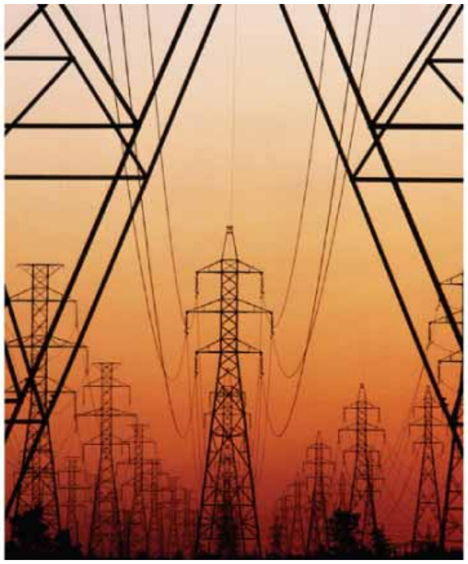
Computer-Aided Dispatch to Transportation Management Center Integration


A White Paper

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1. Introduction

This white paper investigates the benefits of an integrated transportation incident management (TIM) system. It explores implementing intelligent transportation technology in a public safety environment and vice-versa. The bilateral transfer of real-time information between the public safety and transportation subsystems has been researched and discussed much in the last five to six years, but there are presently few such installations.

This paper includes several topics. First, an overview of computer-aided dispatching (CAD) and intelligent transportation is presented. Without a basic understanding of the two subsystems, the interface between the two will not be fully understood. This overview is followed by a summary of the deliverables that are possible between the public safety and transportation subsystems. Not necessarily every conceivable interface has been listed, and not every metropolitan area needs every type of interface. The key point is that the information that is transmitted is beneficial to the system or those entities within the system as a whole in some manner.

Following the list of deliverables, there is a summary of potential benefits of not only intelligent transportation, but also the aforementioned bi-lateral interface. Next is a brief summary of potential ways that intelligent transportation systems and interfaces may be funded. The balance of the paper summarizes the research that has occurred and is still occurring with regard to the potential of interfacing the public safety and transportation subsystems and a list of case studies of a few of these completed and planned interfaces. The conclusion lists some of the key findings learned about interfacing the two subsystems and the benefits that may be obtained from such a system.

1.1 What are Computer-Aided Dispatch (CAD) Systems?

CAD systems utilize an intuitive graphical user interface, database technology, and a detailed map to assist emergency dispatchers in their duties. CAD technology enables the dispatcher to make potentially life-changing decisions in terms of which unit to send to the scene, and which route is the best and fastest.

CAD technology enables the following types of first and second responders to be managed in a high-performance, mission-critical environment:

- Police (local or state)
- Sheriff
- Fire/rescue
- Medical/ambulance
- Roadside assistance
- Tow/wrecker service
- Emergency operations centers (EOC)

NOTE: Sometimes the CAD may be referred to as the Public Safety Answering Point (PSAP).

1.2 What are Intelligent Transportation Systems?

Intelligent transportation systems (ITS) utilize a methodology that uses technology instead of infrastructure to increase traffic flow, decrease congestion, reduce fuel costs, improve safety, and/or enhance the response time of emergency responders. In contrast, a methodology that includes adding or modifying the transportation system infrastructure would not be considered part of ITS.

ITS technology can include a multitude of methods – the most basic is the simple time-programmed traffic signal. However, current-day ITS include some combination of the following technologies:

- Transportation management center (TMC)
- Ramp metering controller
- Traffic cameras
- Highway segment speed metrics
- Traffic signal controller

The hub of all ITS activity is the TMC, which is similar in concept and design to the CAD center. There are often large video wall projection screens displaying live traffic camera feeds, a major highway incident pin map (normally traffic accidents or other delay-causing incidents), as well as a color-coded map of current observed major highway segment speeds. The staff interacts with the traffic signal controller and the ramp metering controller to assist in improving traffic flow and/or assisting emergency response.

NOTE: TMCs are alternately referred to as traffic operations centers (TOCs).

2. CAD-to-TMC Deliverables

TMC provides information to the public.

