University Transportation Research Center - Region 2

Final Report

Integrated Incident Management System (IIMS) Web Client Application Development, Deployment and Evaluation: An Evaluation of a Potential IIMS Deployment in Western New York

Performing Organization: State University of New York (SUNY)

September 2015

Sponsor:
New York State Department of Transportation (NYSDOT)

University Transportation Research Center - Region 2

The Region 2 University Transportation Research Center (UTRC) is one of ten original University Transportation Centers established in 1987 by the U.S. Congress. These Centers were established with the recognition that transportation plays a key role in the nation's economy and the quality of life of its citizens. University faculty members provide a critical link in resolving our national and regional transportation problems while training the professionals who address our transportation systems and their customers on a daily basis.

The UTRC was established in order to support research, education and the transfer of technology in the field of transportation. The theme of the Center is "Planning and Managing Regional Transportation Systems in a Changing World." Presently, under the direction of Dr. Camille Kamga, the UTRC represents USDOT Region II, including New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. Functioning as a consortium of twelve major Universities throughout the region, UTRC is located at the CUNY Institute for Transportation Systems at The City College of New York, the lead institution of the consortium. The Center, through its consortium, an Agency-Industry Council and its Director and Staff, supports research, education, and technology transfer under its theme. UTRC's three main goals are:

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Principal Investigator(s):
Adel Sadek, Ph.D.
Professor
Institute for Sustainable Transportation & Logistics
University at Buffalo
Buffalo, NY 14260
Tel: (716) 645-4367
Email: asedek@buffalo.edu

Andrew Bartlett M.Sc.
Graduate Research Assistant
Department of Civil, Structural and Environmental Engineering
University at Buffalo
Buffalo, NY 14260

Carl Hempel, M.Sc.
Graduate Research Assistant
Department of Civil, Structural and Environmental Engineering
University at Buffalo
Buffalo, NY 14260

Performing Organization(s):
State University of New York (SUNY)

Sponsor(s):
New York State Department of Transportation (NYSDOT)

To request a hard copy of our final reports, please send us an email at utrc@utrc2.org

Mailing Address:

University Transportation Reserch Center
The City College of New York
Marshak Hall, Suite 910
160 Convent Avenue
New York, NY 10031
Tel: 212-650-8051
Fax: 212-650-8374
Web: www.utrc2.org

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Wei Hao*: Research Fellow*

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16. Abstract

Incident Management (IM) is an area of transportation management that can significantly decrease the congestion and increase the efficiency of transportation networks in non-ideal conditions. In this study, the existing state of the Integrated Incident Management System (IIMS) is reviewed, additional user requirements and applications are identified, potential obstacles to successful deployment are discussed, and identification of future steps towards deployment in western New York are determined. This is done through working with incident management organizations, reviewing other existing systems, and researching the potential of IIMS through use of the system.

The main conclusions found are that:
1) The IIMS system has potential to greatly enhance coordination between agencies and that greater integration with existing systems will speed adoption;
2) The IIMS application would have several advantages such as easier incident reporting, decreased maintenance and expansion costs, and the ability to take real-time photos and video;
3) The primary obstacles to deployment are the difficulties with sharing sensitive information (i.e., privacy concerns) and the integration of existing similar and legacy transportation management systems used by the several agencies, along with a lack of deployed hardware for mobile clients;
4) Among other challenges are the need for personnel training, and the lack of screen space on the hand-held clients which precludes the entry of additional desirable information fields;
5) Among the future potential applications and benefits for IIMS include are:
a. Expanded incident coverage;
b. Access to archived incident data for research and training
c. Integration with existing software reducing re-training requirements

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Integrated Incident Management system (IIMS) Web Client Application Development, Deployment and Evaluation

An Evaluation of a Potential IIMS Deployment in Western New York

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Edward Mark

New York State Department of Transportation

Region 11

Prepared By

Evaluation Team

Adel W. Sadek, Ph.D.

Professor of Civil, Structural and Environmental Engineering

Director, Institute for Sustainable Transportation & Logistics

Director, Transportation Informatics University Transportation Center

Carl Hempel, M.Sc.

Graduate Research Assistant

Department of Civil, Structural and Environmental Engineering

Andrew Bartlett, M.Sc.

Graduate Research Assistant

Department of Civil, Structural and Environmental Engineering

University at Buffalo, the State University of New York

Buffalo, NY 14260

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DEFINITIONS OF TERMS

ATM	-	Active Traffic Management
AVL	-	Automatic Vehicle Location
C2C	-	Center to Center
CAD	-	Computer Aided Dispatch
CCTV	-	Closed-Circuit TeleVision
CHART	-	Coordinated Highways Active Response Team
COC	-	Certificate Of Commitment
CORBA	-	Common Object Request Broker Architecture
DOT	-	Department Of Transportation
EMS	-	Emergency Medical Services
EOC	-	Emergency Operations Center
FEMA	-	Federal Emergency Management Agency
FIMS	-	Freeway Incident Management System
FHWA	-	Federal Highway Administration
FOIL	-	Freedom Of Information Legislation
GDIT	-	General Dynamics Information Technology division
GIS	-	Geographical Information System
GPRS	-	General Packet Radio Service
HTTP	-	Hyper-Text Transfer Protocol
HTTPS	-	Hyper-Text Transfer Protocol Secure
ICM	-	Integrated Corridor Management
I3B	-	Intelligent Information Integration Broker

IEN - Information Exchange Network

IEEE 1512 - Institute of Electrical and Electronics Engineers -

Incident Management Working Group

IM - Incident Management

IIMS - Integrated Incident Management System: developed for NYSDOT by GDIT

IT - Information Technology

ITE - Institute of Transportation Engineers

ITS - Intelligent Transportation Systems

TMDD - Traffic Management Data Dictionary

TOC - Traffic Operations Center

TRB - Transportation Review Board

MAC address - Media Access Control address

MMS - Multimedia Messaging Service

MOU - Memorandum Of Understanding

MTA - Metropolitan Transportation Authority

NIMS - National Incident Management System – run by FEMA

NITTEC - Niagara International Transportation Technology Coalition

NTCIP - National Transportation Communications for ITS Protocol

NYC - New York City

NYPD - New York Police Department

NYS - New York State

NYSDOT - New York State Department of Transportation

NYSTA - New York State Thruway Association

OER - Office of Emergency Response

OEM	-	Office of Emergency Management
PD	-	Police Department
PMS	-	Public Messaging Systems
RSDA	-	Road Side Damage Assessment: developed by NYSDOT for damage assessment
UB	-	University at Buffalo, The Sate University of New York at
WAIMSS	-	Wide Area Incident Management Decision Support Software
WNY	-	Western New York
WNYTIM	-	Western New York Transportation Incident Management group from NITTEC
XML	-	eXtensible Markup Language

ABSTRACT

Incident Management (IM) is an area of transportation management that can significantly decrease the congestion and increase the efficiency of transportation networks in non-ideal conditions. In this study, the existing state of the Integrated Incident Management System (IIMS) is reviewed, additional user requirements and applications are identified, potential obstacles to successful deployment are discussed, and identification of future steps towards deployment in western New York are determined. This is done through working with incident management organizations, reviewing other existing systems, and researching the potential of IIMS through use of the system. The main conclusions found are that:

1) The IIMS system has potential to greatly enhance coordination between agencies and that greater integration with existing systems will speed adoption;
2) The IIMS application would have several advantages such as easier incident reporting, decreased maintenance and expansion costs, and the ability to take real-time photos and video;
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4) Among other challenges are the need for personnel training, and the lack of screen space on the hand-held clients which precludes the entry of additional desirable information fields;

5) Among the future potential applications and benefits for IIMS include are:

    a. Expanded incident coverage;

    b. Access to archived incident data for research and training

    c. Integration with existing software reducing re-training requirements

In terms of potential pilot implementation of the IIMS in western New York, it is recommended that such a pilot implementation involve the Amherst Police Department and the New York State Department of Transportation, with additional support from the Niagara International Transportation technology Coalition (NITTEC), due to application's usefulness to their organizations. A possible geographic location could be the town of Clarence, New York using NITTEC for hosting the server. An example for a Commitment of Cooperation or Memorandum of Understanding between the agencies involved was also developed to encourage the different agencies to consider how to best integrate IIMS into their programs.

1. INTRODUCTION AND MOTIVATION

Generally speaking, Incident Management (IM) is a process designed to provide a clear chain of command and help in the communication necessary to resolve incidents quickly. At the national level is the National Incident Management System (NIMS) which is used to "provide a systematic, proactive approach to guide departments and agencies at all levels of government, nongovernmental organizations, and the private sector to work seamlessly to prevent, protect against, respond to, recover from, and mitigate the effects of incidents, regardless of cause, size, location, or complexity, in order to reduce the loss of life and property and harm to the environment"(Chertoff, 2008).

In transportation, incident management is used extensively for road safety, event planning, and reducing congestion through reduced secondary accidents and decreased incident duration. Incident duration is composed of the detection time, the response time, clearance time, and recovery time. The recovery time is a function of the length of the queue formed by the reduced capacity of the roadway. Reducing the incident detection time, response time, and clearance time, has a greatly increased effect because it also reduces the recovery time for the roadway.

One of the biggest challenges and priorities in Incident Management (IM) is communication among the various involved agencies. Traffic Operations Centers (TOC) are set up in most metropolitan areas to help the responding agencies communicate to coordinate traffic, detect incidents, and manage disruptions and congestion in traffic flow from accidents, planned events,

weather events, and other unforeseen circumstances.

1.1. Causes of congestion

All congestion can be broadly categorized as either recurring or non-recurring congestion. Recurring congestion occurs consistently due to over-saturation of the roadway – having traffic volume greater than the capacity. Non-recurring congestion can be caused by severe weather and incidents – events that cause a reduction in the operating condition, speed, and/or capacity of the roadway that do not happen on a recurring basis. Car accidents, vehicle breakdowns, and other vehicle related problems are classified as incidents.

Fifty percent (50%) of all traffic congestion is non-recurring and about half of that amount, 25% of all congestion, is due to traffic crashes – incidents (Helman, 2004). Traffic incidents impact traffic far more than just the reduction in lanes alone would indicate. For example an incident blocking one of three lanes will reduce the capacity of the roadway by 50%.

Reducing incident frequency, severity, and duration can reduce not only transportation injuries, but also traffic congestion, and therefore the environmental and financial damages due to lost fuel and time respectively.

1.2. Incident Duration and its Components

There are four components of incident duration that are tracked in transportation incidents: Incident detection time, incident response time, incident clearance time, and the recovery time.

Figure 1.2-1 below gives a graphical view of the four components.

