the Primary Safety Answering Point (PSAP) for all of Salt Lake County and works closely with the Salt Lake City police, fire, and DPS dispatchers at the TOC. This center managing approximately 2,000 incidents per average day handles dispatching for 15
fire and eight law enforcement agencies, with agents fielding about 3,500 telephone calls. As a CommuterLink partner, UDOT has active agreements in place with VECC to provide ATMS support from the TOC, including real-time video feeds and access to the video switch for camera selection control.

**Salt Lake City (SLC)**

This is a 111-square mile jurisdiction city having police, fire, transportation, and airport security services to all the areas in the city through individual departments. The City transportation department owns a Traffic Control Center (TCC) that operates as an extension of the CommuterLink TOC. Additionally, the City Police and Fire departments each have an ATMS fiber connection to monitor transportation and video feeds from the TOC. Operators do camera control from either the City TCC or UDOT TOC.

**Utah Transit Authority (UTA)**

UTA is a very active member of CommuterLink. With its effective ITS program, UTA is setting new milestones from which other transit agencies measure their programs. It manages huge number of transit operations and has a strong congestion management program. It works with UDOT and SLC officials to deploy priority systems for UTAs light rail (TRAX) and bus services at signalized intersections. UTA has also deployed automatic vehicle locations (AVL), various traveler information programs (e.g., use of PDAs to access real-time schedule information), and has become the first transit agency in the nation to implement a connection-protection program designed to alert passengers and bus drivers of delayed light rail vehicles, which holds the bus until connecting passengers arrive.
Federal Highway Administration (FHWA)

A key member in the CommuterLink program, the local FHWA division is a major supporting partner of this statewide program, and will continue to be heavily involved as advisor, liaison to Washington, and local oversight administrator for this project.

Existing Systems

Computer-Aided Dispatch Systems

Every agency have their own computer-aided dispatch (CAD) systems. The UDOT ITS Division installed a new CAD system for joint use by the TOC DOT dispatchers and UHP-DPS dispatchers.

CommuterLink Advanced Traffic Management System

The CommuterLink ATMS installed several different systems to actively manage, coordinate, and disseminate transportation-related events and information.

- 260 Closed-Circuit Television Cameras (CCTV)
- 70 Variable Message Signs (VMS)
- 640 Centrally Controlled Traffic Signal Systems
- 23 Ramp Meters
- 191 Freeway Traffic Monitoring Stations
- Vehicle Detection Systems
- 7 Highway Advisory Radio
- 35 Roadway Weather Information Systems (RWIS)
511 Traveler Information System

Utah was the first state to use interactive voice recognition (IVR) technology to disseminate real-time information on incidents, road conditions, and roadway weather conditions.

Automated Vehicle Location and Geographic Information Systems

DPS has an AVL/GIS technology in place (completed an off-site pilot implementation) for tracking UHP vehicles and reviewing with the commuterLink to integrate ITS components with GIS. Current efforts include configuration management of all ATMS devices with future applications being developed to identify shortest route; real-time estimated times of arrival (ETAs) based upon speed flow data; incident monitoring; and real-time dissemination to PDAs or MCS devices for use by field units.

Signal Priority Systems

The UTA, in cooperation with UDOT, has deployed signal priority systems for both light rail (TRAX) and buses at signalized intersections.

Mobile Computer Systems

The mobile computer systems (MCS) units are essentially laptop computers that are installed in field units that communicate with a command center via wireless communications. These MCS units are typically cellular digital packet data, although new generation and higher speed wireless options such as GSM/GPRS will be widely available in large urban areas within the next few years. The uses for MCSs are unlimited, and constrained only by the communication network and application.
UTA Systems

UTA receives approximately 25 video feeds from other agencies at its dispatch center. These views were selected based on their ability to cover key UTA facilities such as light rail stations. In addition, UTA uses a CAD system to support the operations of its bus and rail dispatchers, including revenue, supervisory, and maintenance vehicles. This system monitors the status of radio system communications and current incidents.

UTA dispatchers have a significant degree of responsibility for making on-the-spot decisions about the operational response to unexpected events (e.g., rerouting, assigning replacement/ additional vehicles), and these decisions have a significant effect on UTAs operational efficiency. The types of unexpected events to which UTA dispatchers respond include traffic delays, equipment breakdowns, and driver absences. Currently, the information available to UTA dispatchers for these important decisions is primarily limited to radio communications with other UTA personnel, video feeds, and the media.