The above technologies include data-gathering methodologies that can be distributed to the public via the following means:

- Dynamic message signs (DMS)
- Traveler advisory radio
- Web traffic information portal
- Cell phone/PDA alerts

TMC provides information to CAD.

The same data will be utilized by CAD systems for the following:

- Detection and verification of major incidents
- Video surveillance and video analysis for suspects/offenders – can zoom in on license plates from current or archived traffic video and run National Crime Information Center (NCIC) queries
- Override automatic routing of emergency vehicles and/or close/open roads in the CAD database (see Figure 1)

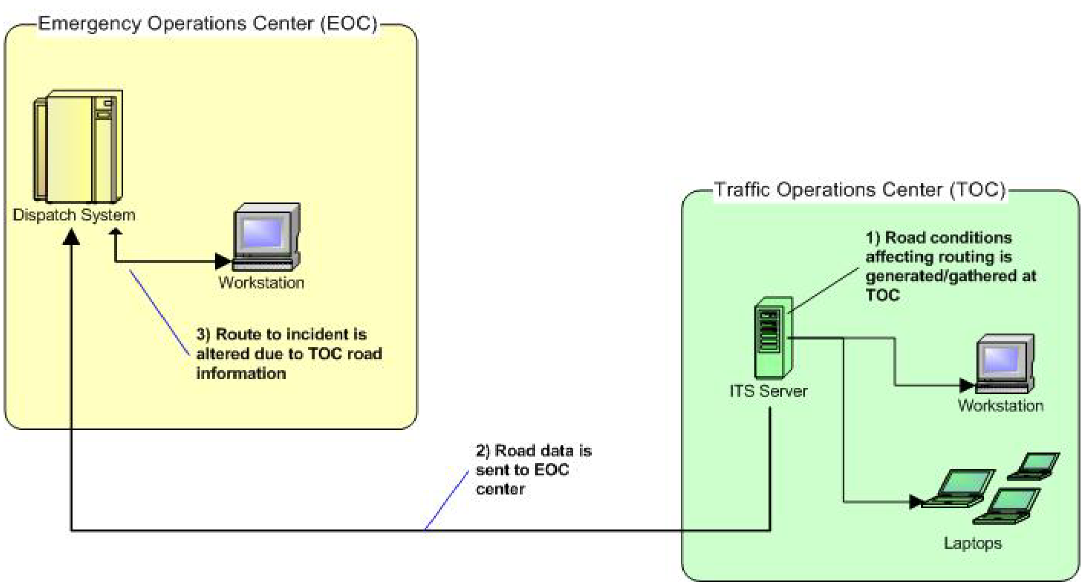

Figure 1 – Example of information transfer from transportation to public safety

CAD uses the TMC to provide information to the public.

The following information captured by the CAD center can be routed through the TMC to get the following information out to the public:

- Advance notice of major incidents, expected delays, road closures/alternative routes (see Figure 2)

- Weather bulletins (tornado/hurricane/flood/ice/snow/fog)
- Amber Alerts (missing persons)
- Homeland security (terrorist attack)