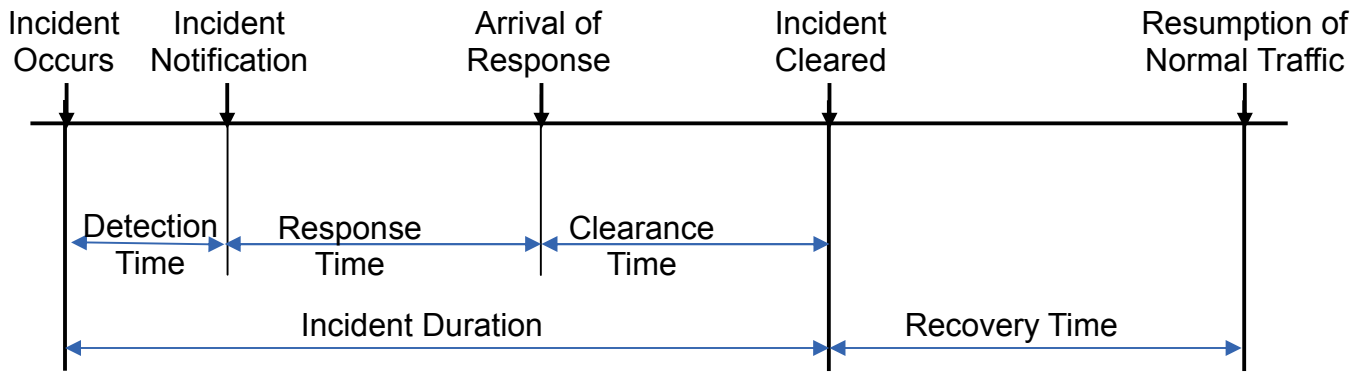


Figure 1.2-1: Incident Time Structure

Incident detection and verification time is the time it takes from the start of the incident until it is detected and verified. Incidents are detected primarily through police responding to a scene, bystanders calling them in to the TOC and through the use of traffic cameras - where they are available.

After an incident is detected, the response time quantifies the amount of time it takes for the first responders dispatched by the TOC or another organization to arrive and begin responding to the incident.

When the response team arrives, the process of clearing the roadway begins. The clearance time is the time it takes to clear the incident from the road and return the traffic to pre-incident traffic flow. This involves reopening any closed lanes and bringing the roadway capacity back to the

original pre-incident traffic flow. Further cleanup may continue off the roadway on a shoulder.

After an incident has been cleared, and all lanes are opened back up it takes time for traffic to resume normal operation, this is referred to as the recovery time. Due to the capacity being reduced, by blocked lanes and shoulders and reduced visibility or safety conditions, to below the demand volume, queues form that can take a long time to clear.

Reducing the detection, verification, response, and clearance time has a greatly increased impact in that a reduced incident duration decreases the recovery time as well, due to the shorter queue lengths waiting to be cleared. It is for achieving that goal of reduced incident duration through more effective communications and incident management that the Integrated Incident Management Systems (IIMS), the focus of this study, was developed.

1.3. Purpose and Scope

The purpose of this research is to reach out to stakeholders to evaluate the potential usefulness of the Integrated Incident Management System (IIMS) in the Western New York (WNY) region. IIMS is an Incident Management (IM) system that works to integrate existing traffic management software to increase the efficiency of operation and coordination between traffic management agencies by keeping their traffic management systems in sync with each other and adding the capability for users in the field to detect and verify incidents. IIMS was first deployed in Staten Island in New York City (NYC), and since then is being expanded to cover other areas of the city and state.

The study also aims to determine any additional user requirements of the incident management organizations of WNY, and to identify other potential applications, obstacles, and further steps necessary to a deployment in the upstate/WNY region. These are the three tasks this research aims to address.

1.3.1. The stakeholder outreach in WNY.

Stakeholder outreach is important for building buy-in in the region, to build awareness of the usefulness and functionality, and to get feedback on ease-of-use. Buy-in is critical for the success of the deployment. If the software does not get buy-in, it will not be used by the transportation organizations and will quickly fail to be used by enough agencies to be useful. The more organizations using it the more useful it becomes. Awareness of the software's capabilities and ease-of-use are also critical to the success of the project.

1.3.2. Define Additional User Requirements for IIMS in Upstate/WNY

Being deployed in a very different area from prior phases of development, which were in urban NYC, the user requirements for IIMS in upstate/WNY need to be identified. This is needed in order to ensure maximum usage and usefulness of IIMS by the WNY transportation management agencies.

1.3.3. Identify Potential Obstacles, Applications and Deployment Locations for IIMS in WNY

Finding obstacles, potential applications, and deployment location for IIMS in WNY are critical for the future deployment to ensure a smooth launch, and increase the usefulness of the software.

In NYC, the NYC Department Of Transportation (DOT) Office of Emergency Response (OER) found IIMS could be adapted to track and manage highway maintenance issues. Other areas of potential application native to the upstate/WNY region would greatly increase the benefits of the system to the stakeholders.

Identifying the appropriate deployment location for IIMS in WNY can further spur the use of IIMS provided the host location is trusted and has good relationships with the other agencies and potential users of the system.

1.4. Significance of Research

This research is additive and significant to the body of knowledge in transportation engineering for four reasons. First, it is the only known review of IIMS in the Buffalo-Niagara region. Second, it is the first review of the mobile clients utility and usefulness in New York State (NYS). Third, it evaluates other potential uses for incident management software by transportation and incident response agencies. Fourth, it outlines a possible plan of action for deploying an IIMS pilot in WNY.

1.5. Organizational Overview

This report is composed of 7 sections. Section 1 gives an introduction and the motivation for the research. Section 2 contains the literature review which reviews and presents the existing state of practice in incident management systems and technology. Section 3 covers the

methodology applied to find the results. Section 4 details the result of the study. Section 5 goes over the conclusions and areas where future work could be done. Sections 6 and 7 contain the references and appendices, respectively.

2. LITERATURE REVIEW

The following is a review of (1) the Integrated Incident Management System (IIMS), (2) traditional freeway incident management systems, (3) the costs and benefits of the traditional system, (4) some examples of other non-traditional freeway incident management systems and programs, (5) mobile technologies used in incident management, (6) active traffic and integrated corridor management strategies, (7) integration of other systems with IIMS, and finally (8) a summary of the review.

2.1. Integrated Incident Management (IIMS)

IIMS was developed, starting originally in New York City (NYC), through funds from USDOT and New York State Department of Transportation (NYSDOT). The system is being developed by General Dynamics Information Technology (GDIT) division, and is managed by NYSDOT in partnership with New York Police Department (NYPD), NYC DOT, NYC Office of Emergency Management (OEM). Several other city and state agencies are also part of the system. (Mark, 2004).

Phase 1 began field testing in July 2001 and developed the basic capabilities needed – allowing for the creation of incidents and sharing of pictures and location information. Phase 2 rolled out changes supporting all aspects of incident management including merges and splitting of incidents. Phase 2c further expanded the system allowing for filtering of incidents and use of eXtensible Markup Language (XML) for communication via the IEEE 1512 standards. Phase 2d

began the development of the blackberry hand-held application. Current efforts are focused on the further refinement and usability of the system and development of both a mobile client (i.e., blackberry, Android and iphone) and a web-based client, allowing first and second responders to create incidents from anywhere. (Research, 2012)

The system is designed around incidents, once an incident is created by a user or agency, the incident is not considered completely closed until all agencies close it down. This allows for example a police officer who first arrives at the scene to open an incident, update with information while on scene, and then upon leaving the scene to close his interaction with it. The incident itself continues as other agencies such NYSDOT may continue to update with infrastructure damage repair information until they are done at the site. This allows each agency to coordinate and update the incident with information specific to their responsibilities.

Figure 2.1-1 below shows the architecture of the system in NYC, and illustrates how IIMS helps to sync incidents between the city agencies and NYSDOT. In NYC the system plan was to use IIMS to keep incidents synced originally between TRANSCOM RA, SMARTS, and IIMS. IIMS collects the mobile incident information, SMARTS used in the TOC then serves as the "gateway interface" to confirm and merge incidents, and finally TRANSCOM RA interfaces with the infrastructure for sensors and controlling Intelligent Transportation Systems (ITS) in the field. TRANSCOM RA has since been replaced by NY Open Reach, and integration is planned for the future. (Russ & Brundage, 2013)

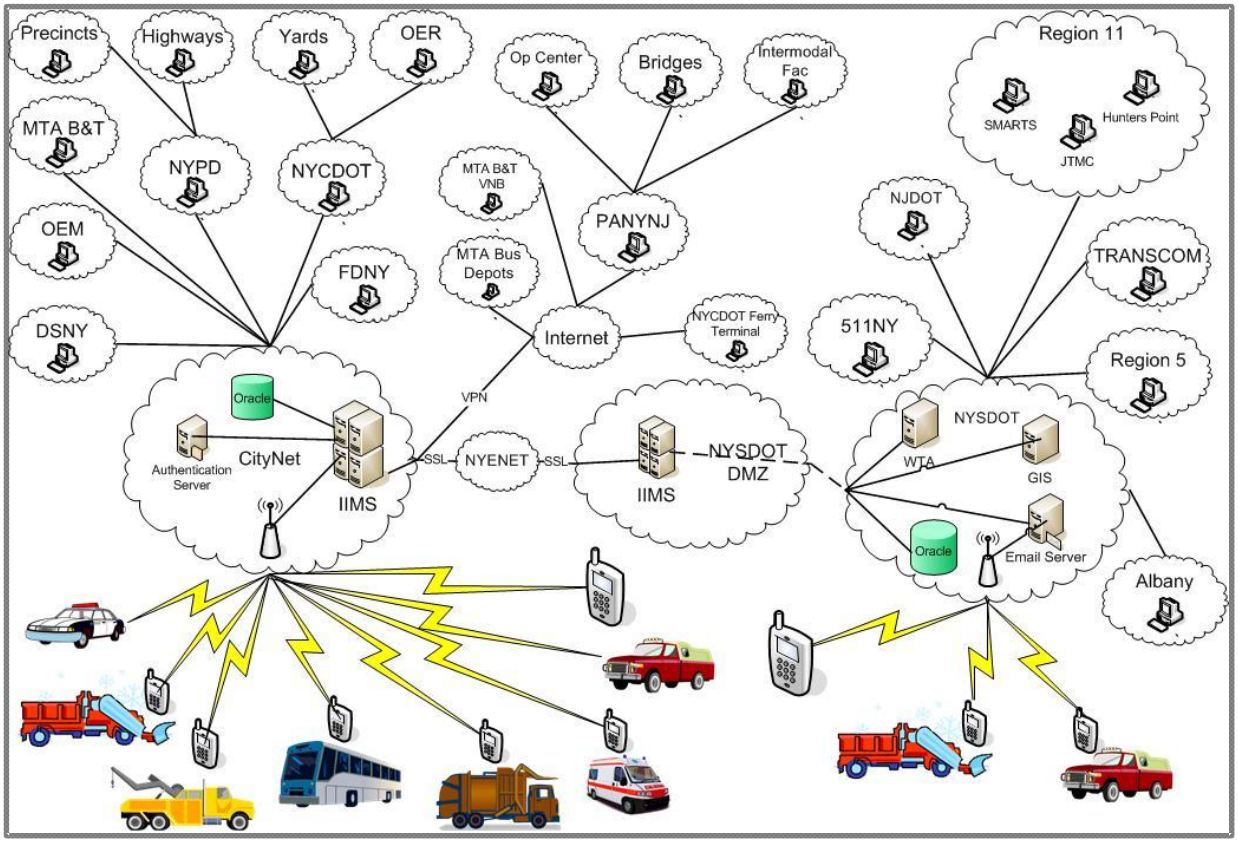


Figure 2.1-1: IIMS Architecture (General Dynamics Information Technology, 2012)

IIMS's interface was originally built around a local unit and a mobile unit (Newton, Owens, Carter & Mitchel, 2007); these are currently being replaced by a web and several mobile clients. The local units are stationary work stations at incident management centers that allow the managing of incidents. Figure 2.1-2 below shows a screen shot of the local unit.

