Title

Organizing For Its: Computer Integrated Transportation Phase 2: Results For Emergency Operations

Authors

Lo, H.
Rybinski, H.

Publication Date

1996

CALIFORNIA PATH PROGRAM
INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

Organizing for ITS: Computer Integrated Transportation Phase 2: Results for Emergency Operations

Hong K. Lo
Holly Rybinski

California PATH Research Report
UCB-ITS-PRR-96-11

This work was performed as part of the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation; and the United States Department of Transportation, Federal Highway Administration.

May 1996

ISSN 1055-1425

ACKNOWLEDGMENTS

The authors would like to thank Art Aclaro, Ralph Blackburn, Bob Bassett, Bob Guinn, Kin Ho, Jim McCrank, Jim Pursell, Alex Skabardonis, Bon Yee for their participation in this study. This Project is funded by the California Department of Transportation. The views expressed in this report are those of the authors; they do not necessarily represent the official views of their affiliations.

ABSTRACT

Computer Integrated Transportation (CIT) is envisioned as an integrated network of public and private transportation organizations, each with unique responsibilities, but working toward a common mission of facilitating travel across all modes of transportation. This paper extends the research on CIT to emergency operations (EOs). The objectives of the study are to examine EOs in California, identify their role in gathering and using traffic incident information, establish the basis of coordination between EOs and TMCs, identify Intelligent Transportation System (ITS) services and technologies that may be beneficial to their operations, and finally compare and contrast similarities and differences between the California emergency operations and the emerging ITS National Architecture. We conducted this study through site visits and interviews with different EOs. This report covers our findings for the San Francisco Bay Area.

Keywords: **Emergency Operations, Emergency Management, Transportation Management, System Architecture**

EXECUTIVE SUMMARY

Computer Integrated Transportation (CIT) is envisioned as an integrated network of public and private transportation organizations, each with unique responsibilities, but working toward a common mission of facilitating travel across all modes of transportation. CIT is designed to achieve effective coordination of the transportation system, while at the same time respecting the individual responsibilities of participating organizations.

This paper extends the research on CIT to emergency operations (EOs). The objectives of the study are to examine EOs in California, identify their role in gathering and using traffic incident information, establish the basis of coordination between EOs and TMCs, identify Intelligent Transportation System (ITS) services and technologies that may be beneficial to their operations, and finally compare and contrast similarities and differences between the California emergency operations with the emerging ITS National Architecture. We conducted this study through site visits and interviews with different EOs. This report covers our findings for the San Francisco Bay Area. Summary findings are discussed in the following:

Making Great Strides: California leads the nation in developing its emergency management system. Some examples include the provision of ubiquitous coverage of E-911 service, development of a unified command-and-control system for all its emergency agencies, establishment of Emergency Operations Centers and close working relationships between emergency agencies for traffic incident management.

Assessing Existing Performance:
Figure 1 illustrates the performance of the incident response procedure in the San Francisco Bay Area. These estimates are rough averages with high standard deviations. Nevertheless, they show that the overall performance of the incident response system is reasonable.

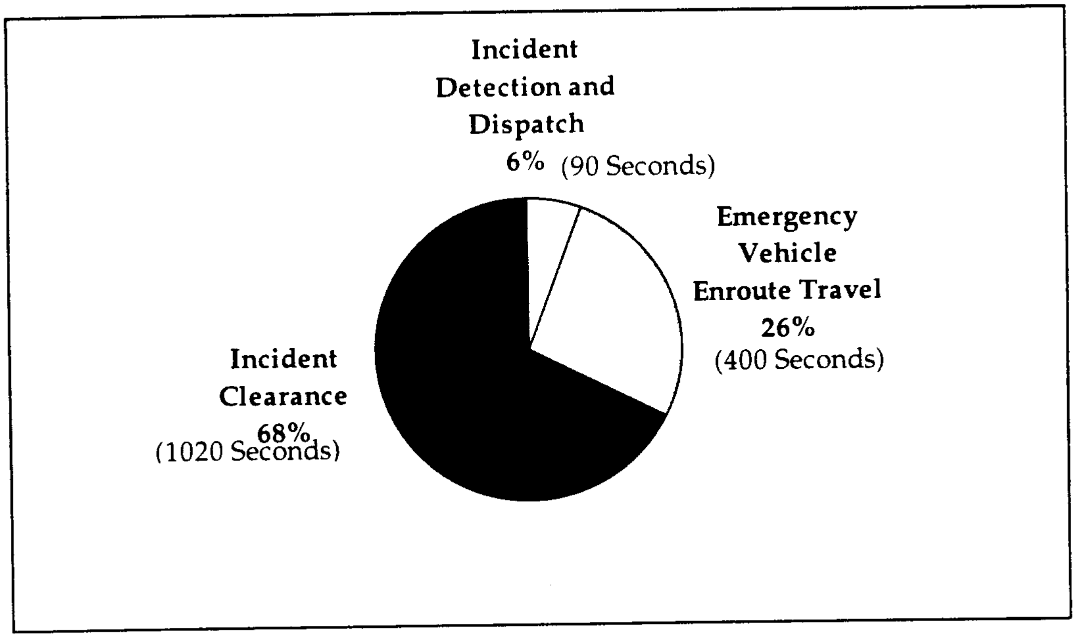

Figure 1 Time duration of the incident response components[1]

Streamlining Dispatch Communication: One of the critical elements of incident clearance is the dispatch of heavy equipment via Caltrans Maintenance branch. It seems that unifying the communication between Caltrans Maintenance and TMCs would be instrumental in reducing incident clearance time[2].

Improving Coordination with cities: In general, the coordination between highway oriented incident response agencies and city ones can be improved substantially by simply establishing a set of communication procedures between the involved agencies.

Ascertaining Coordination Level with TMC: The communication between TMC and emergency agencies exists primarily for updating incident status. Higher level of communication involving the use of real-time traffic information is not perceived as necessary by the emergency agencies.

Adding new functions and Technologies: Emergency agencies are cautious in expanding existing functions and adopting new technologies.

---

[1] These estimates were complied from FSP reports and on-site interviews.
[2] Recently, this concept of unifying the communication between Caltrans Maintenance and TMC has been implemeneted in Caltans's new TMC in San Diego.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The impact of incidents on congestion has been well documented. The most widely cited study indicated that incidents account for 61% of all the congestion delay in the US (Lindley, 1986). On a similar scale, a study by the California Department of Transportation (Caltrans) reported that 50% of motorist delays on freeways are related to incidents (Hicomp Report, 1992). Therefore, it is critical to design procedures to respond to incidents in a coordinated and timely fashion so that such delay can be minimized. In fact, realizing this need, big metropolitan areas had initiated programs to respond to incidents even in the 60's. For example, Chicago started the "Minutemen Program" in 1961, which was consisted of tow trucks that patrolled segments of the freeway system and offered assistance to vehicles in trouble or incidents (McDermott, 1975). These programs are commonly known as the freeway service patrols (FSPs).

The National Intelligent Transportation Systems (ITS) Program Plan (Euler and Robertson, 1995) in a like manner recognized the important of providing effective emergency management for the transportation system. Two specific user services were depicted as recommended elements for ITS: Incident Management, and Emergency Management. The former user service focuses primarily on developing incident detection methods, and tools to manage traffic at a system level such as traffic modeling and decision support systems. The latter emphasizes emergency notification, emergency fleet management through communication and vehicle location technologies, and provision of route guidance and signal priority. The National ITS Program Plan highlighted the need from the perspective of service and technology provision. In addition to this aspect, what the Program Plan did not address was the need to examine how these technologies may fit with various operating institutions and agencies who are responsible for the different facets of emergency operations.

Generally, effective in incident management requires the coordinated effort of a number of operating agencies, such as freeway surveillance systems, traffic management teams (TMT), law enforcement officers, freeway service patrols, state department of transportation's maintenance division to clear heavy debris, hazardous material identification and clearance teams, ambulance, fire trucks, and for fatal accidents, even coroners. How can these different agencies work together to achieve the goal of restoring freeway capacity in the shortest possible time and of managing traffic responding to the incident? In the advent of Intelligent Transportation Systems (ITS), how can communication and database technologies assist in this process? Or will these technologies be able to serve as a catalyst for promoting and facilitating inter-agency coordination?

In an earlier report (Hall et al., 1994), we proposed the concept of Computer Integrated Transportation (CIT)--envisioned as an integrated network of public and private transportation organizations, each with unique responsibilities, but working toward a common mission of facilitating travel across all modes of transportation. CIT is designed to achieve effective coordination of the transportation system, while at the same time respecting the individual responsibilities of participating organizations. These earlier studies examined the concept of CIT from the perspective of arterial and highway transportation management centers (TMCs). We conducted site visits and interviews at Caltrans and city TMCs, and organized subsequent focus group meetings with TMC managers and engineers. Among other findings, institutional impediments and opportunities for inter-TMC coordination were identified. The reports, however, only touched on the issues of how transportation agencies interact with non-transportation agencies. As contended in the beginning, such interaction, especially in the case of emergency or incident management, could have significant impact in mitigating congestion. This study, therefore, examines the coordination between TMCs and emergency operations, and investigate whether an appropriate level of coordination can be determined.