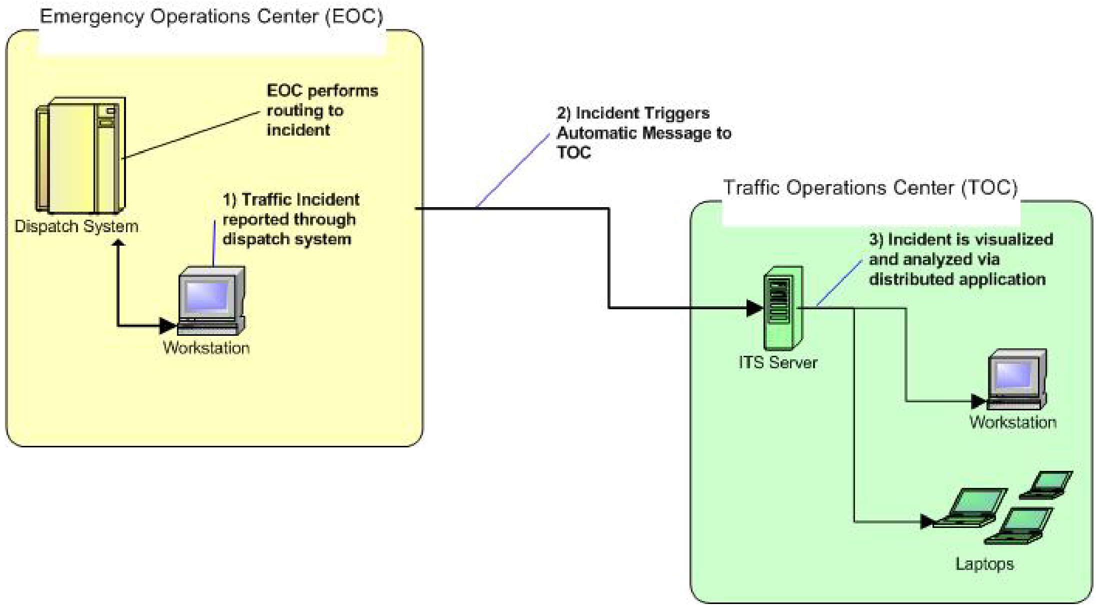

Figure 2 – Example of information transfer from public safety to transportation

3. What are the Benefits of TMC and Integration with CAD?

These are some of the standalone benefits of having a TMC implementation.

Here are some of the problems that TMCs are designed to improve:

- Annual delay per rush-hour period per traveler has tripled since 1982
- Annual fiscal cost of traffic congestion has quadrupled since 1982
- Annual wasted fuel from idling engines is 5.6 billion gallons

Samplings of independent studies as well as those by the U.S. Department of Transportation (DOT) − using data from the nation's largest cities where TMCs and associated technology are implemented − reveal the following benefits:

- Accidents reduced by 24-50% while increasing speeds by 13-48%.
- Advanced traffic surveillance and signal control systems have resulted in travel time improvements ranging from 8-25%.
- Traffic management systems - primarily through ramp metering – have reduced crashes by 24-50% while handling 8-22% more traffic at speeds 13-48% faster than pre-existing congested conditions.
- Incident management programs can reduce delays associated with congestion caused by incidents on highways by 10-45%.

These are some of the additional benefits that come with an integrated solution between CAD and the TMC:

- Reduce the average first responder response time by 1-2 minutes.
- Reduce the average time to clear the accident scene by 4-5 minutes.
- Reduce the number of delays in emergency response to other nearby incidents.
- Reduce the delay time for vehicles on the thoroughfare where the incident occurred.
- Lower the traffic volume upstream of the incident in order to facilitate emergency and tow/wrecker response to the incident, increase the safety of responders on the scene, and reduce secondary incidents.
- Alert the general public in advance of their departure of trouble spots, thereby further reducing traffic volumes through the incident scene.

4. How is Funding Acquired?

CADA system funds come primarily through local telephone company 911 tax collections. However in some communities where more technology than what this tax can pay for is needed, other means of raising funds must be investigated.

ITS funds come primarily from the federal government as part of the provisions defined in the transportation bill. The current transportation bill up for vote in 2006 is called the Transportation Equity Act: A Legacy for Users (TEA-LU).

According to Neil D. Schuster, President and CEO, ITS-America, "The programs proposed in the Congestion Relief and other sections of TEA-LU will help us make substantive progress in solving the transportation challenges facing the United States. Our Board of Directors recently adopted a new vision – Zero Fatalities, Zero Delay. TEA-LU will enable the United States to achieve this vision, to create a transportation system in which people and goods move without fatality, injury, or delay on safe, integrated, efficient transportation systems."

The following are other methods for funding ITS projects:

- Federal matching Congestion Mitigation and Air Quality (CMAQ) funds are available for showing that the ITS will help reduce air pollution and/or improve air quality.
- Homeland security monies are available if the specifications are written properly.
- Private/public partnerships may be employed. For example, the local television news media may help pay for traffic cameras if they can use them in their news broadcasts. Local businesses may help pay for fiber optic cable installation (used to transmit in-field data back to the TMC) if they can share in its use.
- Local government dollars usually supplement federal dollars through a bond issue. They can then use the dollars shown to be saved by consumers and government agencies after implementation of the ITS as collateral.
- Toll roads can also be used to help pay for ITS. (Part of a complete ITS implementation would include rapid pass toll collection systems where regular users would prepay and be charged an access fee triggered by a barcode scan on the windshield.)