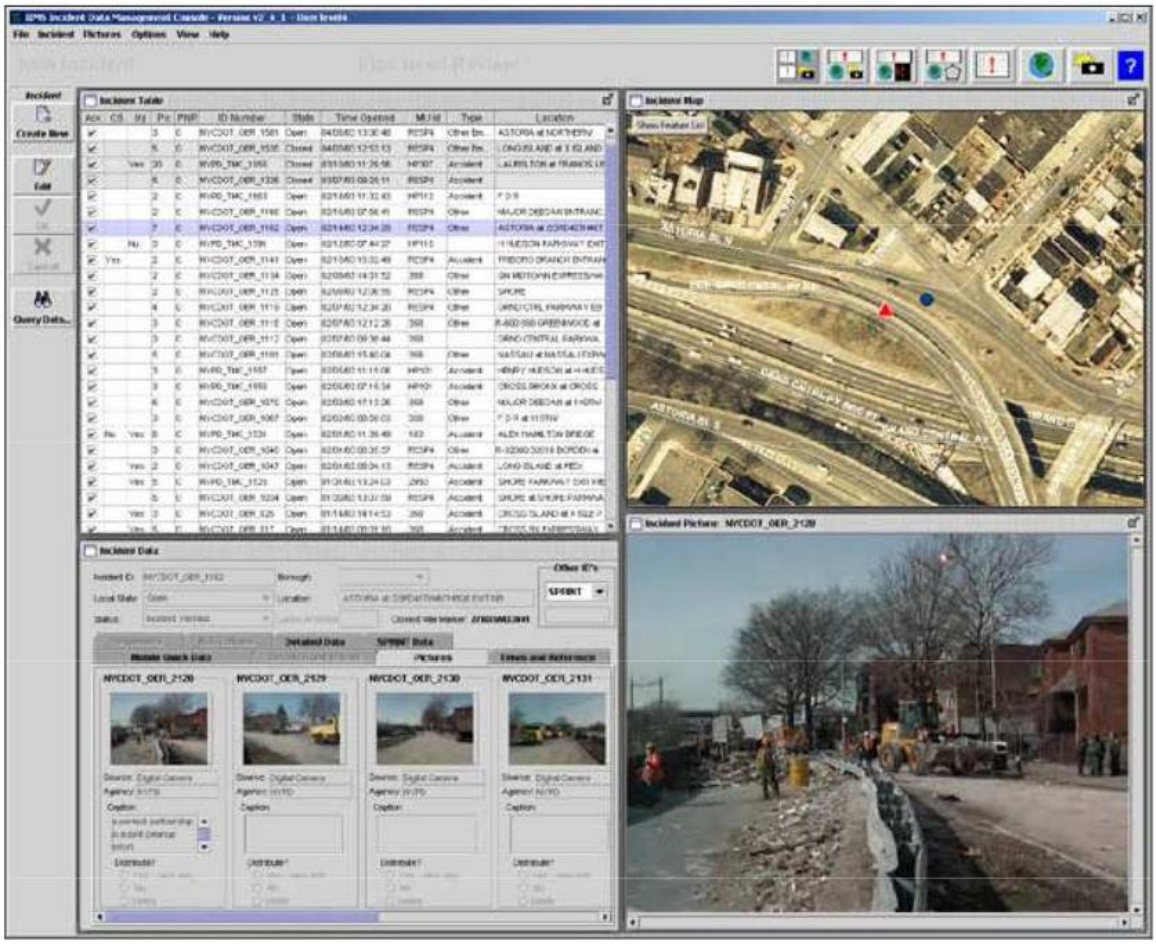


Figure 2.1-2: IIMS Local Unit Screen Shot

The mobile unit consists of a touchscreen display connected to a computer, GPS, camera, and keyboard to allow the user to enter information on the incident at the scene including the incident type, photos, and details on lanes blocked, injuries etc.

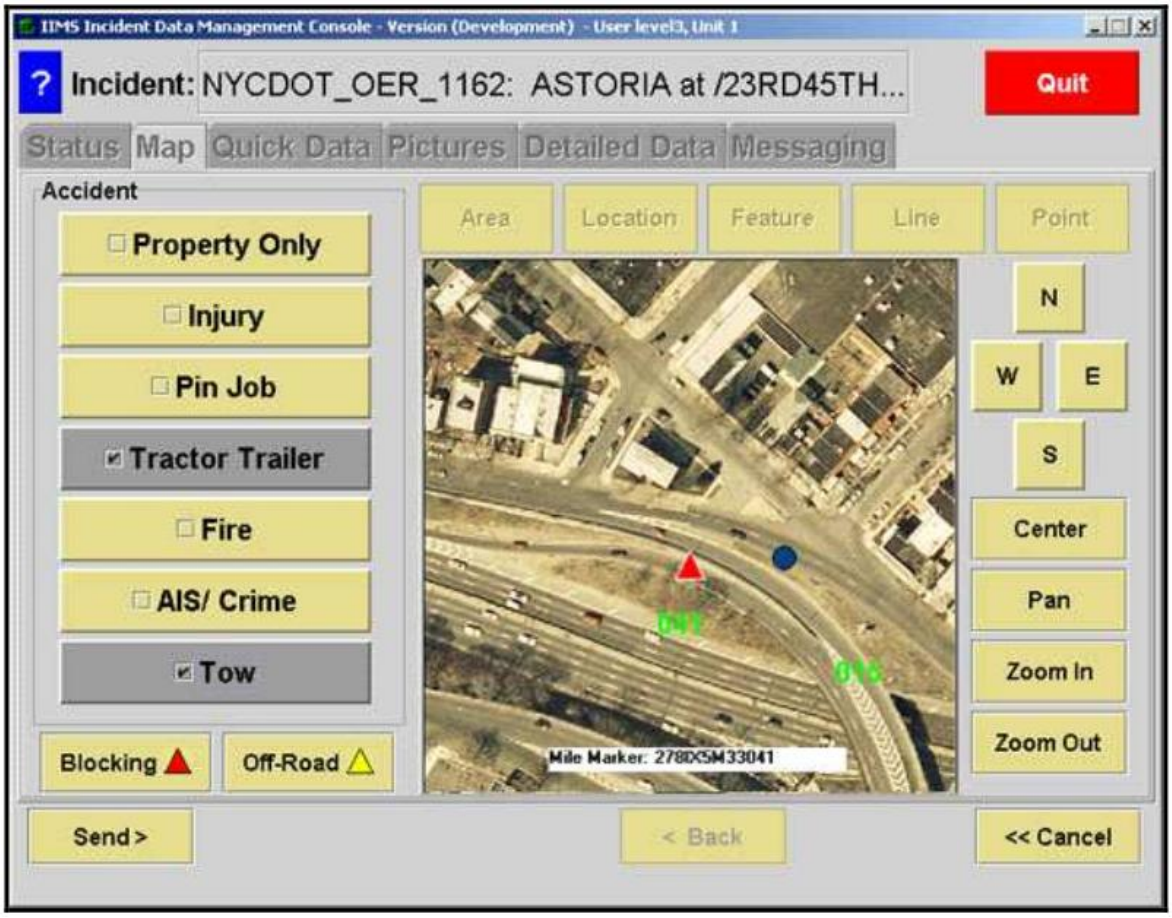


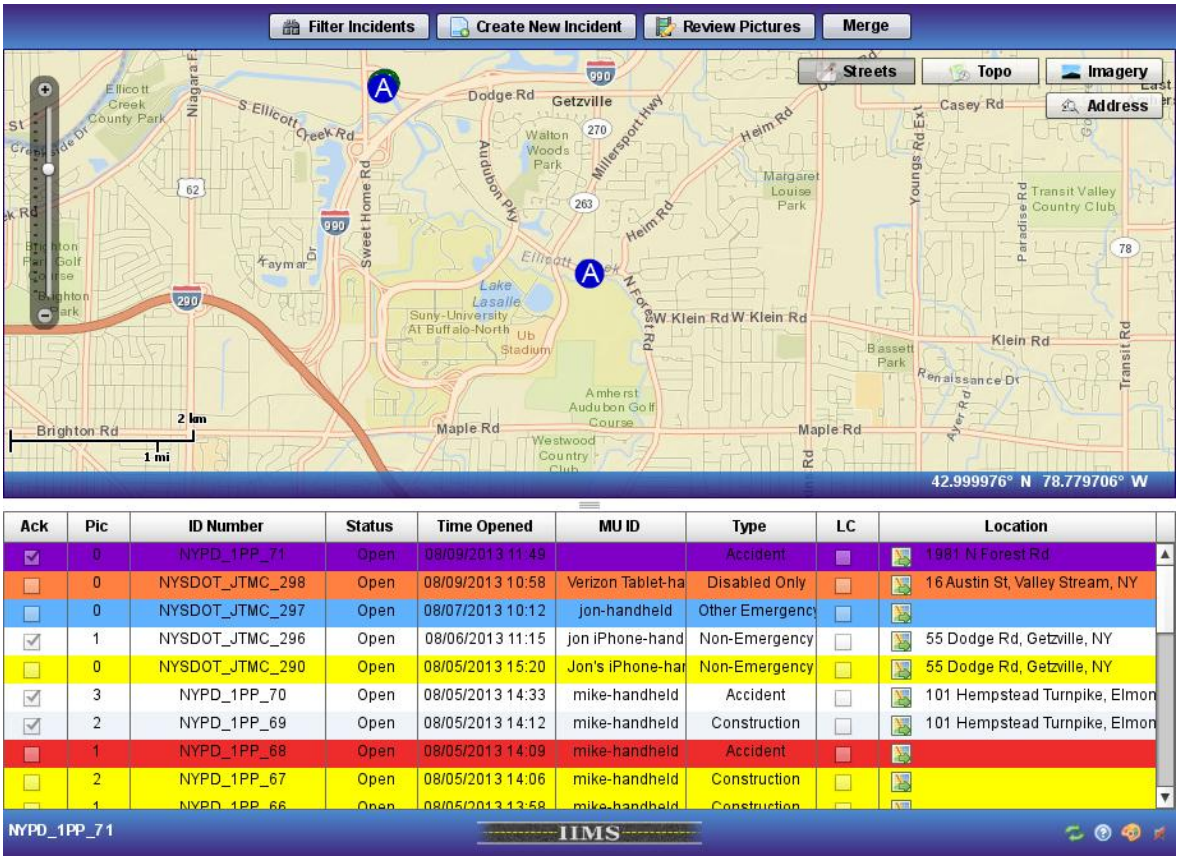
Figure 2.1-3: IIMS Mobile Unit Screen Shot

The new web client and mobile clients work over the web using secure sockets HTTPS protocol in a client-server architecture.

The web-client, which will replace the local unit, has been improved by simplifying, streamlining, and clarifying the incident creation and management processes. The web-client is being transitioned from Adobe Flash to Adobe Air which allows for easier cross-platform usage and should allow the web-client to be used on large screen android and iOS devices such as tablets in the field. This will allow not only single incidents to be opened, updated, and closed, but also other incidents to be viewed, updated, and managed, all from the field.

Figure 2.1-4 below shows the web client with the list of incidents. Incidents can be created, merged, and the list can be filtered.

Figure 2.1-4: IIMS Web Client Screen Shot



As a part of the current project, General Dynamics Information Technology (GDIT) developed and refined the IIMS mobile client for BlackBerry. GDIT also developed new mobile clients for Android, and both iPads and iPhones, during the latter part of the project, and are currently in testing. The new and enhanced mobile clients allow more agency personnel to create and incident, then update and finally close that incident in the field - sending location data, text updates, and images to the server.