The research presented in this report was completed in parallel with two companion studies, one on commercial vehicle operations (Hall et al., 1995) and the other on transit agencies (Hickman et al., 1995). The three studies together would provide a more comprehensive view of how traffic agencies at the state and local level can improve their coordination with other types of transportation organizations to achieve the goals of CIT.

The organization of this report is divided into five sections. Section 2 states this study's objectives, and survey design. In section 3, based on the interview results, we describe the state-of-the-practice emergency operations in California. Section 4 discusses the coordination between emergency operations and TMC. Section 5 depicts the recommended ITS user services as viewed by the practitioners. In section 6, we compare and constrast the California emergency management system with the one proposed by the National ITS Architecture Program. Finally, we delineate our observations and conclusions in section 7.

2. STUDY OBJECTIVES AND DESIGN

Although the importance of incident or emergency operations is well documented, there have been few studies that examine the coordination between TMCs and various emergency agencies (EAs). In fact, to our knowledge, there is no report that depicts the existing coordination among the various involved agencies in California. Realizing this gap in knowledge and understanding, the objectives of this study are to:

(i) Survey the operations of emergencies agencies,

(ii) Identify their potential roles as traffic or incident information providers or users according to their ways of data acquisition and utilization. In other words, what types of TMC data will be beneficial to the agencies and what kinds of data they can provide to the TMCs?

(iii) Identify ITS user services that may be beneficial to the emergency agencies,

(iv) Identify potential coordination structure that may be favorable and acceptable to the involved agencies.

The scope of the study covers California EAs who deal with traffic-related incidents, including: Caltrans TMCs, Caltrans Maintenance Department, California Highway Patrol, Freeway Service Patrol, Local 911 Center or commonly known as Public Safety Answering Points (PSAPs).

It is anticipated that EAs that are far apart will have little operational interaction, and that within California, being public safety agencies, EAs will follow similar and consistent organizational structure and operational procedures. Therefore, we conveniently divide the study into two geographical regions: EAs in Northern California and the ones in Southern California. The study is conducted in two phases. First, we surveyed emergencies agencies in Northern California. Subsequently, Northern California survey results will be mailed to Southern California EAs for consistency checks. Presently, we have finished the first phase, and are in the process of conducting the second phase.

The survey on EAs was designed to cover the following major aspects:

I. Functions performed
   - A. Incident management
   - B. Security
   - C. Planned events/closures
   - D. Disaster response
   - E. Public information

II. Channels of communication
   - A. Handling 911 calls
   - B. Dispatching response units
   - C. Coordination with Transportation Management Centers
   - D. Coordination with neighboring agencies

III. Use of technologies
   - A. Communication technologies
   - B. Mobile computers (In-vehicles)
   - C. Automatic vehicle location (AVL) technologies
   - D. Database

IV. Intelligent Transportation System user services
   - A. Incident management
   - B. Emergency vehicle management
   - C. Emergency notification and personal security
   - D. Public travel security
   - E. Hazardous materials incident response
   - F. Advanced vehicle safety systems

V. Agency profile

The survey was administered through site visits to each of the EAs mentioned. After a few visits, we found that the EAs have close working relationships, and they understand each other's responsibilities quite clearly, especially between Caltrans and CHP. Perhaps this is due to the establishment of coordination structure from the top management, as we will see in the next section. We anticipate a very similar coordination structure for EAs in Southern California.

3. EXISTING PRACTICES

For the purpose of this study, we define two different levels whereby the EAs organize themselves. For convenience, we call them the disaster mode and the day-to-day incident mode. The former refers to disastrous situations such as major earthquake, flooding, fire, etc. It involves managing major resources such as personnel and equipment across multiple jurisdictions, and occurs perhaps only a few times a year. The latter refers to daily operations to handle incidents on the transportation system, and occurs many times a day.

For the disaster mode, it involves mainly setting up a command-and-control management structure, so that the situation can be monitored and resources deemed necessary can be allocated. Generally, it involves longer term events, on the order of days. The day-to-day mode on the contrary react to incidents based on an established and operating management or coordination structure. It works on a much shorter time scale, perhaps on the order of minutes, or hours for some severe situations. In the next two sections, we discuss how each mode operates.

3.1. Disaster Mode

In order to get prepared and organized to handle major disasters, among other items, Senate Bill 1841 (Petris) required the establishment of a statewide standardized emergency management system (SEMS) and development of an approved course of instruction for all emergency response personnel. Specifically, the Bill required that by December 1, 1993, Governor's Office of Emergency Services (OES) shall establish a SEMS, and by December, 1996, all state agencies shall use SEMS as adopted to coordinate multiple jurisdictions or multiple agency emergency and disaster operations.

Responding to the requirements of this Bill, the California Highway Patrol (CHP) proposed the use of an approach called Incident Command System (ICS), and the establishment of Emergency Operations Centers (EOS) or Emergency Resource Centers (ERC) to serve as sites for coordinating actions to disastrous situations. Caltrans, or more specially Caltrans TMCs, are included as part of the jurisdictions that should comply with SEMS. Recently, for example, an ERC has been established along with the new Caltrans TMC in Oakland. The ERC was activated during the recent flooding situations in 1995 before the TMC even became operational.

3.1.1. Incident Command System (ICS)

ICS is proposed as the foundation for the development of California's Standardized Emergency Management System or SEMS. The development of ICS can be traced back to 1970 after a disastrous fire season in Southern California. Subsequently, after further development by the San Bernandino Country Sheriff's Department, in November, 1988, the Governor Deukmejian sent a memorandum to all state agencies to encourage full-scale implementation of ICS at the state level. And in 1989 CHP approved the use of ICS for all emergency incidents occurring within CHP jurisdiction.

ICS is proposed as an emergency management system that enables emergency response personnel to manage incidents effectively by the proper use of resources, common organizational structure, and common terminology. Since major disasters often involve multiple agencies and jurisdictions, ICS is intended to provide a management structure that can achieve:

- Common terminology
- Modular organization
- Unified command structure

- Consolidated action plans
- manageable span-of-control
- Pre-designated incident facilities
- Comprehensive resource management
- Integrated communications

By establishing a common organizational structure based on functions, as illustrated in Figure 2, personnel from each involved agency or jurisdiction can communicate according their task assignments.

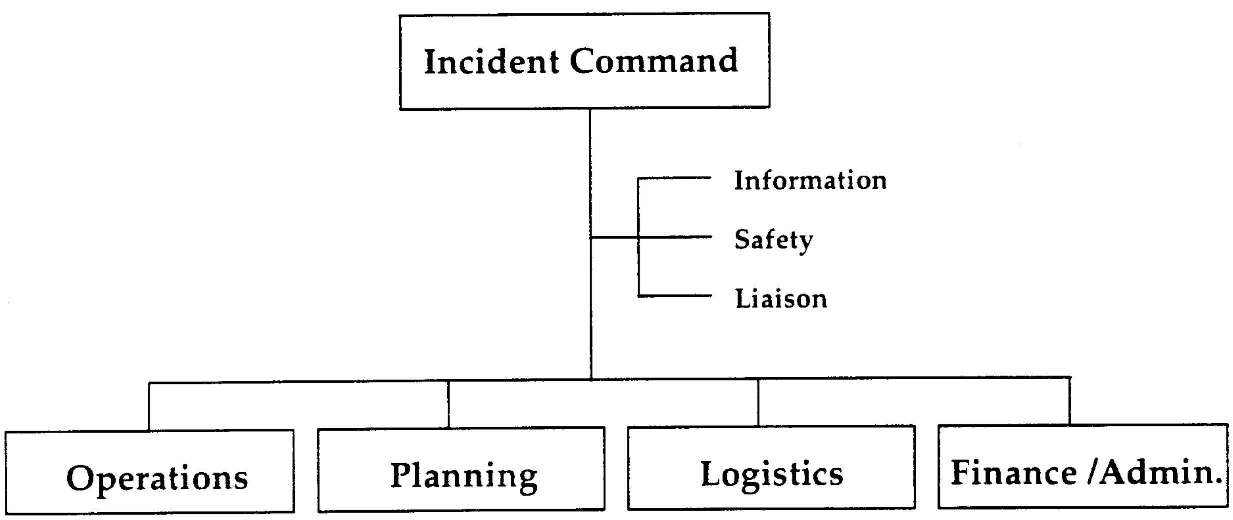

Figure 2 Major components of the incident command system.

More specifically, the major function of each component includes:

1. Incident Command: in charge of all emergency operational and tactical decisions
2. Operations: implementing the strategy and tactics directed by the Incident Commander
3. Planning: analyzing information and providing intelligence to the Incident Commander to develop strategies to mitigate the emergency
4. Logistics: procuring all resources necessary to support the incident objectives
5. Finance: ensuring collection of financial cost data

Caltrans TMCs and Maintenance Branches have just started to develop a parallel management structure in support of this ICS management structure. Since ICS is intended as a management structure for multi-jurisdictions as well as for single-jurisdictions, it is unclear at this time whether this will become a standard internal management structure for Caltrans TMCs/Maintenance.