5. Research on CAD-to TMC Integration

Federal Government

The federal government has undergone extensive research in the area of CAD-to-TMC integration. The following are some details of the research:

The Federal Highway Administration (FHWA) researches road capacity and other types of traffic operations, and reports on these changes over time. One significant fact is that in the last 25 years, vehicle mileage (number of vehicles on the road multiplied by miles driven in a given year) in the U.S. has increased 90 percent but capacity (new lanes and/or roads built) has only increased around five percent. Lane blockages due to traffic accidents do great harm to highway capacity; therefore, they must be quickly alleviated. ITS that have been installed during this time period have benefited commuters in reducing delay. The top priorities of emergency responders are to save lives, rescue people, minimize injury and loss of property, thoroughly investigate the accident scene, and manage any environmental concerns. Traffic control must be depended on to facilitate these priorities, and improve traffic operations. The FHWA Associate Administrator for Operations, Jeffrey F. Paniati, considers it unacceptable for a freeway or road network to have a TIM system that is not integrated in a multi-jurisdictional environment to public safety. [7 11]

The U.S. DOT has also conducted research on traffic operations and understands how the role of public safety is important to a successful ITS system. Emergency response depends on the roadways having a high level of service in order to more quickly respond to incidents. Alternately, transportation resources depend on the public safety subsystem to facilitate incident scene clearance. The U.S. DOT has promoted the need for law enforcement to cooperate with TMC in order to promote important public safety functions. [4 8 9]

Private Sector

Technological advances in computer, database, and geographic information system (GIS) mapping technology have created an environment where an automatic and integrated transportation management system is possible. Fast and accurate incident and location data from the TMC makes the CAD call taker's decision to dispatch emergency resources more rapid. It will be a great time savings in overall performance if a change in the CAD system simultaneously updates the TMC subsystem and vice versa. The time savings will be even greater when the CAD software is optimized during the design phase of the database schema to take advantage of real-time traffic condition data from the TMC. When this is accomplished, CAD routing schemes will be continuously updated based on current highway conditions, thereby recommending the best route. [5]

Public Safety Industry

Three of the top 10 trends in advanced transportation technologies closely involve the integration of the CAD system with the TMC. [8]

- Public safety – sharing of timely information to resolve traffic incidents faster, save lives, and mitigate injuries
- Data gathering – roads and cars will transmit data on the level of congestion in order to generate regular traffic updates
- Standards – common technical approach is needed to bring together similar systems used across the country

5.1 Theoretical Integration Scenario

For example, if Central City has an ITS system and a CAD system that is integrated, and if an accident occurred on a segment of I-98 eastbound between mile marker 18 and 19, the following might occur:

1. A traffic camera would identify the accident and someone in the TMC (or some semi-automatic process) would notify the CAD dispatcher, or a driver would call the CAD center directly. Either way, the incident would be created or the event type in CAD would flag this for processing by the TOC.

2. At the TOC level, a manual, automatic, or semi-automatic process would cause the upstream dynamic message signs to display an alert to drivers to slow, change lanes, or in this case, maybe suggest taking the President's Drive exit to detour. This would in essence lower the volume and increase average speeds on I-98, and make emergency response faster.

3. Automatic sensors along the roadway would identify the slower average speed and could relay that information back to CAD and temporarily lower that segment's speed limit to that value. This would affect recommended routing for other events, if necessary.

4. How many lanes are blocked is something else that could be manually submitted to the CAD database, or some type of automatic means may be employed to get the same data to the CAD database with the same outcome as described in the third example.

5. When the event is cleared (can be identified in the field or by traffic camera or other means), the speed limit and number of lanes can be restored to the previous values. This would require columns in the CAD database to store the default values.