Figure 2.1-5 shows a screen shot of the android client in the process of creating an incident. The options allowed are the Incident type, amount of road closure, direction. The final option at the bottom, report type, allows text, voice, pictures, video, and an incident close report to be sent to the server.

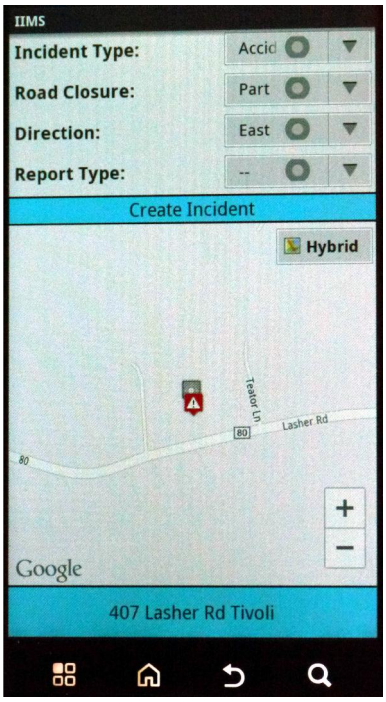


Figure 2.1-5: IIMS Android Client Screen Shot

2.2. Traditional Freeway Incident Management System (FIMS)

As discussed in section 1, incident management is the management of incidents to protect the traveling public, decrease the cost associated with the accidents in terms of lost time, congestion, and loss of life.

The traditional Freeway Incident Management System (FIMS) combines various measures into a comprehensive system that will be effective in dealing with the problem. Such a system has several requirements:

- Incidents must be detected accurately and rapidly.
- The nature of the incidents must be determined quickly.
- Information relative to incidents needs to be collected and passed on to various agencies.
- Roles and responsibilities of the various agencies must be developed, understood, and agreed upon.
- An appropriate coordinated response to the incident is necessary.
- Quick removal of the both major and minor incidents needs to take place.
- Traffic management measures need to be applied for the duration of the incident.
- Information on traffic conditions and bypass routes needs to be provided to motorists..
- Traffic management plans for 'planned incidents' need to be developed, implemented, and operated.” (Roper, 1990)

Roper, lists the following as possible means of incident detection: actual observations of the incident or resulting congestion, sightings through closed-circuit television, electronic surveillance equipment, passing motorists and highway patrolman among others. He mentions that much of this data relies on someone being in the right place at the right time. The quality and clarity of the information is also highly variable depending on the source of information.

This detected incident information is sent to a central focus point, or traffic operations center, where all the information can be collated to give an accurate picture of what is going on on the ground. Once this has been determined, the coordination of the many various involved agencies is critical to the successful mitigation of the incident's effects.

Roper goes on to expound upon the necessity of the operations center being equipped and staffed to analyze the information collected, and pass on the information to the designated agencies so that that an appropriate response can be made to the situation.

Wide Area Incident Management Decision Support System (WAIMSS) (Ozbay, Xiao, Jaiswal, Bartin, Kachroo & Baykal-Gursoy, 2009) was developed in the 1990s as one of the first attempts to combine expert systems with the mapping capabilities inherently found in Geographical Information Systems (GIS) applications. A second example of a traditional FIMS that has been in operation for a number of years is the State of Maryland's Coordinated Highways Active Response Team (CHART) system.

CHART was established and funded as a joint venture between Maryland DOT, Maryland Transportation Authority, and the Maryland State police in cooperation with the Federal Highway Administrator and other federal and local agencies as a traditional Freeway Incident Management System to use teamwork and technology to improve the operations of Maryland's highway system(Maryland State Highway Administration, July 2013).

The software behind CHART, CHART II(Maryland State Highway Administration, 2005), is designed to facilitate highway traffic monitoring and management of the system. It has the capability of interfacing with field devices (traffic signals/detectors, Closed Circuit TeleVision (CCTV) cameras, VMS, Automatic Vehicle Location (AVL) vehicles, etc), the media, and other organizations to coordinate, detect, and announce incidents in real-time. The system is built with an archival service to allow the data collected to be distributed to other organizations and researched. Operators manage congestion events, created either manually or automatically as detected by the system, and can then activate a response.

CHART makes use of the Traffic Management Data Dictionary(TMDD) format for data storage, and Common Object Request Broker Architecture(CORBA) for all external interfaces involving real-time or near real-time communication. Below in Figure 2.2-1 CHART is shown with it's external interfaces.

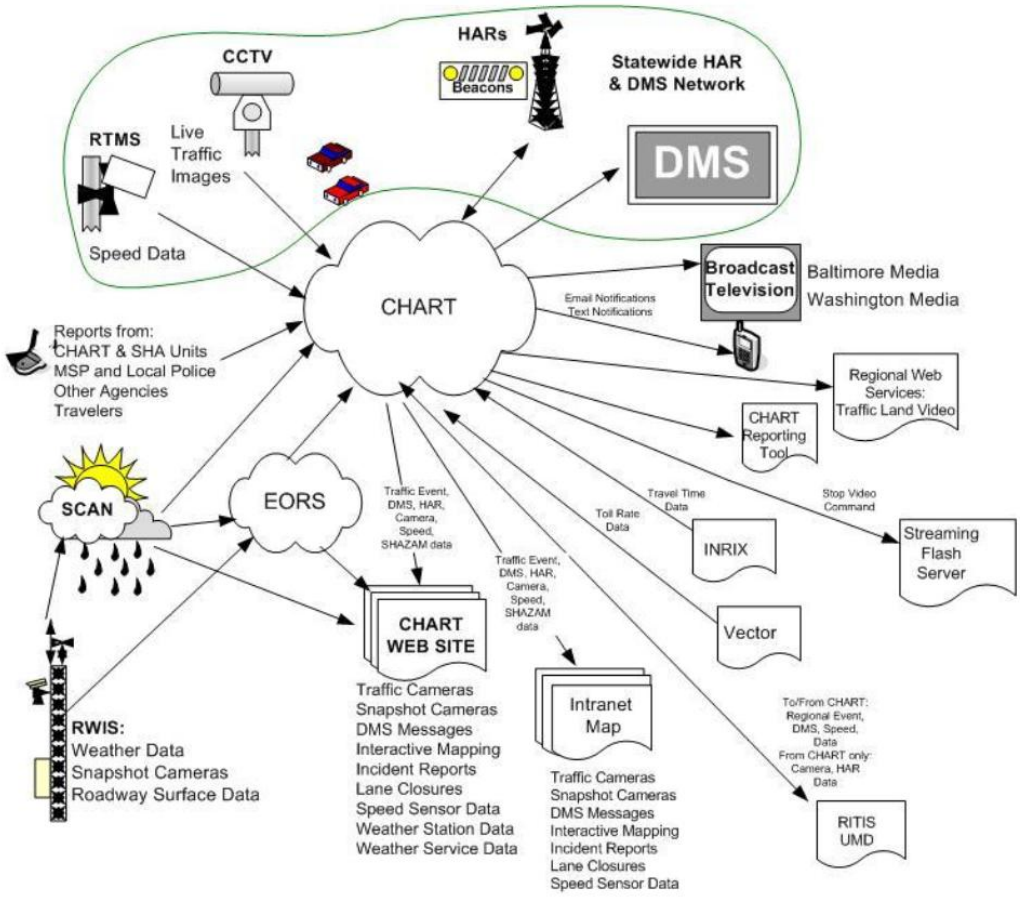


Figure 2.2-1: CHART and External Interfaces (Maryland State Highway Administration, 2011).

Maryland's CHART II system business area architecture report (Maryland State Highway Administration (SHA), 2000) lists many functional requirements for their system including those listed in Table 2.2-1 below that were selected as applying to IIMS's scope and focus. CHART is built to be a single source for management, prediction, automated response, and control of Maryland's transportation system including incident management, and as such its scope is considerably larger than IIMS is currently built to cover. The items below were selected for their applicability to mobile incident detection and integration – the core of IIMS.

TABLE 2.2-1: CHART Literature Review Feature Requirements

CHART(Maryland SHA, 2000)
Operates seamlessly across jurisdictions allowing effective control and performance evaluation by appropriate entities.
Requires minimal training and fosters inter-organizational coordination and sharing of information/resources.
Statewide usage
Data available from field
Have inter-jurisdictional agreements for inter-operable deployment of technology and operations
Provides a framework for collecting, analyzing, disseminating, and utilizing real-time and archived transportation data in an open format.

2.3. Cost/benefit of Freeway Incident Management System (FIMS)

Freeway incident management systems incur costs to government (and therefore society) to maintain and operate, but they provide many times the benefit in terms of saved time, money, fuel, and lives.

The 2009 "Urban Mobility Report" (Schrank & Lomax, 2009) found when summarizing operational improvements for all urban areas that of the 308 million hours estimated to be saved, 46.5% of the saved time(143.3 million hours) were due to incident management. This translated into over $3 billion dollars saved, and a significant reduction in delay on all roads. Reduced delay also saves fuel, reducing emissions from cars and trucks stuck in traffic idling.

In a study done in Hampton Roads using data from 2006, Khattak et. al. (2011) found that secondary incidents: are relatively large in terms of their durations on average, half have longer durations than the primary incidents, and that secondary incident occurrence is statistically linked to primary incident duration. Reducing the length of primary incidents will result in a reduction of secondary incidents, improving the safety and congestion level of the corridor.

One area of research in incident management has been to look into ways to reduce incident duration through the use of various response strategies. In, "Evaluation of incident management strategies and technologies using an integrated traffic/incident management simulation" (Özbay et al. 2009), the incident duration is modeled according to four scenarios, the first of which looks at the effect of variable message signs (VMS) finding that VMS help divert traffic to under utilized links decreasing the arrival rate at the accident site and therefore the total delay due to the incident. The second scenario analyzed the effects of the number of cell-phone users on incident detection times, finding as expected that increased numbers of cell-phone users decrease the incident detection and verification times in most cases, the few abnormalities were attributed to the randomness provided in the simulation to account for some cellphone users choosing not to call in incidents.

Incident management has been found to be a highly cost-effective way to improve the efficiency and operation of freeways, reducing delay, financial loss due to lost time, and therefore environmental impacts from the wasted fuel as well. Improving the efficiency of operation of

the transportation network also helps reduce the need for costly expansion of infrastructure as well.

IIMS as a system helps reduce delay through better and more accurate incident detection through the mobile clients and integration of existing system that are not now integrated.

2.4. Mobile Technology

With recent changes in mobile technology, especially the wide adoption of smart-phones capable of high speed web access, taking pictures, video, and location information, it is now possible to easily have incident detection and verification via first and second responders through their mobile handset, allowing for detection of incidents in areas lacking cameras or other means of incident detection.

Now that there is network and mobile device availability, one remaining challenge is to authenticate connections with mobile devices and users. Data can be transferred via the mobile protocols such as text messaging SMS and Multimedia Messaging Service (MMS), or via the mobile web over web protocols such as HTTP and HTTPS. Authentication done via the users phone number or Media Access Control (MAC) address is vulnerable to hackers (Miller, 2001) as they can change their hardware's address, granting them access to privileged information. Using the standard log-in requirements over HTTPS that web-applications have used for years provides the necessary security for transferred data.