3.1.2. Emergency Resource Center

Similar to SEMS and ICS, which are tools developed recently to respond to major disasters in California, the establishment of ERCs is also very new. Our visit to the ERC in Oakland, California, indicated that it is a conference room with some communications equipment. It is unknown at this time whether there are plans to link the databases and computer systems of the different agencies so that they can have an integrated system to manage resource allocation and equipment and personnel dispatch. As they stand now, ERCs simply provide a site whereby coordination among emergency agencies can occur. How new or existing automation, database, and communication technologies may be used for ICS or SEMS is still open to date.

3.2. Day-to-day incident Mode

Day-to-day incident mode pertains to mitigating congestion through providing quick and coordinated response to clear traffic incidents. This mode is invoked many times a day. From the interviews, we noticed that the involved EAs understand their responsibilities very well. In the following subsections, we discuss their operations from three perspectives: initiation of emergency services, jurisdictional responsibilities, and utilization of communication technologies.

3.2.1. Initiation of Emergency Services

There are two major ways that initiate emergency services for incidents on the freeway system. The first is by citizen calls. Citizens may report an incident through three channels: call box, cellular phone, and regular ground-line phone. In the San Francisco Bay Area

(SFBA), calls from call boxes go to the CHP Communication Center (CHPCC) located in Vallejo, except for those coming from toll bridges (such as the Bay Bridge) and tunnels (such as the Caldecott Tunnel). For the latter cases, the calls go directly to the Caltrans Maintenance dispatch located near the Bay Bridge or the one near Caldecott Tunnel. In the near future, when the District 4 TMC becomes operational, all such calls will be received there.

In addition to receiving calls from call boxes, the CHPCC located in Vallejo receives all cellular 911 calls in the 9-county SFBA. It is a common practice of the CHPCC to grant higher priority to cellular 911 calls than to calls from call boxes. Therefore, it is not uncommon for call-box calls to encounter long delay. For traffic related incidents on highways, through a Computer Aided Dispatch (CAD) system, CHPCC will relay information to CHP field units, Caltrans TMCs, and freeway service patrol (FSPs) if the incident occurs within the FSP's "beat" or patrol regions. Non-traffic related incidents will be forwarded by CHPCC to the local Public Safety Answering Points (PSAPs), which are mostly local police dispatch centers (about 80%), and less frequently fire dispatch centers.

The PSAPs also receive direct ground-line 911 calls within their district, and relays information to either police, medical or fire units depending on the situation. Similarly, traffic-related freeway incident information received through ground-line 911 calls will be forwarded by PSAPs to the CHPCC. Normally, each city has its own PSAP. For small cities and unincorporated regions which do not have their own PSAPs, there are county-wide PSAPs to provide coverage. As of July, 1988, California provides ubiquitous coverage of PSAPs (City and County of San Francisco documents, 1991).

Emergency services may also be initiated by field units such as FSPs who patrol designated segments of the freeway or called "beats", CHP field units or officers, closed circuit Television sets (CCTVs) operated by Caltrans TMCs, or Caltrans tow trucks operated by Caltrans Maintenance branch. In addition, there are automatic ways of using loop detector information for incident detection. However, as of today, loop detector information alone will not automatically initiate emergency services; a confirmation by field units is required.

Figure 3 summarizes the present flow of incident information and how emergency services may be initiated.

Two questions were mentioned during our interviews regarding the organization of future emergency service initiation. The first questions pertain to the reception of cellular 911 calls. As mentioned earlier, all cellular 911 calls are automatically connected to CHPCC. According to Bassett (1995), 40% of all cellular 911 calls are non-traffic related and get transferred from CHPCC to the proper PSAP; these calls would save waiting time if they could skip the middleman and go directly to the proper PSAP. However, the ability to do so requires the development of a positioning method, so that the calls can be transferred automatically to the PSAP that presides over the calling region. This may also involve changes in staffing and communications equipment needs for both CHP and local PSAPs. Bassett also indicated that PacBell has contacted them to examine the possibility of including the technology of position determination within the current cellular network. The second question regards the reception of automatic or manual MAYDAY notifications. Should these signals or calls be received by CHPCC directly, or through an independent service provider (such as American Automobile Association) who receives and filter these signals or calls before sending the emergency ones to CHPCC?

3.2.2. Jurisdictional Responsibilities

After an incident notification is confirmed, a number of emergency agencies are involved in incident management. In general, they established clearly defined responsibilities in clearing incidents and managing traffic around the scene among themselves. According to our interview results, the involved agencies and their responsibilities include:

1. CHP Communication Center, responsible for receiving emergency calls, summoning proper authorities, and operating the computer aided dispatch (CAD) system
2. Freeway Service Patrol (FSP), responsible for taking orders from CHP, acting independently to assist vehicles for non-injury and non-abandonment incidents within their beat
3. CHP Scene Commander, responsible for ensuring public safety, investigating causes of accidents, and short-term traffic control

4. Caltrans TMC, responsible for traffic system management, remotely controlling signals or ramp meters and changeable message signs (CMSs), and coordinating with other units for clearing and managing traffic around the scene
5. Caltrans Traffic Management Team (TMT), responsible for setting up detour and CMS, manually controlling signals and directing traffic around the scene
6. Caltrans Maintenance, responsible for providing tow service on toll bridges and tunnels, short-term clean up, and setting up long-term closures
7. Caltrans Hazardous Material Team (HMT), responsible for identifying types of hazardous material, and contacting contracted private clean-up crew

In this organization structure, FSP and the CHP Scene commander coordinate directly with CHPCC, while TMT, Maintenance, and HMT coordinate directly with Caltrans TMC. Caltrans TMC and CHPCC communicate mainly through the CAD system operated and maintained by CHPCC, although radio communications between CHPCC and CHP field units are also received by Caltrans TMC. Radio contacts between field units coordinated by CHP and those by TMC are in general not encouraged. In this method of coordination, CHPCC and Caltrans TMC should know of any information obtained from and decisions made by their field units. Figure 4 summarizes the responsibilities of each agency.

Due to historical reasons, some Caltrans Maintenance branches have their own dispatch and communication center, and communicate with tow trucks and field units directly without necessarily informing the TMC. This is especially the cases for toll bridges and tunnels since call-box calls on these facilities go to maintenance dispatch directly. Our interview with Caltrans Headquarters personnel (Pursell, 1995) indicated that Caltrans plans to streamline the communication procedure between Caltrans TMC, Maintenance dispatch and their field units. As of recently, this concept to streamline communication has been partially implemented in Caltrans' new TMCs such as the one in San Diego. The eventual goal is to set up an efficient communication system so that relevant information is channeled to the involved parties directly. The initial plan is to combine all dispatch functions (such as TMT, Maintenance) into one district dispatch communication center.

3.2.3. Utilization of Communication Technologies

Emergency communications can be classified by four categories: caller-center, center-center, center-field unit, and between field units. These four categories represent different modes of communications, with each adopts different technologies.

Caller-Center Communications: In the past ten or fifteen years, the communication between callers and emergency agencies has been streamlined. Most notably is the development and deployment of the 911 systems. As mentioned earlier, California leads the nation in providing ubiquitous coverage of 911 and PSAP's. Although the concept sounds simple--replacing local seven digit emergency numbers by a single "911", a full implementation involves procuring expensive communication equipment and resolving jurisdictional problems of replacing various local emergency dispatch centers by a single PSAP. In addition, in many cases boundaries defined by the central office of local phone companies do not necessarily coincide with city or county boundaries. Therefore, PSAP's and phone companies have to coordinate a plan to switch calls by using various transfer, relay, and referral[3] methods (State of California, 1988). Sometimes these manual switchings are an inefficient option. For these reasons, some areas of the country still do not have 911 service.

In addition to the above basic 911 systems, there are the E911 systems, also known as Enhanced 911 systems. E911 systems use one of the following additional features (State of California, 1988; Clurman, 1988):

1. Selective Routing-- automatically routes calls from a predetermined geographic area to the PSAP serving that area regardless of municipal and central office boundary alignments. It replaces some of the manual call transfers of the basic systems.
2. Automatic Number Identification (ANI)--shows automatically the caller's phone number to the PSAP.

---

[3] Transfer: PSAP personnel determine the proper responding agencies and transfer the calls to those agencies for action. Relay: the call is answered at the PSAP where pertinent information is gathered; the PSAP personnel then relay that information to the appropriate public safety agency. Referral: In nonemergencies, the PSAP personnel determine the nature of the calls and refer the caller to the public telephone number of the proper agency. The caller then dials that telephone number.

3. Automatic Location Identification (ALI)--show automatically the caller's street address. In Northern California, the system relies on the Master Street Address Guide (MSAG) to do this. The MSAG is a perpetual document that contains an alphabetical list of street names, ranges, postal communities, ZIP codes, etc.
4. Automatic Call Distributor--enables calls to be answered in turn.