6. Case Studies

Virginia DOT

The Virginia DOT has determined that CAD systems excel at the exchange of incident information and provide for the cooperative management of incidents. The process of mapping CAD data types in the XML format is not always intuitive. CAD operators have been able to see a greater number of incidents and a better picture of what is going on in the roadways. [1]

ITS holds much promise for coordinating traffic management with important incident management tasks in a way that is more efficient and provides greater benefits to the public as well as various stakeholders. An unprecedented level of cooperation is required from traffic departments, first and second responders, law enforcement agencies, commercial and private sector organizations, and other government and non-profit agencies. [2]

Research and analysis indicated clearly that in comparison to other approaches and programs, TIM is one of the most cost-effective ways to achieve delay reductions. TIM is more widely used to improve traffic safety, reduce delays and lower vehicle pollution. [2]

The following is the typical sequential incident management process: [2]

- Detection
- Verification
- Motorist information
- Response
- Site management
- Traffic management
- Clearance

These are some of the key benefits of a cooperative, multi-agency ITS project implementation: [2]

- Safety improvements
- Delay savings
- Traffic throughput
- Customer satisfaction
- Cost savings
- Environmental concerns

State of Utah

For its CAD-to-TMC integration test, the State of Utah had several goals to accomplish. These goals included achieving the seamless transfer of information between the traffic management workstations and the police/fire/emergency medical services CAD system – these two being form different vendors. They also wanted to be able to share data between map databases from different vendors and GIS standards. [12]

The following are some of the improvements the State of Utah expected to achieve form their CAD-to-TMC integration: [12]

- Reduce incident clearance time
- Improve efficiency of on-scene operations
- Enhance efficiency in documenting incident management procedures
- Improve mobility during incident management activities
- Increase safety for response personnel

State of Washington

For its CAD-to-TMC integration project, the State of Washington wanted to employ emergency vehicle signal pre-emption and achieve coordinated management of incidents during daily operations. They also wanted to ensure that construction zones also were part of the plan. Cooperation between the Washington DOT and the Washington State Patrol required the DOT to grant access to its CCTV camera and freeway data and also required that the police grant access to real-time incident information. A timely response and/or removal of incidents requires real-time adjustments to the best route be made when needed. [13]

New York City

The Integrated Incident Management System (IMS) project in New York City integrates first responders to enable efficient secondary response. [8] It employs automated data sharing devices to collect textual, geographic, and photographic information to distribute to the various public safety and transportation agencies. This sharing of information on incidents requires the coordination of the public safety and transportation agencies to mitigate the consequences of incidents and shorten the time to return the situation to normal. [6]

The following are some of the measurable and observed benefits of the New York City IIMS: [10]

- Accurate, complete, updated incident information
- Real-time sharing of information between agencies
- Reduced traffic congestion and secondary incidents yielding faster clearance
- More efficient use of emergency resources and reduced response time

Austin, Texas

The City of Austin, Texas, and Travis County CTECC have an integrated CAD-to-TMC system. The CTECC employs the capture of real-time speed measurements from road sensors installed by the Texas DOT and the application of this data to the CAD mapping engine. This up-to-date information may be used to update the status of the road network and account for traffic slowdowns, road construction, or accidents. The CTECC reports that this configuration has shaved 1-2 minutes off the average response time of 5-6 minutes. [15]

The CTECC system includes a center-to-center communication infrastructure that is applicable to the state of Texas and is based on ITS standards. The following is a summary of the system components: [14]

- Center-to-Center (C2C) communication using COBRA and XML formats
- Closed-circuit television (CCTV)
- Dynamic message signs (DMS)
- Incident detection and response
- Web-based advanced transportation information system

Jackson, Mississippi

Jackson, Mississippi, plans to implement an integrated CAD-to-TMC system called CAPTAIN, which will employ the use of a network of road sensors to monitor traffic flow, capture motorist 911 calls, and transmit CCTV images. CAPTAIN will also support the submission of information to the public through dynamic message signs, traveler advisory radio, and the Internet. [3]

7. Conclusion

After reviewing the research and the limited experience of integrated public safety and transportation subsystems, a few common workflows and benefits are evident. One of the goals of the integrated system is the mutual update of roadway incident information, and this is accomplished bilaterally. While the public safety subsystem benefits from better routing criteria and faster emergency response time, the transportation subsystem benefits from faster travel time, increased traffic volume, and a decrease in average delay. Ultimately, the most important benefit is the ability to facilitate the saving of lives and the reduction or prevention of injury as the integrated system creates a better environment for the entire emergency response and recovery effort.

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