Social mapping applications have been adding the ability to send information about incidents and other problems found en-route. Waze, one of the more popular social mapping applications allows user to report an incident (Fire, Kagan, Puzis, Rokach & Elovici, 2012) and upload a picture. The data collected by the millions of users of Waze was used by Fire et al. to identify locations with higher incident occurrence. Mobile incident detection apps have the opportunity to greatly decrease the duration of incidents and increase the safety and awareness of traffic to conditions ahead.

2.5. Non-Traditional Freeway Incident Management Systems

One big area of improvement allowed by the mobile technology improvements compared to traditional FIMS as reviewed in the previous section is more accurate and comprehensive incident detection and verification using the geo-location and photo information provided by the on-board GPS and cameras built into smart-phones. Two systems that take advantage of these capabilities are PPM2000's perspective incident management solution, and Geomatika's Traffic Incident collection software solution in Slovakia, both are reviewed in the next subsections. This is followed by a description of Wisconsin DOT's InterCAD system built to integrate Wisconsin's systems in much the same way as IIMS.

2.5.1. PPM2000 Perspective Mobile

Perspective is a traditional proprietary incident management system, with additional mobile data collection capabilities provided by a mobile module. It is developed by PPM 2000 Inc. a leading

developer of Incident Management Systems. Perspective was recently added to General Dynamics' Global Security Operations Center Solution – an amalgamation of software designed to work together for incident management (PPM 2000 Inc, November 2012).

The Perspective Mobile module provides in-the-field data capture and retrieval as well as reviewing prior entered data using Black Berry and iOS native applications (PPM 2000 Inc, June 2012). The data collected includes what happened, where and when, and who or what was involved. It also allows photos of the scene to be uploaded. The system is designed to provide the mobile workforce access to incident data wherever they are.

2.5.2. Geomatika

Geomatika, a Slovakian company that works in ITS has developed a two-tiered system for mobile incident data collection (Geomatika, 2013). The system is web-based and communicates with the mobile phones over General Packet Radio System (GPRS) to collect incident data.

Their Java based application that works on Symbian, Windows, and Android allows data to be collected and submitted by the general traveling public. The data once collected is reviewed and by a TOC for accuracy and then pushed to the applicable agencies.

Their second tier application is developed only for windows devices and allows trusted users such as police and other official agency employees to view their location and submit additional data including direction and classify the incident according event tables.

2.5.3. Wisconsin DOT InterCAD

Wisconsin's DOT has developed and deployed InterCAD, a system for automated, real-time public safety to traffic operations incident data exchange (Parker, Sama, Mishfske, King, Ran & Noyce, 2012). The system works by transforming the data from disparate proprietary formats to standard IEEE 1512 messages, and then transmitting the incident data to the other connected stakeholder systems.

Stakeholders for the system have included the Wisconsin State Patrol and the Wisconsin Department of Transportation Statewide TOC since 2009 and work is being done to incorporate several new county Sheriff's Department Computer Aided Dispatch (CAD) systems. The long term goal is to create a framework for data exchange including Fire, Emergency Medical Services (EMS), E911 and other systems.

The system allows for filtering of the data much like the Intelligent Information Integration Broker (I3B) built by GDIT. The incident history is also tracked.

Lessons learned throughout implementation are the need for buy-in from the agencies, the need for complete and consistent location information, the issue of integration cost with existing CAD systems, and that though the use of national ITS standards may take more time they do provide a longer-term benefit than a proprietary system.

2.6. Recent Traffic Management Strategies

Integrated corridor management (ICM) and Active Traffic Management (ATM) are two transportation stratagies that have recently come to the forefront of transportation management strategies. ICM, which predates ATM, focuses on integrating the management of corridors among agencies to better use existing roads' capacities. ATM focuses on better dynamic use of existing infrastructure through reallocation of transportation capacities.

2.6.1. Integrated Corridor Management

The Florida DOT defines ICM as, "a collection of operational strategies and advanced technologies that allow transportation subsystems managed by one or more transportation agencies to operate in a coordinated and integrated manner, thereby increasing overall system throughput and enhancing the mobility, reliability, and safety for corridor users" (Hadi, Xiao, Wang, Zhan, Ozen & Cabrera, 2012).

The U.S. DOT has been working to promote ICM in eight "pioneer" sites across the country as a way to promote research and enhance the state of ICM. In traditional highway management individual roads are managed, whereas with ICM a corridor is integrated to provide travelers and shippers with information concerning changing traffic conditions, congestion ahead, and alternate routes. Travelers will thus be able to make informed decisions to avoid congestion, using alternate modes or routes of travel. This allows for greater use of the available capacity of the corridor and more reliable travel times (Baltes, Cronin, Murthy & Thompson, 2007).

2.6.2. Active Traffic Management

ATM focuses on the better management of freeway segments to enhance the capacity of the individual segments. It has been widely implemented in Europe, and is now becoming a focus for managing congestion, both recurring and non-recurring, in the US.

The Federal Highway Administration (FHWA) sent a scan team to Europe (Mirshahi, Obenberger, Fuhs, Howard, Krammes, Kuhn, Mayhew, Moore, Sahebjam, Stone, & Yung, 2007) to learn and recommend strategies to be implemented here in the US. The strategies used in Europe and proposed by the team include, speed harmonization, temporary shoulder usage, dynamic routing and signing, and junction control. The benefits observed in Europe include:

- An increase in average throughput for congested periods of 3 to 7 percent
- An increase in overall capacity of 3 to 22 percent
- A decrease in primary incidents of 3 to 30 percent
- A decrease in secondary incidents of 40 to 50 percent
- An overall harmonization of speeds during congested periods
- Decreased headways and more uniform driver behavior
- An increase in trip reliability
- The ability to delay the onset of freeway breakdown

By better using the existing infrastructure and developing additional ways to allocate capacity on the freeway, via using shoulders and switching center lanes depending on peak demand flows, recurring congestion can be reduced. The impact of incidents can be also be reduced through expanding capacity – actively shifting traffic to use the shoulder, or using excess capacity from lanes in the opposing direction.

IIMS, as a mobile data collection and integration system would allow these two traffic management strategies to be further enhanced beyond the use of embedded sensors. Incidents on

roads lacking CCTV coverage could be verified and the condition of the incidents ascertained through the mobile clients, allowing the TOC to properly activate the ATM or ICM strategies, as well as allowing the ATM and ICM systems to communicate and synchronize data with each other.

2.7. Other Systems / Integration with IIMS

IIMS was developed to connect and work with I3B - middleware that facilitates real-time information exchange between applications. This combination allows IIMS to communicate, sending and receiving data to any other system using transportation industry standards, primarily TMDD and IEEE 1512 message sets, which are standardized protocols for transmitting traffic and incident information between transportation management systems.

The architecture of IIMS is set up along the lines of Figure 2.7-1 below. The figure shows how individual instances of IIMS can be connected to each other through an I3B to share updates from region to region and system to system.

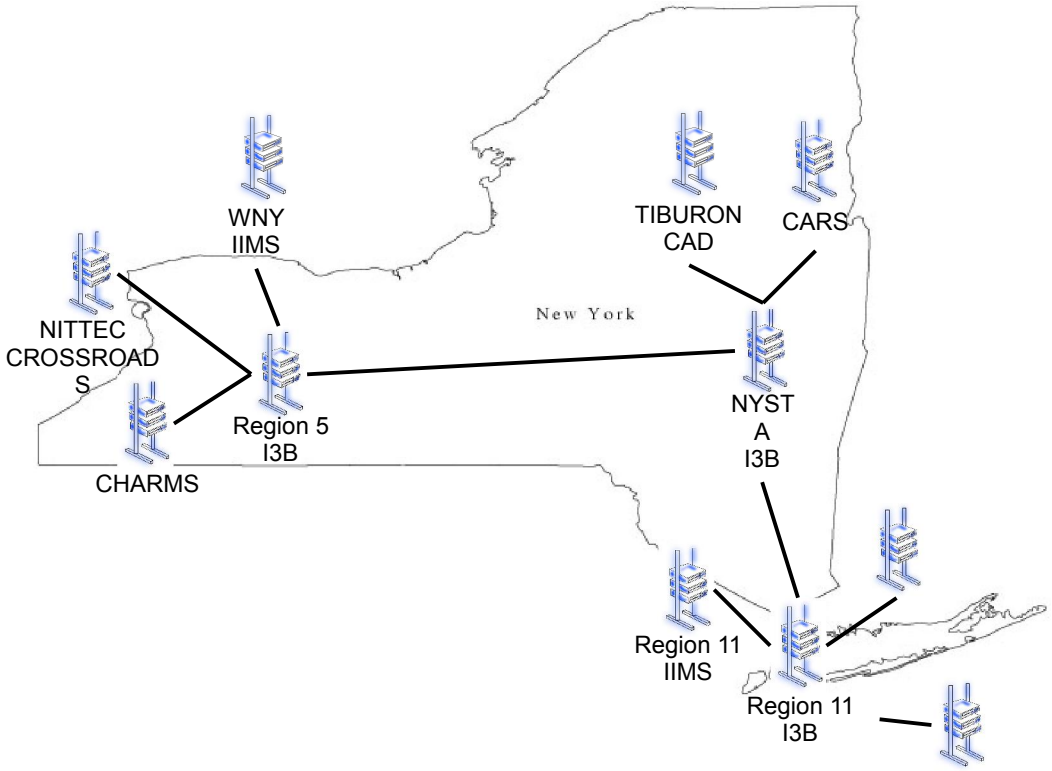


Figure 2.7-1: IIMS System Architecture

2.7.1. Intelligent Information Integration Broker (I3B)

The I3B interface works over standard web protocols, receiving and sending data in any XML format. Data adapters are used to connect systems lacking a web-interface and can be configured to work with any format on any protocol. All data entering the I3B is formatted into a standards based format to simplify processing and transport within the I3B. The I3B middleware has been adopted by NYSDOT as part of their Information Exchange Network (IEN) (NYS Intelligent Transportation Society) and as such is widely used by other services and agencies in transportation in NYS including at Niagara International Transportation Technology Coalition (NITTEC).

2.7.2. Standards

In the early 2000's it became apparent as TOCs began working with larger sets of data and needed to be able to exchange information between systems and agencies, that it would be necessary to develop a unified set of standards. NTCIP, the National Transportation Communications for ITS Protocol, was established to develop these standards. It coordinated with the Institute of Transportation Engineers (ITE) to develop the Transportation Management Data Dictionary (TMDD) for data and information storage and exchange, with IEEE's Incident Management Working Group to develop the IEEE 1512 set of standards for Center to Center (C2C) communications.

The TMDD standard aims to provide a way for C2C communication in a high level, protocol independent standard way (Institute of Transportation Engineers., 2011). It supports requests for road network data, sharing of event information and other functions performed by the TOC, sharing of control of ITS infrastructure, data collection.

The IEEE 1512 family of standards uses the TMDD message set as well as several others to build an expanded incident management specific standard that is able to communicate incident related information. ("Guide for implementing," 2008)

2.8. Conclusions

This section has reviewed the IIMS, its purpose and how it functions, traditional Freeway Incident Management Systems (FIMS) and their characteristics and requirements, the benefits of FIMS in terms of safety and cost savings, technology associated with freeway management and mobile systems, some of the more recent traffic management strategies including Integrated Corridor Management and Active Traffic Management, and integration of other systems with IIMS through the I3B middle-ware module and industry standards.