California again leads the nation as having a completely E-911 system for ground-line calls. For cellular 911 calls, the system is at the basic level with all calls in the nine-county Bay Area automatically routed to the CHPCC in Vallejo. Our interviews with the CHP and County Sheriff Office indicated that the technology to introduce an E-911 system for cellular calls already exists, including ANI and ALI technologies. This may be a direction where the cellular 911 calls will head.

Center-Center Communications: One of the most important tools to maintain real-time communication is the computer aided dispatch (CAD) system. The CAD system is a database system that registers incident information and is updated continuously as new information comes in. CHP's CAD uses has the capability of automatically coding the incident location according to a "geo-file", similar to the MSAG. After incident information is gathered by a call evaluator and entered into the CAD, the case will be automatically assigned to the proper dispatcher who directs field units in the region where the incident occurs. Each call is prioritized as it comes in based on the impact of a given incident on public safety. After initial information is collected, the calls are ranked from 1-4, with 1 being the most serious. In general, call-box calls are given a lower priority than cellular 911 calls. The CAD constantly re-orders the calls as they come in, and arranges the order whereby the incidents will be handled. After receiving the call, the dispatchers will dispatch field units in their region through radio. To avoid interference, each dispatch region uses a specific radio frequency in the 900 MHz range (code-named as gold, blue frequency, etc.). For severe incidents that require multi-regional coordination, CHPCC uses a designated frequency to broadcast to all the regions.

The CAD also keeps track of assignments to field units, so that idle units can be assigned to new cases. Incident status in the CAD is updated constantly by information gathered by the assigned field units or officers. The system was originally intended to aid the CHP dispatch process. Since it contains lots of real-time incident information, Caltrans TMC and Maintenance, and in some cases even the media or the press are allowed access to the CAD system through remote terminals. However, only incident location and severity information are released; personal information (such as names of involved persons) is concealed from these remote terminals.

It should also be noted that as important as the CAD system is for inter-agency communications, there is no uniform standard in CAD designs. According to our interviews, there are four different vendors supplying CAD systems for PSAP's in the Bay Area. Without a standard, it is common that information registered in different CAD's of different cities or counties cannot be linked directly.

Center-center communications of course also rely on the regular phone system to do much of the day-to-day coordination. In addition, CHPCC and Caltrans EOC have set up a backup communication system using the microwave and UHF/VHF channels in the event that the regular phone system is down.

Center-Field Communications: The communications between various dispatch centers and field units are mostly accomplished through these means: radio, scanner, pager, and cellular phone. In addition, two new modes are being tested: automatic vehicle location (AVL), and mobile data terminal (MDT). For the first mode, four FSP vehicles in the SFBA are equipped with AVL devices to determine their location. A transmitter onboard the vehicles then transmits their real-time locations to the CHPCC. This information is monitored by the CHPCC and is used for assigning the nearest FSP to an incident scene.

According to CHP, a few MDTs are being tested in Southern California. These MDTs received digital information directly from CHPCC's CAD system. It saves verbal communication and reduces miscommunications between the dispatcher and the field units. Assignment of field officers to incidents is still directed at the CHPCC, however.

Field-Field Communications: In general, field units use radio to communicate with each other. These radio communications are audible to the dispatch centers so that they are informed of the latest development. Based on this information, the dispatch center updates the CAD accordingly, and directs additional resources as necessary.

Figure 5 illustrates the existing usage of communication technologies between the emergency response agencies in the SFBA. Other than these existing technologies indicated, by way of summary, emergency agencies face these four technological issues and opportunities: (i) introducing E-911 capabilities for cellular 911 calls, (ii) routing cellular 911 calls to the appropriate PSAP instead of indiscriminately to the CHPCC, (iii) standardizing CAD systems or data used in them for increased coordination and data sharing, (iv) introducing AVL capabilities for field units to aid dispatch, and finally (v) installing mobile data terminals in field units to reduce verbal communications and miscommunications.