UTA currently has no direct data communications link or formal protocol for sharing incident information with the TMC, public safety, or law enforcement. Traffic or other incidents along UTA routes can have a tremendous impact on UTAs ability to maintain its schedules; however, UTA often first learns of an incident when UTA personnel encounter it on the street. Subsequent transit operations can be rerouted, and the initial vehicle may be significantly delayed. When this incident is already known to another agency in the region, sharing this information with UTA could help overall operations tremendously. Conversely, when UTA is the first to encounter an incident, UTA personnel could help by sharing the information with other agencies. In addition, once rerouting is established, UTA often has difficulty determining when an incident is cleared so that normal operations may resume.

UTA uses its Website and telephone information system to publish information for the public on longer-term operational responses to road conditions (e.g., rerouting due to construction activity). This information is also available through the 511 Website and telephone information system. UTA does not, however, currently attempt to provide information to the
public about shorter-term operational decisions that affect revenue service. One reason that UTA does not provide this information is that it does not feel it has reliable and current information as the basis for these types of reports.

The primary role and responsibility of UTA in the FOT will be to share data with the TMC and other responding agencies using the standardized incident status messages. Since UTA is not an incident responder, the data shared by UTA will primarily be limited to notification about incidents first detected by UTA personnel. UTA will be monitoring incidents already in progress that affect its operations, and would normally only provide notification about incidents not previously reported by other agencies.

This enhanced information for UTA is expected to significantly improve its ability to quickly implement effective reroutings after incidents occur, and to quickly end each rerouting once the incident is cleared. Subsequently, UTA also expects to build enough confidence in this information to start publishing short-term operational responses to the public using the UTA and 511 Websites and telephone information systems.

The system architecture developed for the FOT is shown in Figure 3

For the FOT, the participating agencies will use their current CAD and related technologies as depicted in Figure. The TOCs CommuterLink will continue to provide the current ITS technology, including CCTV roadway coverage. UDOT currently distributes CommuterLinks CCTV video images and image selection controls to SLCPD, SLCFD, VECC, and UTA. Traffic information is also available via CommuterLinks Web pages. The FOT will then test the specific effects of the introduction of the shared data identified above, facilitated by CAD-to-CAD ISRs and CAD-to-ATMS IAMs, on the performance of responders and related benefits. Utah CAD TMC-Existing Infrastructure is shown in fig 4
Integration and sharing

Using the new CAD integration software, when a call comes in, the dispatcher enters the data into assigned computer program fields and includes such information as the number of roadway lanes impacted, data more useful UDOT than to DPS. The dispatcher then selects which agencies should receive the information and marks a code to indicate the DPS planned response. After receiving the data, each selected recipient sends confirmation that the agency has received the information. Those agencies then have the option to electronically add incident details to the report and send them back to the DPS dispatcher. As the information flows among agencies, the system automatically integrates the data into appropriate fields in each agency's separate CAD software. Data that an agency deems sensitive is filtered and protected from distribution. Instead of just hearing an explanation of the incident, now
dispatchers and traffic operators can see it.

The system integrators also aim to automate the software to notify specific agencies of an incident according to the fields entered, eliminating the need for a dispatcher to select message recipients. Data that is sent to the UDOT CAD program automatically populates UDOTs travel information Web site (commuterlink.utah.gov), its free 5-1-1 Travel Information Line and its e-mail and pager-alert system. The public gets information about traffic incidents and related road closures in real-time. The proprietary CAD systems now have interfaces that can communicate with other CAD systems using a common standard, because the integration software was written to conform to the Institute of Electrical and Electronics Engineers (IEEE) 1512 standards, the national guidelines used for sharing incident informa-
tion. Writing the integration software to comply with IEEE 1512 standards makes it more usable over the long term.

Integrated CAD systems will better prepare all the agencies involved and make for better and faster emergency responses. Initial dispatchers can disseminate the data more quickly and efficiently with the integration of systems. Reducing a little delay in the transfer of information can mean the fire department gets there 40 seconds faster. And 40 seconds is a lot of time when it comes to emergency response. It can mean the difference between tragedy and survival. The integration technology also allows responders to clear incident scenes quicker, reducing the number of secondary crashes, or those caused by confusion or slowdowns related to the first crash. It also helps drivers avoid congestion caused by a crash.