3. METHODOLOGY AND DATA

3.1. Motivation behind a Mobile or Hand-held Client for IIMS

As a deployed desktop application, the IIMS system limits user access to those computers that have IIMS installed on them. In today's first responder environment, supervisors and managers need to be able to access system data remotely in order to assess the current operational status and make command decisions.

Likewise, the IIMS mobile unit is currently deployed to a ruggedized computer that is mounted in a responder's vehicle. This requires users to sit in their vehicle to enter information. Since a responder's first priority is to secure the incident scene, they cannot afford to spend time sitting in their vehicle entering information. Thus they often enter only a quick overview of the incident or a later responder actually reports the incident information to IIMS.In addition, the cost requirements for the IIMS mobile units are prohibitive, which limits the ability to expand the IIMS deployment to other mobile responders in Region 10 and across New York State.

Once the need for change in western New York's incident management strategy had been identified, it was determined that the best solution would be a mobile IIMS application. The reduction in cost and widespread use of smart devices in recent years has allowed this solution to be feasible. The central goal in the development of this application was to provide an interface that is intuitive to use and gives responders the ability to input incident information easily and efficiently. Such an application would address many of the problems identified in the current system but would also have some drawbacks. The potential advantages and disadvantages of the

IIMS mobile application are identified below. Given the potential advantages and disadvantages of an IIMS mobile application, a thorough evaluation of a WNY possible deployment was needed.

Advantages

1. An intuitive application which can be used to input basic information means responders can **report incidents much more easily and efficiently**
2. The prevalence of smart devices will allow users to **report incidents at any time**, without needing access to the Mobile Unit
3. Use of pre-existing smart device hardware will greatly **reduce the difficulty and cost of maintenance**
4. Abandoning dependence on specialized hardware will lead to a significant **reduction in the cost of expanding the system**
5. The ability to take **real-time pictures and video** at the incident scene is greatly facilitated

Disadvantages

1. An expansion of the IIMS support staff will be needed due to **infrastructure changes**
2. A short **training** program would be required to familiarize users with the new interface
3. The **lack of screen space** on a smartphone minimizes the amount of the interface that can be displayed at one time
4. There are inherent **privacy** concerns associated with real-time incident imagery which will need to be addressed

3.2. Evaluation Framework

To complete the Purpose and Scope of this project, the method relies heavily on obtaining user feedback through meetings and follow-up, researching past projects' difficulties and recommendations, and analyzing the resulting data to determine how to implement IIMS to be of maximum use to the people of WNY. Also original research was done by the author through using the system and looking for ways to improve upon, or use IIMS in other areas.

The methodology used was to first study the IIMS system; secondly to identify and reach out to stakeholders to collect data; thirdly to analyze the data from: (a) stakeholders, (b) original research, and (c) the literature review; fourthly to determine the user functional requirements; fifthly to identify potential applications and likely benefits; and finally to identify suitable deployment locations.

3.3. Study of the IIMS system

In order to fully understand IIMS it is necessary to understand how the system works: what it was designed to do, how it will be used in the incident management process, what the role of each agency will be, and how IIMS interacts with other systems such as NITTEC's Crossroads System and the NYSDOT's Road Side Damage Assessment (RSDA) system to name a few. The IIMS design was reviewed and explained in the literature review section 2.1 – listing the structure and idea behind IIMS as far as organizational structure and functionality.

3.4. Stakeholder outreach

To find our stakeholders, let us first define what that word means.

> Stakeholder *(noun)*: a person or group that has an investment, share, or interest in something, as a business or industry. (Stakeholder, 2013)

From this definition it quickly becomes apparent that any organization that works in incident management would be a priority, such as highway maintenance, TOCs, police departments, and emergency services providers, such as firemen and ambulance companies. Also any group or organization that helps in the clearance of the roadway such as tow companies would also be included as a stakeholder.

3.4.1. Lessons from Staten Island for finding stakeholders

The "New York Integrated Incident Management System Evaluation Project Final Report", found that the involvement of all user agencies in the development of the system made sure that all agency needs and concerns were addressed, and gave an opportunity for differences between agencies to be resolved. It was determined also that forming a rigid structure through Memorandum of Understanding's (MOU)'s and other means would have likely dampened the response from the involved agencies.

Current IIMS stakeholders and users in NYC include: NYSDOT, NYC DOT, NYC Police Department, NYC OEM, NYC Fire Department / EMS, NYPD Emergency Operations Center(EOC), Metropolitan Transportation Authority (MTA) Police, NYC Department of Sanitation, NYC DEC.

3.4.2. Other systems, who are the stakeholders?

CHART stakeholders included the Maryland State Highway Administration, Maryland Transportation Authority, Maryland State Police, Federal Highway Administration, University of Maryland Center For Advanced Transportation Technology, as well as various local agencies.

The stakeholders for InterCAD are the Wisconsin State Patrol and Wisconsin DOT. Other stakeholders currently being brought in, are primarily police agencies, though in the future Fire, EMS, E911 and other emergency responders will be included.

3.4.3. NITTEC – why they are a good platform?

In the Buffalo-Niagara region, NITTEC as the transportation management center for the area is an ideal platform for locating and working with the stakeholders in the region. NITTEC is a coalition of fourteen agencies working to promote mobility and improve the infrastructure and management of the region. The fourteen agencies are:

- Buffalo and Fort Erie Public Bridge Authority
- City of Buffalo
- City of Niagara Falls, New York
- City of Niagara Falls, Ontario
- Erie County
- Ministry of Transportation, Ontario
- New York State Department of Transportation
- New York State Thruway Authority
- Niagara County,
- Niagara Falls Bridge Commission
- Niagara Frontier Transportation Authority
- The Niagara Parks Commission
- Niagara Region
- Town of Fort Erie.

The Western New York Transportation Incident Management (WNYTIM) working group within NITTEC is a group of agencies involved in incident management that meet together regularly to improve the incident response of the region. A subset of the agencies including the New York State Thruway Association (NYSTA), NYSDOT, Amherst Police Department (PD), and a representative from NITTEC agreed to form a focus group to provide feedback on April 3rd at a meeting about the current state of IIMS and to give feedback on what improvements and obstacles they could see to its deployment and use in WNY and the upstate region. This focus group constituted the core stakeholders group for the project.

3.4.4. Stakeholders Outreach and Feedback for WNY

3.4.4.1. Kick-off Presentation to NITTEC Incident Management Committee

The process to develop and implement an IIMS application for western New York began in November 2012 with a presentation by the research team to the Western New York Transportation Incident Management (WNYTIM) working group within NITTEC. The presentation provided an overview of IIMS, along with an outline of the tasks involving WNY outreach (a copy of this presentation, entitled Presentation1_kickoff, is provided with this report).

3.4.4.2. Focus Group Feedback on April 2013

A key component of this study's stakeholder outreach involved working with a focus group of the WNYTIM committee. On April 2013, the research team met with the focus group on the University at Buffalo north campus. Attending the meeting were representatives from the New

York State Thruway Authority (NYSTA), NYSDOT, the Amherst Police Department (APD), and the Niagara International Transportation Technology Coalition (NITTEC). The meeting discussed the IIMS concept with the agencies which would comprise its user base and sought to obtain their opinions. This included information about how useful they felt the application would be to their organization, what features the application should have, and what obstacles might prevent their organization from using it. The results of this discussion are presented in the following section of this report (Section 4). After the meeting, the research team followed up with the members of the focus group to obtain further feedback.

3.4.4.3. Additional Feedback on August 2015

Following the initial discussion with the stakeholder organizations on April 2013, General Dynamic Information Technology (GDIT) completed the development of the hand-held IIMS smartphone/tablet application for iOS, Android and refined the BlackBerry version. The application was developed over a period of approximately 2 years and features both a mobile application and a web application which operate in tandem.

The mobile application is designed for use by responders at the scene and features an intuitive interface allowing users to quickly enter basic incident information. This is vital due to the number of tasks responders often have to perform in a limited amount of time. The information recorded by the phone application includes automatically detected GPS location, primary incident type (Accident, Construction, Disabled Vehicle, Non-emergency, Obstruction, and Other

Emergency), road closure, direction, text description, and real-time photos or videos. The map view of the application will also show other active incidents in the surrounding area.

The web application is intended for either dispatchers, traffic operators, or the responders themselves when they return to a desk. It can be accessed through the web browser of any desktop computer and allows users to either create new incidents or edit the information of existing events. The information fields of the web application are much more detailed than those of the mobile application and allows for a much more comprehensive description of the incident. In addition to the incident fields included in the mobile application, the web application includes provisions for more incident types and subtypes, roadway features, road closure details, and specific fields related to the incident. For example, a collision will include fields for number of vehicles involved and severity.

Following the completion of application development, the stakeholder organizations were re-invited to test the application and provide feedback. It was hoped that access to the demo application would help these organizations to better identify how likely their organization would be to use the application and help to identify potential users for an initial deployment of the application in western New York.

Feedback was obtained in two different settings. The first of which was a meeting with representatives from the three most interested organizations: NYSDOT, APD, and NITTEC,

which took place on August 14, 2015 on the North Campus of the University at Buffalo. After discussing and demonstrating the application, the attendees were asked to install the app on their own phones and provide their thoughts through a short survey. The results from this meeting are presented in the next section of this report (Section 4).

3.4.4.4. Feedback during the 2015 ITS Upstate Annual Meeting – October 2015

The second setting for obtaining feedback on the new Android and iOS IIMS app was during the 2015 Annual Meeting of the Upstate New York Chapter of the Institute for Transportation Engineers (ITE) which took place on October 1, 2015 in Buffalo. A presentation about the development and features of the application was given at the meeting, followed by a discussion. The audience was composed of members of several private and public organizations in the western and upstate regions of New York. The presentation generated a significant amount of feedback which was recorded and is summarized in section 4 of this report.

3.5. Analysis of Data

In order to gather data for this project, the focus group was shown the current capabilities and given access to the in-development software, both mobile and web-based, to allow them to have hands-on experience and give feedback as to how intuitive they found the software as well as to be able to request features and changes that would improve the functionality of IIMS for their respective organizations. Additionally a demonstration server was set up to allow them to try it out and additional follow-up was done to collect further feedback.

This data was then combined with the literature review observations and original research done

through the use of the mobile and web clients and analyzed, determining the results and conclusions of the project.

3.6. User Functional Requirements

To find the user functional requirements, meetings were held with WNYTIM members interested in the software to determine what functions they required to make IIMS more useful and attractive to their organizations. The agencies that expressed interest were NITTEC, NYSTA, NYSDOT, and the Amherst PD. Additional follow-up was done to further investigate the requirements and needs of the agencies.

Combined with the data from the literature review and the original research performed by the researchers of this project, the user functional requirements were determined and are listed in the results section of this report.

3.7. Identify Potential Applications and Likely Benefits

Likely benefits and potential applications of the system were found through researching similar systems and reaching out to stakeholders in WNY for feedback on how they see IIMS potentially used to improve the response to incidents.

3.8. Identify Candidate Deployment Site, and research MOU for future deployment

In order to identify good locations for the deployment to be located, NITTEC and other organizations in WNYTIM were reached out to for their comments and ideas for the ideal location and process of deployment in WNY. Additional thought was put into determining a good location and setup for future deployment.

4. RESULTS

The results from the research into the three sets of data: literature review, focus group, and original work; have been broken down into seven main areas. These areas are: first new developments in IIMS, second insights from users' responses, third analysis of the collected data, fourth the user functional requirements, fifth the potential obstacles, sixth applications and likely benefits, and seventh preparing for future deployment of IIMS in WNY.