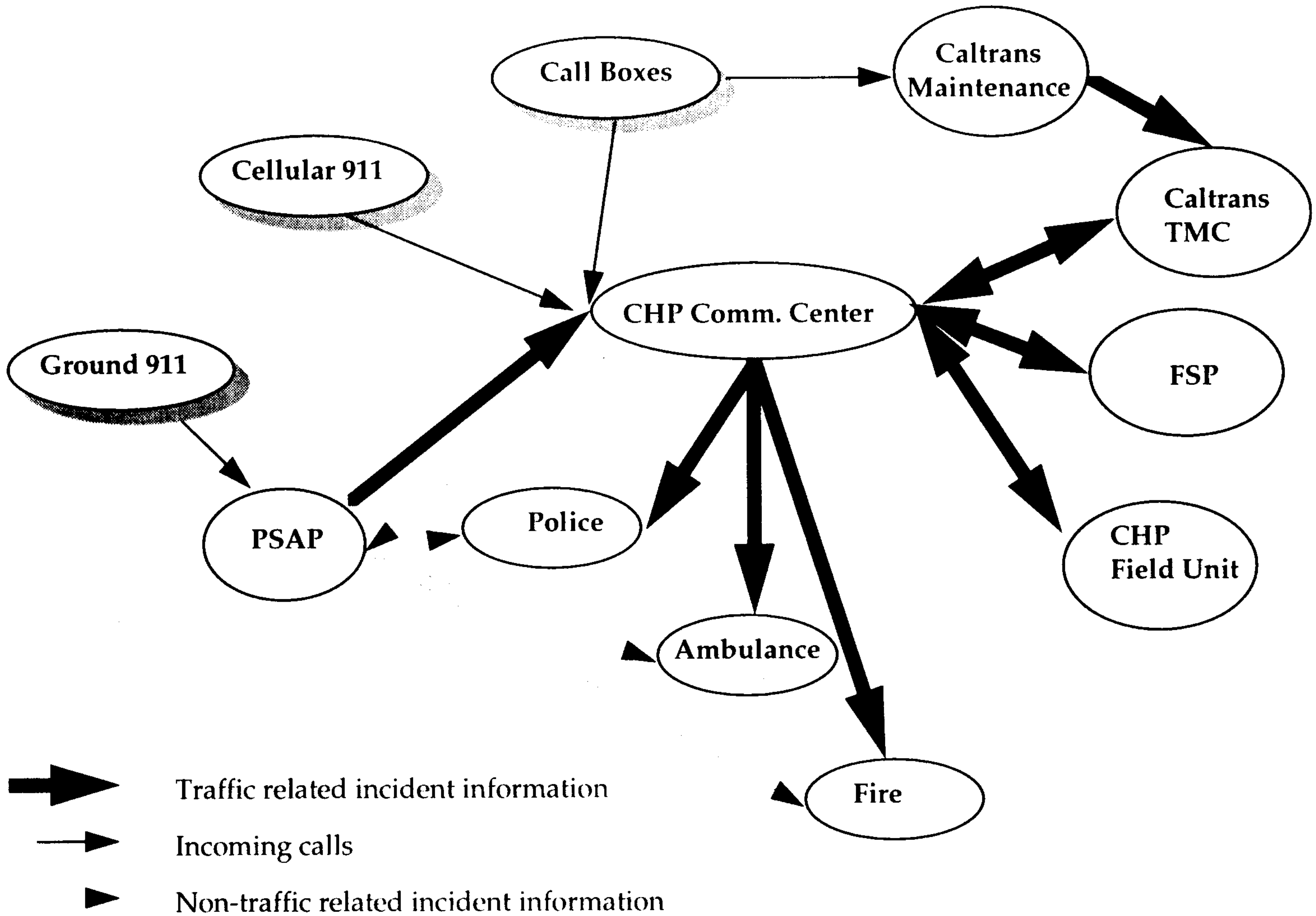

Figure 3 **Initiation of emergency services**

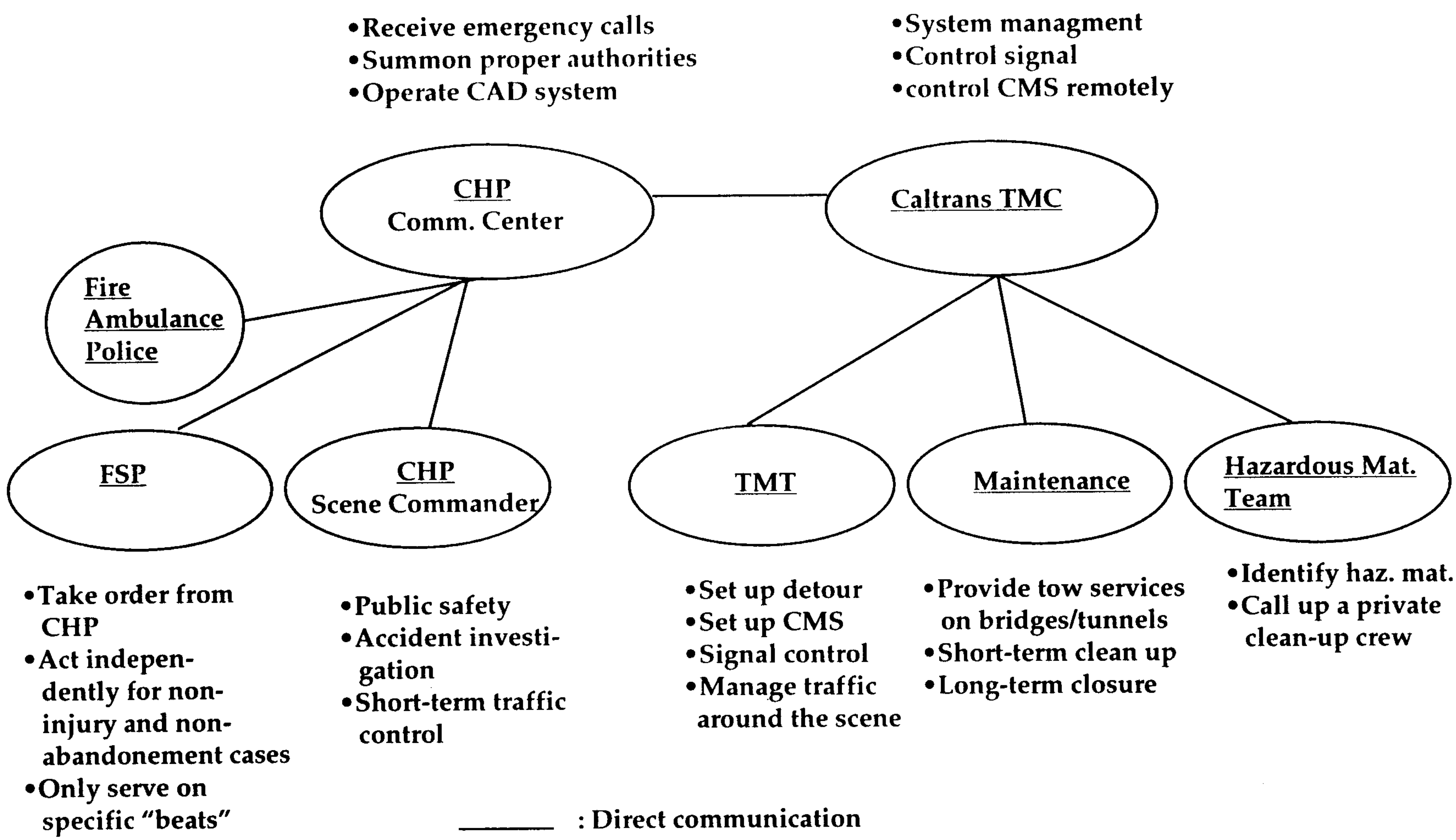

Figure 4 Agency responsibilities

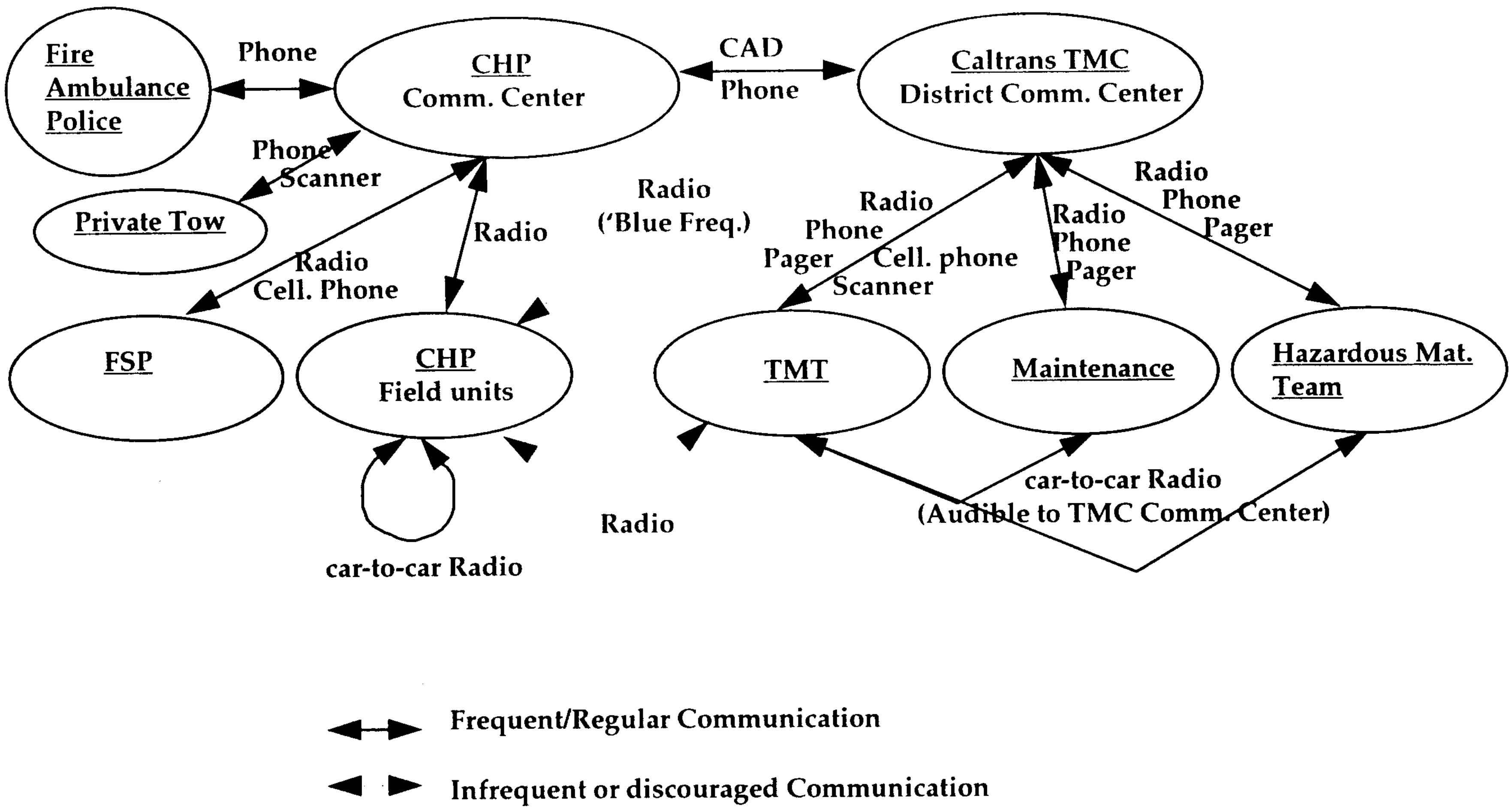

Figure 5 Utilization of Communication technologies

4. COORDINATION WITH TMC

The most important coordination between emergency agencies and TMCs is information exchanges pertaining to incident locations and severity, and to the dispatch of field units for incident clearance and short-term traffic management around the incident scene. To this end, the CHP CAD system, and phone and radio communications, are sufficient to accomplish this task. The emergency agencies do not see the need of any further or higher level of coordination level between CHP and TMC. Of course, in many situations, the co-location of CHP and Caltrans TMC also assists significantly in this coordination effort.

For disaster mode coordination, as mentioned in Section 3.1, Caltrans TMCs may reorganize themselves, or simply designate personnel to form an ICS structure in the near future. The goal of which is to allow personnel from different emergency agencies work together in short notice.

Regarding the use of real-time traffic information collected by Caltrans, most of the emergency agencies only use detour and lane closure information. CHP mentioned that it would be beneficial to their operations if Caltrans TMCs can provide routing service for response vehicles, supply road condition information, and disseminate incident information to the public. The Bay Bridge TMC also uses speed and volume data to alert the operator to potential incidents on the Bay Bridge. Other than these comments, our interviews indicated that emergency agencies expressed no strong desire for having real-time traffic information such as speed and volume data. Even if these real-time data are made available to them, in the short-term, it is not clear how they are able to use them.

5. ITS SERVICES DESIRED

Our study also interviewed the emergency agencies on what Intelligent Transportation System (ITS) services may be of value to their operations. Based on the 29 User Services as defined by the ITS National Program Plan (Euler and Robertson, 1995), we polled them based on these six related services: Incident Management (IM)[4], Emergency Vehicle Management (EVM)[5], Emergency Notification and Personal Security (ENPS)[6], Public Travel Security(PTS)[7], Hazardous Materials Incident Response (HMIR)[8], and Advanced Vehicle Safety Systems (AVSS)[9].

Unlike the interviews on existing practices, in which the emergency agencies provided a very consistent view, they responded differently to this set of questions. This is unsurprising since they have different roles in handling incidents, and perhaps there is no *long-term* plan to articulate an official view of these future emergency services. It should also be noted that during the interviews, cost and benefit estimates of these ITS services were not available to them. Their responses may have been different and perhaps more realistic if they could trade the value of these services in light of a set of realistic budgetary constraints. At any rate, these responses are summarized in Table 1.

Table 1 Value of ITS emergency services as viewed by the emergency agencies.

ITS Services	Caltrans Maintenance and TMC	CHP	County Sheriff's Department
Incident Management	"Most important"	"Extremely valuable"	"Very important"
Emergency Vehicle Management	"Not of interest"	"Not of immediate interest"	"Very high interest"
Emergency Notification and Personal Security	"Not of interest"	"Undecided"	"Not very important"
Public Travel Safety	"Not of interest"	"Not interested"	"High interest"
Hazardous Materials Incident Response	"Of great interest"	"Of great interest"	"High interest"
Advanced Vehicle Safety Systems	"Moderate interest"	"Of interest"	"Moderate interest"

[4] detects incidents and takes appropriate actions in response to them
[5] reduces the time from the receipt of notification of an incident to the arrival of the emergency vehicles on the scene, including fleet management, route guidance, signal priority
[6] sends immediate notification of an incident to response personnel, including manual initiation and automated collision notification
[7] supports the detection, identification, and notification of security incidents
[8] conveys a description of the hazardous materials carried on a vehicle after an incident has occurred
[9] focuses on increasing the safety and efficiency of vehicle operations

The views of Caltrans and CHP are similar in many areas. They expressed high interest in having incident management, hazardous materials incident response, and some interest in advanced vehicle safety systems, while expressed little interest in the other emergency services. Caltrans TMC is very interested in speeding up the detection of incidents. Although CHP expressed the same importance of its value, they are skeptical of how much improvement they can get. Currently, according to CHP, response time is very good: average phone wait time is about 56 seconds, and average FSP response time is about eight minutes (Skabardonis et al., 1995). In a similar way, Caltrans TMC personnel have doubts about the actual value of emergency vehicle management. They believe that the existing system already performs very close to what the ITS technologies could deliver. On emergency notification of Mayday signals, CHP is undecided on how helpful these notification would be. They are also concerned about false alarms that would burden their resources. About hazardous materials incident response, both CHP and Caltrans expressed high interest. However, CHP raised the questions about liability and public safety risks if the devices mis-identify or mis-communicate the nature of the spill, such as issuing "harmless" notification to actually hazardous materials.

For the county Sheriff's department, they expressed interest in every service except emergency notification and personal security. They did not feel that this service is important to the PSAP, and were concerned that not enough information (such as nature of incident, and incident confirmation) could be provided through such notifications. It seems that the service of emergency notification and personal security is especially not well-received by the public emergency agencies interviewed. None of them expressed desire to be receiving such emergency notifications.

Overall it seems that emergency agencies have reservations about the technologies to perform these ITS emergency services. For new proposed services, they are hesitant to include them to their operations. For existing services, they believe that their current operations are of sufficient quality, and that new technologies cannot improve their operations substantially.

6. NATIONAL ITS ARCHITECTURE

Since 1993, the United States Department of Transportation has chartered four teams (which was subsequently downselected to two teams--Loral and Rockwell--in 1995) to develop a National ITS systems architecture (NISA). Emergency management along with traffic management and 29 User Services (Euler and Robertson, 1995) are included as part of this national ITS architecture development effort. It is, therefore, timely and appropriate to compare and contrast the California emergency management system with the proposed national ITS architecture. It should be reminded that the national ITS architecture is currently being developed; as such, the version presented herein should not be viewed as final. This section attempts to bring to light similarities and differences between the California system and the national ITS architecture. Thereby, considerations and perhaps improvements to both approaches would be possible.

Figure 6 presents a simplified national ITS national Architecture framework, which portrays how the various components can be linked (ITS Teams, 1995). It should be noted that some components may not exist to date. The framework divides transportation related entities into four major subsystems: center, roadside, vehicle, and (traveler) remote access. Figure 6 highlights the communication approaches between these subsystems. The emergency management center is linked via wireline communications to other centers, and via wide area wireless communications to the emergency vehicle. At this level, the California emergency management system is entirely consistent with the NISA.

Table 2 illustrates the information flows between the emergency management center and related entities as represented in the NISA and the California system (CAS). The comparison indicates that, to a large degree, the existing CAS is consistent with the NISA, though the linkage between EMC and many entities (such as transit management center, commercial fleet management center) is not as close as represented by the NISA. In many situations, incident-based telephone contacts remain the major mode of communications in the CSA.

The comparison also illustrates three aspects that are relevant for system design considerations. The first pertains to the receipt of automatic MAYDAY notifications by the EMC. The NISA represents such a connectivity in its framework, whereas the CHP is skeptical of its value and is concerned about resources required to provide this service (Section 5). It would seem that the private sector (or the Independent Service Provider in the NISA) can play a role in this regard by charging a fee from the vehicle users for providing this service. The Independent Service Provider would receive these automatic MAYDAY notifications, confirm their accuracy and perhaps determine the location of the troubled vehicle, and then forward the incident information to CHP. For regional and national interoperability, a standard that involves MAYDAY notification is needed. How to and who will provide ubiquitous coverage including rural areas for the reception of MAYDAY notification is undetermined to date.

The second question pertains to the provision of routing service to emergency vehicles. The NISA indicates that such requests for the emergency vehicles can be either handled by the traffic management center or the independent service provider. This is consistent with our interview results that the emergency agencies do not have a strong inclination to process real-time traffic information themselves to route their vehicles. Moreover, since emergency vehicles are authorized to preempt traffic signals and other vehicle movements, it seems that routing service[10] is not on the emergency agencies' priority list. It is undecided as to how valuable is this service to the emergency agencies.

The third question regards the standardization of the coordination data among emergency agencies. For interoperability, the NISA encourages the establishment of standards for such communications. As can be seen in Table 2, the CHP CAD system has become the de facto coordination means between emergency agencies in California. Yet there is no standard established for inter-CAD communications. It is beneficial to have such standards established so that local PSAPs can link directly with CHP via their individual CADs. However, according to our interviews, it would seem like there is still a remote goal.

[10] Routes determined by normal traffic conditions may not be necessarily the best for emergency vehicles, which preempt other vehicles and traffic signals.

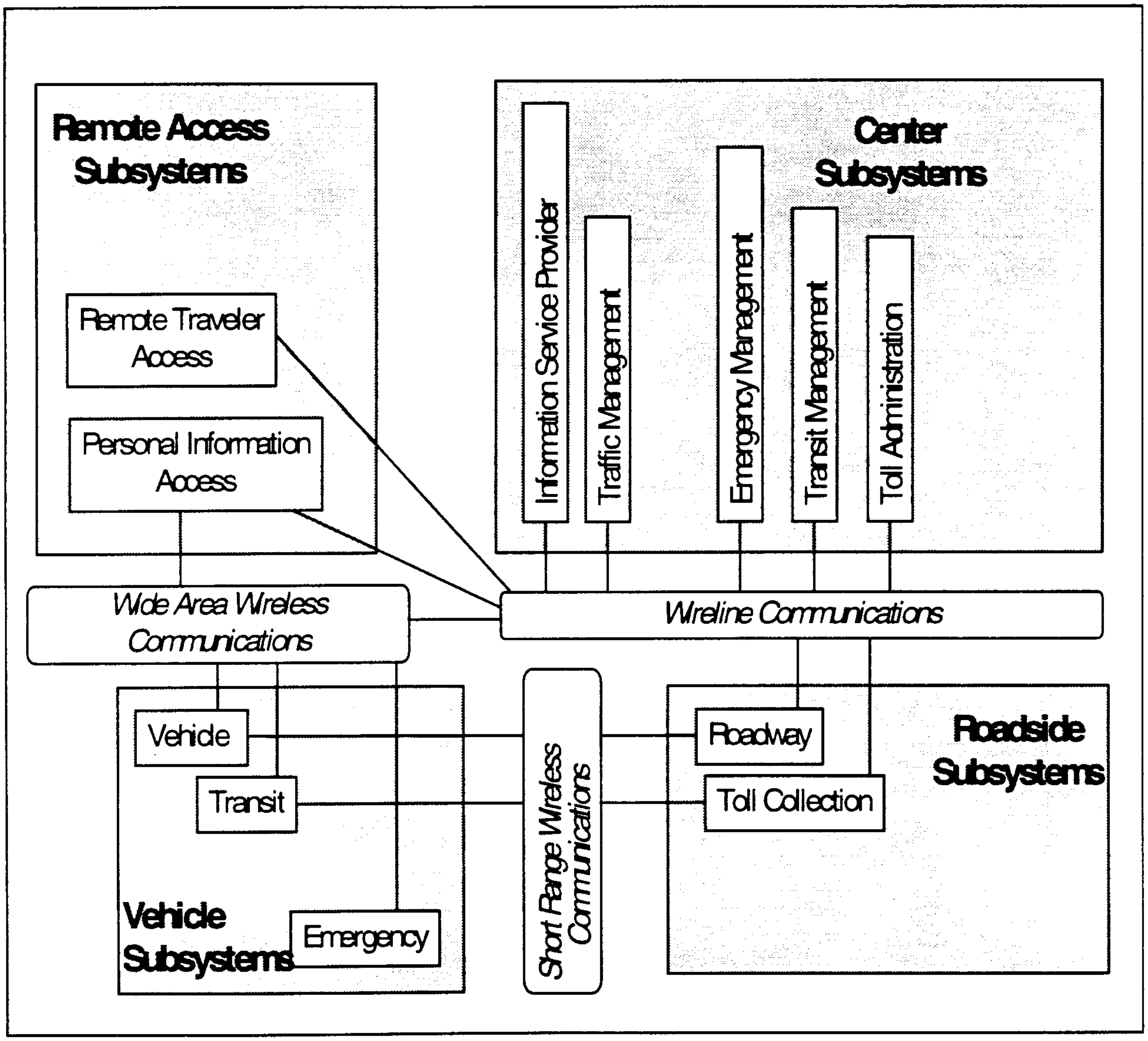

Figure 6 **A simplified national ITS architecture framework**

Table 2 Information flows between emergency management center (EMC) and other entities in the National ITS Systems Architecture and in the California system (CAS)