4.1. New developments in IIMS

Further work is currently being done to integrate the ability to use the mobile clients to update NYSDOT's RSDA system from the field. This work allows further integration and therefore usefulness of the system in traffic incident management throughout the State of New York. As previously mentioned, the mobile and web-clients have been improved and updated, allowing them to work on mobile devices, providing incident read/access from the field.

4.2. Insights from the focus group, literature review, and original research

In this section, data from the three sources, focus group, literature review, and original research, are outlined.

4.2.1. April 2013 Focus Group Insights

At the focus group meeting, the current status of IIMS was presented including both the web-client and the mobile client, and also how it is structured to allow different agencies to work together on the same incident. At the conclusion of the meeting they provided feedback through a brief survey.

After discussing the software capabilities, it was agreed that all agencies would benefit and would likely use IIMS, provided cost was kept low. The meeting notes and agenda for the meeting are available in Appendix A.

Table 4.2.1-1 lists a summary of the responses received from the focus group at the end of the first focus group meeting.

TABLE 4.2.1-1: Focus Group Survey Responses

Question\Agency	NYSTA	NYSDOT	Amherst PD	NITTEC
How useful would IIMS be to your organization?	Very	Very	Very	Useful
What features would you like to see in IIMS to make it more useful to you?	Inclusion of detour/diversion routes, Highway radio signal, permanent message boards	Mobile incident read feature	iOS / iPhone support	Integration with Crossroads, Receive and view information on mobile devices
What are some potential applications you can see your organization using IIMS for?	Monitor Incidents and traffic delays, Construction projects	Work zone notification & confirmation, Maintenance followups, Quick accurate incident reports / response	More frequent updates to dispatch and NITTEC	Collect incident and maintenance information, Situational awareness
What obstacles do you see to your organization using IIMS?	Legal red-tape for information sharing, Cost, Existing applications that provide some of the services	Available hardware	User reluctance Agency policies, Privacy	Cost Sharing of information between organizations
How likely would your organization be to use IIMS?	Likely depending on cost	Very likely Especially Help Patrol	Would give it a try	Very

Figure 4.2.1-1 below shows the frequency of some of the primary responses from the focus group about the required features, obstacles, and potential applications they would can see towards deploying IIMS in the WNY region. The highest frequency is 4, given that four different agencies were involved in the focus group.

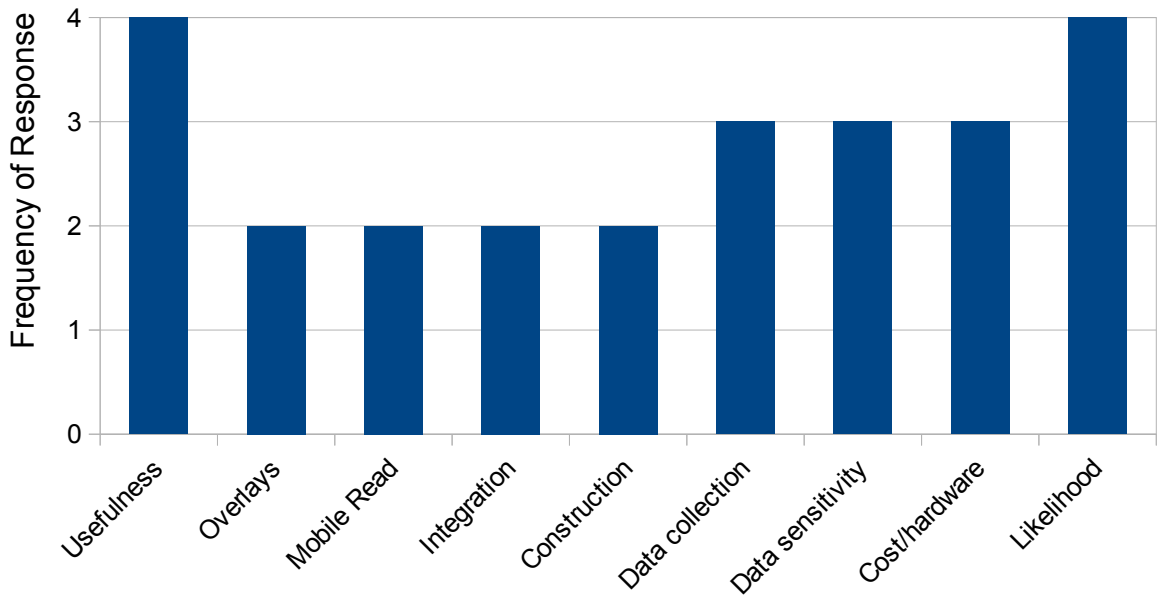


Figure 4.2.1-1: Focus Group Response Frequency Plot

The ability to filter incidents for specific agencies was also brought up during discussion as being important to the usefulness of the system. This is already implemented in IIMS through the I3B and can also be done through the web interface. Several other areas that were brought up were: jurisdictional differences between agencies, multi-platform requirement, ease-of-use and general usefulness of the clients, and archival of incident video and data.

4.2.2. August 2015 Focus Group Insight

As mentioned, additional feedback was sought following the completion of work on developing the Android and iOS version of the IIMS hand-held client. On August 14, 2015, a meeting was held with representatives (see Table 4.2.2-1) from the three most interested organizations: NYSDOT, APD, and NITTEC (for meeting notes see Appendix B). Further details about the meeting are provided in Appendix A. After discussing and demonstrating the application they were asked to install it on their own phones and provide their thoughts through a short survey (Appendix C). These results are shown in Table 3.

TABLE 4.2.2-1: List of WNY Representatives

Representative	**Agency**
Richard Jones	NYSDOT
Scott Preston	Amherst PD
Mike Smith	NITTEC

Table 4.2.2-2: Stakeholder Application Testing Feedback on August 2015

	Name of Organization		
Question	NYSDOT	APD	NITTEC
How useful would the IIMS application be to your organization?	Somewhat useful	Somewhat useful	Somewhat useful
Which features of the application would be most useful?	Incident pictures and video taken in real-time	Easy and efficient incident reporting, Ability to view active nearby incidents in real-time	Incident pictures and video taken in real-time
What features could be added to the application to make it more useful?	Integration of detour resources, Further hardware support (iOS/Blackberry), Access to CCTV and traffic volume information, Weather/condition information, Prediction of incident magnitude, Associating freeway incidents with mile marker locations, Additional indecent types (e.g. emergency maintenance, special events), Additional incident information fields	Access to CCTV and traffic volume information, Additional incident information fields	Additional incident information fields
What are some potential applications of IIMS for your organization?	Expanded incident coverage	Work zone notification/confirmation, Expanded incident coverage	Integration with older systems for coordination and cooperation, Archived data: research and reports
What possible obstacles do you see to your organization using IIMS?	Cost, Integration with older systems, User training/acceptance	User training/acceptance	Integration with older systems, privacy concerns
How likely would your organization be to use IIMS?	Possibly, if some changes are made	Possibly, if some changes are made	Likely

4.2.3. ITE Meeting Feedback

As previously mentioned, feedback was also collected during the 2015 ITE NY Upstate Annual Meeting (meeting details in Appendix B). A presentation about the development and features of

the application was given followed by a discussion. The presentation generated a significant amount of feedback which was recorded and summarized here.

ITE NY Upstate Meeting Presentation Feedback

A great amount of interest was shown in the application, with the real-time photos/video again being highlighted. Members of private firms who frequently worked with incident data noted that potential improvements to data quality due to ease of recording would be beneficial, especially if the data was recorded and stored in an organized way.

Some questions were raised about how the data is stored and organized on the back end and how it could be integrated into already existing data structures.

Additionally, a more in depth conversation about privacy concerns was had, especially with regards to the photos and videos. Many felt that well defined guidelines for who would have full access (e.g. DOT, police) partial access (e.g. private firms) and limited/no access (e.g. media organizations) would be necessary for full implementation.

Across all organizations and settings, some trends in feedback stood out. Many believed the application would be useful and would be willing to try it. While most currently had access to the majority of these features in one way or another, the ability to take real-time photos and video was a significant feature that many felt would be useful. Many also saw the utility of a fast and easy way to report incidents at the scene. Most concerns were not with the application's functionality but other external issues, such as privacy and integration with existing systems. Each organization also desired more incident fields related to their respective activities. Overall, responses to the application were positive despite some concerns.

4.2.4. Literature Review Insights

See Section 2.2 and Section 2.5 for the feature requirements and other data obtained through the literature review.

4.2.5. Original Research Insights

From use of the existing IIMS system's clients, both mobile and web, it was determined that the following areas are unique to the WNY region and upstate NY and would not be as applicable in the NYC region where IIMS was first developed, they are:

- Extreme weather events from snow storms.
- Limited cell coverage in rural areas.

Another potential obstacle to usage is the potential for reluctance to fully integrate IIMS with existing legacy systems, and reluctance on the part of individuals to use the available mobile clients, which will greatly limit the overall usefulness of the system. The incidents created will still be shared between agencies via the I3B, but the full potential of the system may be difficult to reach due to entrenched use of other systems and older methods of communication.

A potential area of application for the IIMS would be for dissemination of data to news outlets and researchers for planning. Also due to the real-time nature of the incident updates it will be possible for the transportation agencies to integrate response through updates to incidents which will be synced through IIMS through the I3B middle-ware module.

4.3. Data Analysis

From examining the responses and feedback from the user focus group it quickly became apparent that all the representatives of the agencies felt that the software would be very useful to their organizations, and that their organizations would be highly likely to at the very least try it out.

Combining the data from the three sources, focus group, literature review, and original research, the following tables, Table 4.3-1 to Table 4.3-3, were compiled of features, obstacles, and applications, listing their status. The tables are further discussed in the coming sections of the report.

TABLE 4.3-1: Feature Requirements / User Requirements

Feature Request/User Requirement	Add to IIMS?			Comments
	Yes	No	Done	
Integration with detour resources: Portable Messaging System (PMS), detour routes, etc.	YES			Yes but only as an overlay, no control from IIMS
The ability to read incident information from IIMS in the field.	YES			Planned via Adobe Air web application
iOS support	YES			In progress
Integration with legacy systems	YES			Possible through I3B
Filtering of incident types			Done	Available through I3B and web client.
Operates seamlessly across jurisdictions allowing effective control and performance evaluation by appropriate entities.			Done	Already available through web application
Requires minimal training and fosters inter-organizational coordination and sharing of information/resources.			Done	System is quite straight forward
Statewide usage	YES			Planned
Have inter-jurisdictional agreements for inter-operable deployment of operations	YES			Planned, see Commitment of Cooperation (COC) in section 4.7
Provides a framework for collecting, analyzing, disseminating, and utilizing real-time and archived transportation data in an open format.	YES			Through data archival and integration with data warehouse.
Weather Incident Type	YES			
Offline incident creation	YES			Needed for rural areas

- **TABLE 4.3-2: Potential Obstacles**

Potential Obstacles	Possible to Overcome			Comments
	Yes	No	Done	
Cost/Hardware	Yes			
Sensitive information sharing / legal issues	Yes			See COC Section 4.7
Legacy system integration	Yes			Can be integrated with I3B

TABLE 4.3-3: Potential Applications / Benefits

Potential Applications / Benefits	Implemented?			Comments
	Yes	No	Won't	
Work Zone Notification and Confirmation	Yes			Some modifications may be needed of incident types
Road/Roadside maintenance	Yes			Some modifications may be needed of incident types
Expanded incident coverage	Yes			Available through mobile clients
Integration with other systems for coordination and cooperation		No		In progress through I3B
Archived Data: Research and Reports		No		When integrated with I3B

The next four sections go into more detail on the details of the requirements, obstacles and possible applications listed above.