Other Entity	System	Information to EMC:	Information from EMC:
E911	NISA	Incident information	Emergency status
	CAS	Incident information from both groundline and cellular 911	None
Other Emergency Management	NISA	Emergency coordination data	Emergency coordination data
	CAS	Incident information shared via CHP CAD	Incident information shared via CHP CAD
Traffic Management	NISA	Support requests	Emergency status; request for emergency route
	CAS	Incident information collected by its field unit, CCTV, or loop data	Incident information shared via CHP CAD
Transit Management	NISA	Security alarms	Emergency status
	CAS	Phone calls	None
Fleet Management	NISA	Hazmat spill notification	Emergency status
	CAS	Phone calls	None
Independent Service Provider (ISP)	NISA	Emergency notification	Request for emergency routes
	CAS	ISP does not exist	ISP does not exist
Media	NISA	None	Incident information
	CAS	None	Incident information via CAD
Emergency vehicle	NISA	Emergency vehicle data	Emergency dispatch requests
	CAS	Incident conditions updated by field vehicles; AVL information	Emergency dispatch requests
Vehicle	NISA	Emergency notification Incident notification	Emergency status
	CAS	Cellular 911 calls report incidents; No automatic MAYDAY notification	CMS and HAR disseminate incident information (infrequent)
Commercial vehicle	NISA	Hazmat spill notification	None
	CAS	Cellular 911 call; No automatic MAYDAY notification	CMS and HAR disseminate incident information (infrequent)
Personal info. Access (PIA)	NISA	Emergency notification	Emergency status
	CAS	PIA does not exist	PIA does not exist
Remote Traveler Support (RTS)	NISA	Emergency notification	Emergency status
	CAS	RTS does not exist	RTS does not exist

7. SUMMARY REMARKS

Making Great Strides: California leads the nation in developing its emergency management system in many aspects. For example, the state leads the nation in providing ubiquitous coverage of E-911 service back in 1988; it is streamlining a unified command-and-control structure--Incident Command System--for all its emergency agencies, and is in the process of establishing Emergency Operations Centers or Emergency Resources Centers across emergency agencies. For day-to-day traffic incident management, CHP, Caltrans, and FSP work closely together. New technologies, such as automatic vehicle location and mobile data terminals (in Southern California) are being tested.

Assessing Existing Performance: Based on (Skabardonis, et al. 1995) and our interview results, we developed Figure 7 to illustrate the performance of the incident response procedure in the San Francisco Bay Area. Three time durations are depicted in Figure 7: (i) Incident detection and dispatch, defined as the time between an incident is notified (mainly through cellular 911 calls) and emergency dispatch, (ii) Emergency vehicle route travel, defined as the time between dispatch and arrival of emergency vehicle, and (iii) incident clearance, defined as the time between the arrival of emergency vehicle and incident clearance. These estimates are rough averages with high standard deviations. Nevertheless, they show that the overall performance of the system is reasonable. They also illustrate the areas that have high potential for improvement. Incident detection and dispatch already perform very well; it is difficult to find large improvements. On the other hand, emergency vehicle enroute travel and incident clearance times have higher potentials for improvement. Unfortunately, due to its scope, this study provided limited results to determine the amount of improvement possible with new technologies, such as route guidance and more advanced communication and coordination approaches. We leave this as a topic for further research.

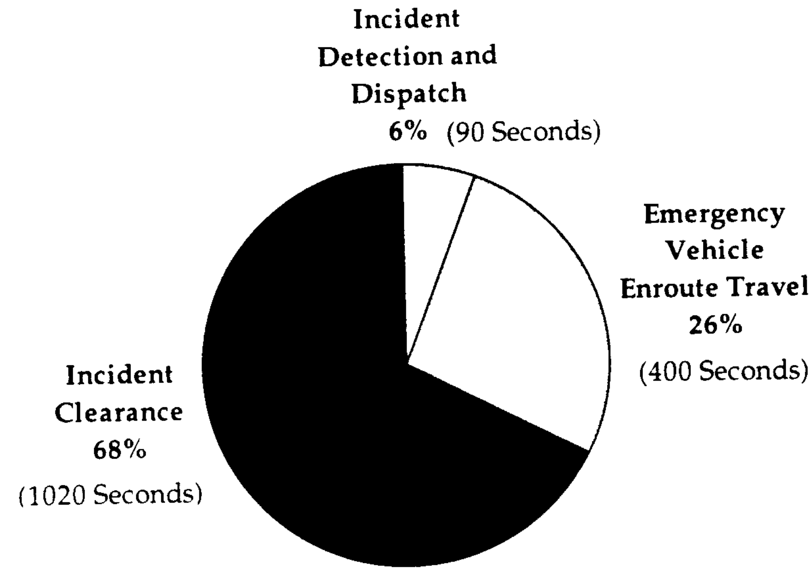

Figure 7 Time duration of the incident response components

Streamlining Dispatch Communication: One of the critical elements of incident clearance is the dispatch of heavy equipment via Caltrans Maintenance branch. This dispatch is initiated after emergency personnel arrive at the scene, who then determine the kind of equipment needed. It seems that streamlining the communication between Caltrans Maintenance and TMC, perhaps by unifying them to one dispatch/communication center, would be instrumental in reducing incident clearance time. Caltrans has started to implement this concept, as indicated in the new TMC in San Diego (Section 3.2.2).

Improving Coordination with cities: The CHP CAD is not connected to county or city CADs. And the city CADs themselves are unconnected with each other due to lack of standard communication protocols. During the course of the interviews, we found that communication or interaction between city traffic branches and Caltrans-CHP to be inadequate. An example quoted by an interviewee was that during a recent chemical spill on the Eastbound deck of the Bay Bridge, Caltrans--CHP did not at all inform the city of San Francisco so that they could redirect traffic; traffic headed for the Bay Bridge was gridlocked in their city streets for hours (City of San Francisco, 1995). Since then, Caltrans and the city of San Francisco have established a protocol to improve their communication. In general, the coordination between highway oriented emergency agencies and city ones can be improved substantially by simply setting up a communication procedure and mode between the involved agencies.

Ascertaining Coordination Level with TMC: The communication between TMC and emergency agencies exists primarily for updating incident status. The existing CHP CAD can more than adequately perform this task. Higher level of communication between them involving the use of real-time traffic information is not perceived as necessary by the emergency agencies. First, they do not want to handle large quantities of traffic data. Second, they do not believe this information can improve their emergency enroute travel time substantially.

Adding new functions and Technologies: Our interviews showed that emergency agencies are very cautious in expanding existing functions. In general, they expressed great concerns for receiving automatic emergency notifications from vehicles. Likewise, although they are experimenting with new technologies such as AVL and MDT, they are cautious in employing these technologies in a broad scale.

8. REFERENCES

Bassett, B. 1995. Interview results with Alameda County Sheriff's Department.

City of San Francisco. P1995. Public Works Department. Phone interview.

Clurman, C. 1988. Communities Scramble to Meet Call for 911: But It's Still a Long Distance From Universal. Governing. Vol. 1, No. 8, pp. 62-65.

Euler, G. And H. D. Robertson (Editors). 1995. National ITS Program Plan: Intelligent Transportation Systems. Washington, D.C.

Hicomp Report. 1992. Statewide Highway Congestion Monitoring Program. Caltrans. Division of Operations, Sacramento, CA.

ITS Teams. 1995. ITS Implementation Plan. Deliverable to FHWA for the National Systems Architecture Program.

Lindley, J.A. 1986. Qualification of Urban Freeway Congestion and Analysis of Remedial Measures, FHWA Report RD/87-052. Washington, D.C.

Hall, R., H. Lo, and E. Minge. 1994. Organizing for ITS: Computer Integrated Transportation Phase I: Results for Arterial and Highway Transportation Management Center. California PATH Research Report UCB-ITS-PRR-94-24.

Hall, R. and I. Chatterjee. 1995. Organizing for ITS: Computer Integrated Transportation Phase 2: Results for Commercial Vehicle Operations. California PATH Draft Working Paper D95-39.

Hickman, M., and T. Day. 1995. Information and Institutional Inventory of California Transit Agencies. California PATH Draft Working Paper. Forthcoming.

McDermott, J.M. 1975. Incident Surveillance and Control on Chicago Area Freeways. Transportation Research Board, Special Report 153: 123-140. Washington, D.C.

Pursell, Jim. 1995. Interview results with Caltrans Headquarters personnel.

Skabardonis, A, et al. 1995. Freeway Service Patrol Evaluation. California PATH Research Report UCB-ITS-PRR-95-5.

State of California. 1988. 9-1-1 Operations Manual. V Edition.

9. APPENDIX A EMERGENCY AGENCY SURVEY

Emergency Agency Survey

I. Contact Record

Agency Name: ______________________________

Person Contacted: ______________________________

Phone Number: ______________________________

Date: ______________________________

II. Introduction

We are conducting a survey for Caltrans, to assess how they can integrate their TMCs with the emergency agencies to provide more efficient and effective means for incident and/or emergency management for the road network. We will be asking questions about your use of information and information technologies for emergency management.

III. Functions Performed

(A) Incident Management

1. For each of the incident types below, define the role of your agency

Type	Role (Lead, Support--whom)	Responsibilities (e.g., incident clearance, manage traffic around scene, dispatch etc.	How do you become aware of this incident type?
(a) Accident			
(b) Vehicle breakdown			
(c) Signal Malfunction			
(d) HAZMAT			
(e) Health emergency			
(f) Flooding/blockages			
(g) Others			

2. *For each of the following responsibilities, whom do you coordinate with?*

Responsibility	**Coordinate with (e.g., CHP, police, fire, ambulance, tow trucks, HAZMAT, Caltrans Maintenance, public works, coroner, etc.)**
Clear incident	
Manage traffic	
Dispatch units	
Route units	
Preempt signal	
Others	

(B) Security

3. *For each of the security issues below, define the role of your agency.*

Type	**Role (Lead, Support--whom)**	**Responsibilities**
(a) Car-theft Tracking		
(b) Transit mayday - operator initiated		
(c) Transit mayday - passenger initiated		
(d) Others		

(C) Planned Events/Closures

4. *For each of the tasks below, define the role of your agency.*

Task	**Role (Lead, Support--whom)**
(a) Plan detour	
(b) Set up detour	
(c) Direct traffic	
(d) Control signals--manual	
(e) Control signals--automatic plan	

(f) Others	

(D) Disaster Response

5. *For each of the task(s) below, define the role of your agency.*

Type	Role (Lead, Support--whom)	Responsibilities
(a) Prepare plans		
(b) Act as Command and Control Center		
(c) Execute signals		
(d) Broadcast inf.		
(e) Broadcast route plans		
(f) Dispatch units		
(g) Others		

(E) Public Information

6. *What are the means of communicating the incident information to the public (if any)?*

(a) Via third party private information providers, e.g., COM TV. Specify: ________________ ; when: ________

(b) Via third party public information providers, e.g., TravInfo. Specify: ________________ ; when: ________

(c) Direct Dial-up line, via either voice or modem, when: ________________________________

(d) Direct broadcast, specify: CMS, HAR, TV, Radio, ________________ ; when: ________________

(e) Others, specify: ____ ; when: ________________

(F) Other functions not covered

____

____

____

____

IV. Channels of Communication

(A) Handling 911 Calls

7. *What kinds of calls do you handle?*

(a) Cellular

(b) Ground-line

8. *Is your system "enhanced 911"?*

(a) Yes

(b) No

9. *Are you the Public Safety Answering Point (PSAP) for your area?*

(a) Yes

(b) No

10. *If your center is the PSAP, what agencies are connected to your center?*

____

____

11. *If your center is not the PSAP, which PSAP is connected to your center?*

____

12. *How do you prioritize calls?*

____

____

13. *How do the PSAP's communicate with each other and under what conditions?*

(a) Communication medium: ____________________

(b) How often/when: ____________________

(c) Information contents: ____________________

(d) Conditions: ____________________

14. *How do the PSAP's communicate with the emergency operations center and under what conditions?*

(a) Communication medium: ____________________

(b) How often/when: ____________________

(c) Information contents: ____________________

(d) Conditions: ____________________

<u>(B) Dispatching Response Units</u>

15. *Which response unit(s) do you dispatch?*

(a) CHP

(b) Police

(c) Ambulance

(d) Fire

(e) Coroner

(f) HAZMAT

(g) Tow truck

(h) Others, specify: ____________________

16. Do you assign the units to respond to an incident?

(a) No

(b) Yes, is there any automated system that helps you do that? Specify below.

____

____

17. Is your center in charge of any incidents (to be defined in question 18) at the scene?

(a) No, go to Question 19

(b) Yes, go to Question 18

18. If your center is in charge of the incident at the scene, specify the incident type and how do you dispatch the response units, such as tow trucks, fire, ambulance?

(a) Specify the incident type: ______________________________

(b) Direct communication lines, specify: ______________________________

(c) Via remote communication centers, specify: ______________________________

(d) Others, ______________________________

19. In the case of an incident, do you communicate ***directly*** *with the officer in charge of the scene, and how?*

(a) No, but indirectly via ______________________________

(b) Yes, via (what comm. means and medium?) ______________________________

20. Do you provide routing services to the response units?

(a) No

(b) Not directly but via third party routing services providers, specify ______________________________

(c) Yes, specify how:

____

____

____

(C) Coordinating with Transportation Management Centers

21. Do you communicate with any transportation management centers (TMCs)? Which ones? And what information is exchanged? What is the data format for exchange?

(a) No

(b) Yes, which one: ______________________

How often/when: ______________________

Information exchanged: ______________________

Data Format: ______________________

22. Do you see any needs for having traffic information? If so, what kind of data?

(a) No

(b) Yes, specify: ______________________

23. Do you see any needs for working with the TMCs? If so, for what functions?

(a) No

(b) Yes (e.g., providing routing service for the response vehicles, preempting signals, etc.)

Specify: ______________________

____

(D) Coordinating With Neighboring Agencies

24. If an incident occurs at the boundary of regions, how do you coordinate with the neighboring agencies?

(a) Based on established agreements and procedures

(b) Based on ad-hoc procedures

(c) Others, specify: ______________________

____

____

25. *Under what circumstances do you coordinate with neighboring agencies?*

(a) Major disasters

(b) Others, specify: ________________________________

____

____

V. Use of Technologies

(A) Communication Technologies

26. *How do you communicate with the response units or vehicles?*

(a) Cellular phone

(b) Radio

(c) Mobile data unit, specify: ______________________________

(d) Others: ____________________________________

27. *How do you communicate with other emergency centers during incidents?*

(a) Phone (cellular/ground-line?)

(b) Radio

(c) Linked computer networks, specify: ________________________

(d) Others: ____________________________________

____

28. *How do you communicate with TMCs?*

(a) Phone (cellular/ground-line?)

(b) Radio

(c) Linked computer networks, specify: ________________________

(d) Others: ____

____

(B) Mobile Computers (In-Vehicles)

29. Are response units (vehicles) equipped with computers?

(a) No

(b) Yes, describe what functions/information they have:

____

____

____

(C) Automatic Vehicle Location (AVL) Technologies

30. Are response units (vehicles) equipped with AVL technologies?

(a) No.

(b) Yes, describe how the system works (e.g. via GPS, etc.): ______________________

____

31. How is the AVL information used?

(a) Dispatch

(b) System performance evaluation

(c) Others: ____

(D) Database

32. What information is available on screen for E911 calls?

(a) Address of caller

(b) Phone number of caller

(c) Others: ____________________

33. *What information is collected and stored in the database?*

(a) Call time

(b) Response time (?)

(c) Response unit (?)

(d) Others: ____________________

____

34. *Who maintain the database for E911 calls? How often do they update it? Is it accurate?*

____

____

____

35. *How do you or who maintain the database for agency call forwarding?*

____

____

____

36. *What kind of data do you archive? How long do you store them?*

____

____

____

37. *How and when will you use the archived database?*

____

____

____

VI. Intelligent Transportation System User Services

For each of the following: will provision of the service have a significant impact on your operations. What is the impact, and why?

38. *Incident Management, enhances existing capabilities for detecting incidents and taking appropriate actions in response to them*

____

____

39. *Emergency Vehicle Management, oriented toward reducing the time from the receipt of notification of an incident by a PSAP operator to the arrival of the emergency vehicles on the scene. It consists of three subservices: emergency vehicle fleet management, route guidance, signal priority.*

____

____

40. *Emergency Notification and Personal Security, sends immediate notification of an incident to response personnel. It includes two subservices: manual initiation, automated collision notification.*

____

____

41. *Public Travel Security, supports innovative application of technology to improve the security of public transportation. It includes the detection, identification, and notification of security incidents.*

____

____

42. *Hazardous Materials Incident Response, provides for a system to convey a description of the hazardous materials carried on a vehicle after an incident has occurred.*

____

____

43. *<u>Advanced Vehicle Safety Systems</u>, contains seven services that focus on increasing the safety and efficiency of vehicle operations.*

____

____

VII. Agency Profile

Questions regarding your service area:

44. *What is the size?* ______________ (Sq. miles)

45. *What is the population?* ______________

46. *How many fire departments?* ______________

47. *How many police departments?* ______________

48. *How many miles of freeway?* ______________

49. *How many response units (vehicles)?* ______________