4.4. User functional requirements

Several of the above features are already available in the system once deployed. These features

include the requirements for IIMS to operate seamlessly across jurisdictions, the requirement that it requires minimal training to use. Also the requirement for it to be functional across the entire state, is a planned objective of the system. The desire is that the system be used to integrate the disparate transportation management systems used in different areas by the different agencies.

The addition of a weather incident type would be extremely useful in the upstate area for the maintenance of roads and management of roads. In the upstate region weather events can often shutdown the interstates, stranding drivers on the freeways ("Upstate n.y. Digs," 2010).

Inter-jurisdictional agreements for operation of IIMS and use of the system are primary requirements for the system to succeed and are expounded on in more detail in section 4.7.2.

4.5. Integration of Overlays

Several overlays were requested to be added to the map to make using the map more useful to the users. The New York State Thruway Authority representative mentioned he would like to see integration of detour diversion routes, the location of highway advisory radio signals, and permanent variable message boards into IIMS either through a link or overlay on the map, allowing greater coordination of efforts and visualization of resources available in the area.

The Amherst PD uses mile-markers for their reports, and so is interested in having access in IIMS to the mile-marker locations on the map along highways, instead of only having the geo-

coordinates as currently provided by the web client. The addition of this would enhance the ability of both police and maintenance units that are in the field to find and respond to incidents they are dispatched to.

4.6. Access Incident Data from the Field

Two of the participating agencies specifically requested read and write access on hand-held devices in the survey and other agencies mentioned a desire for it during the discussion. They stated it would be helpful for supervisors in the field to be able to fully manage/monitor incidents without being tied down to an office center. Another added benefit to having access would be that units arriving at an incident location could select an already created incident and add additional information instead of having to create an second incident that will then have to be merged at the TOC by an operator.

GDIT is currently working to convert the web access client to Adobe air which will allow iOS and Android tablet devices to access all the functionality now available in the web-client. Though this will allow mobile access to read and follow incidents in the field away from personal computers.

4.7. iOS Support

The Amherst Police Department representative mentioned that they have been issuing iPhones to

their officers and would therefore be interested in having access to a native iOS application for incident management. The upcoming Adobe Air application will allow read and write access from larger iOS devices. Also, as previously mentioned, an iPhone and an iPad application have already been developed and is currently entering testing.

4.8. Integration with legacy systems and filtering

One key area that was brought up by at least two of the represented agencies was how important integration with existing systems in the organizations would be for adoption by the agencies. NITTEC already has management applications it uses for incident management and controlling the VMS in and around Buffalo. NYSTA has several other systems it uses, having a seamless integration through the data sharing ability of IIMS would allow the existing systems to be enhanced while bringing in the power of IIMS to coordinate information across agencies - one of the main objectives of the system. This integration would be accomplished through the use of the I3B module reviewed in section 2.7.1.

Also possible through the I3B is another feature requested during the focus group meeting which was the ability to filter incidents and push said incidents to specific agencies, as well as the ability to restrict sensitive information to tow operators and other agencies.

These features are available through the Intelligent Information Integration Broker (I3B) communications control module which regulates the information shared between applications

over IEEE 1512 and other communication standards. This data can be shared with agencies based on filtering selected fields, content, and other content in the data.

4.9. Archival video and incident data.

The Amherst Police Department has also been interested in obtaining video records of incidents for use in best-practices training. For example the recorded video could be used to show how incidents duration could be decreased and safety increased by pushing a disabled vehicle out of the travel lanes and on to the shoulder. Another great advantage to have archival video would be for research purposes.

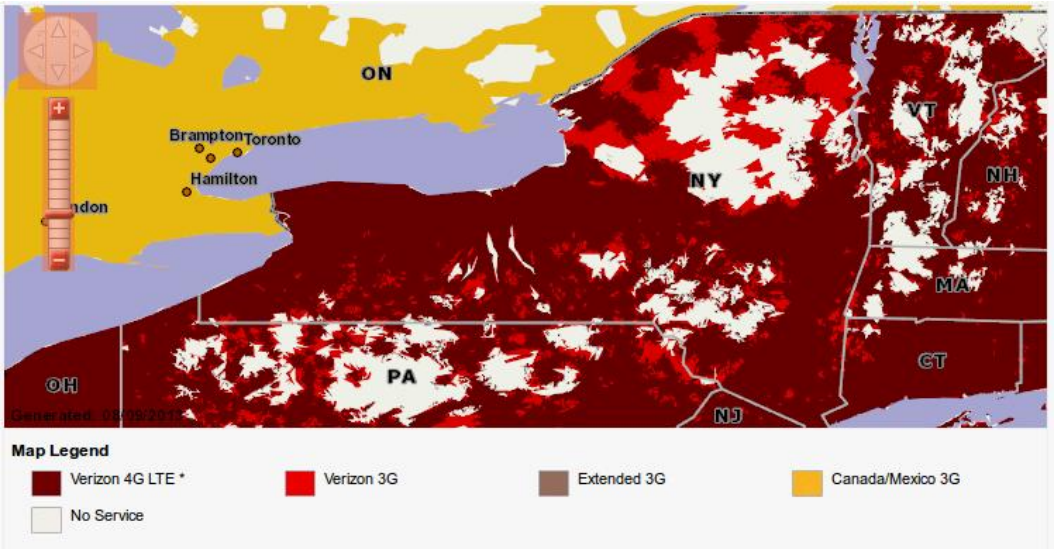
The incident data would also be beneficial for training and research allowing further determination of ways to enhance the response, reducing the response time and increasing highway safety for both the traveling public and for responders.This feature is already at least partially available through the built-in archival system and with further integration into the regional data warehouse could greatly enhance the operations of the system.

4.10. Offline Incident creation

The need for the offline creation of incidents can be seen by looking at the coverage maps for AT&T and Verizon, two of the bigger mobile access providers. Figures 4.4.6-1 and 4.4.6-2 show the gaps in coverage in the southern tier and also in the Adirondack region.

Source: http://www.att.com/maps/wireless-coverage.html

Figure 4.10-1: AT&T Cell Coverage



Source: http://www.verizonwireless.com/b2c/support/coverage-locator

Figure 4.10-2: Verizon cell coverage

The areas of Liberty and Monticello New York in the southern tier and throughout the Adirondacks really make the need for an offline incident creation apparent for when IIMS expands to these areas, and there are other pockets where cell coverage is not good enough to create an incident.

There is already the ability to store pictures and upload them when there is adequate reception in the Black Berry mobile application. To further expand this would allow incidents in areas with spotty coverage to still be covered and allow them to receive the benefits IIMS offers in incident detection and information collection.

4.11. Potential Obstacles

The respondents when asked to list potential obstacles to deployment listed the following three primary areas: the first being cost of deploying the server infrastructure and mobile devices to employees, the second being the difficulty of differences between agencies in terms of protecting sensitive data from being released to reporters or other non-vetted individuals or agencies, and the third being the failure to integrate IIMS into existing legacy systems.

4.11.1. Cost/Hardware

NITTEC and representatives from NYSTA mentioned cost of deploying the hardware, both phones and servers as being a possible obstacle towards usage. Currently NYSDOT has been

developing and deploying the server side infrastructure as one of their projects and as it can likely be hosted on existing state infrastructure and servers, the cost to deployment comes down primarily to the cost of maintenance and deployment of the mobile handsets for other agencies.

CHART is funded cooperatively by the various agencies using the system, IIMS will likely be funded long term for maintenance and server costs in the same way, each agency providing some funding towards the operation. The cost will not be as high as for CHART because IIMS mainly integrates existing systems, and would be used by the existing employees of the incident management agencies.

Because many agencies have been moving towards deploying mobile handsets to their users (whether iOS, Black Berry, or Android), the additional cost to these agencies will not be great. For agencies that have not yet moved towards using smart-phones, the cost may be somewhat greater, and the users given access to these devices may be somewhat more targeted. The trend has been towards greater usage of mobile infrastructure in public agencies, so as time goes on the cost barrier will decrease and the number of agency employees able to contribute updates will increase.

Also, even if the agencies are not able to field the mobile clients, they will still benefit from the integration of IIMS into their systems as they will have access to the expanded incident coverage from other agencies and their systems as well.

4.11.2. How to resolve jurisdictional differences

One difficulty identified was the liability related to sensitive information gathered by the system in the process of managing incidents. Two main vectors were considered: Freedom of Information Legislation (FOIL) requests and leaks of sensitive information. Resolving these legal and Information Technology (IT) concerns will be critical to future progress and deployment.

FOIL requests were mentioned as being filed by news organizations before incidents are even closed out on the highway - any information stored may be accessible under the law, and so it may be desirable to not store certain information to protect sensitive information. Sensitive information leaks through non-government agencies such as tow companies leaking that sensitive data to news organizations or the internet, is another area that the transportation organizations are concerned about.

For both the first and second parts concerning FOIL requests and access to sensitive data, as mentioned in Section 4.4.4, the I3B module will allow filtering to possibly keep sensitive data from being recorded and/or remove sensitive information from being pushed out to other agencies that have a legitimate need to access some data but should be kept from accessing the more sensitive stored data, organizations such as tow companies.

4.11.3. Legacy System Integration

The Thruway and other agencies already have software (CARS, Tiburon, CAD, Crossroads) that

provides much of the capability provided by IIMS, so integrating IIMS with them so that incidents can be pushed to and pulled from these applications will allow for greater collaboration without the cost and difficulty of retraining employees to the new system. As mentioned previously, this is already possible with some work towards building an interface between I3B and the legacy system in question.

4.12. Potential Applications and likely benefits

Potential applications and likely benefits of using IIMS are listed below. Potential Applications include: Work zone notification and confirmation, road and roadside maintenance, communication and coordination between agencies, dissemination of data, and greater availability of data for research. Likely Benefits are: Interfacing/data entry into other systems, and expanded incident coverage in areas lacking other means of incident detection.

4.12.1. Work Zone Notification and Confirmation

There was interest expressed in using IIMS for work zone tracking, allowing supervisors in the field to update agency office with the progress of the work zone. The system would allow pictures to be uploaded, problems to be troubleshot, by supervisors when away from the site, and would also have the added benefit that as incidents are created and updated the information would be pushed out to the 511 system that is integrated with NITTEC, keeping traffic notification systems up to date on work areas.

One specific area of request was the ability to show road closures in IIMS. This is already possible using the existing features. Roads can be set as partial closure, full closure, etc during incident creation and updates.

4.12.2. Road/Roadside Maintenance

One useful application for IIMS is tracking and repairing maintenance issues on and off the roadway. Potholes, shoulder erosion, graffiti, missing signs and guide rail damage can all be entered as incidents and tracked over time. This has already been used by NYC DOT OER especially to track maintenance issues that prior to IIMS were not documented as they were frequently fixed on the spot or required no emergency repair.

NYSDOT Maintenance has expressed an interest in using IIMS for this purpose already for documenting and tracking incident damage and for otherwise maintaining the road infrastructure. An incident can be created for each maintenance location to track progress visually on a map as well as allowing for sorting and tracking through tables.

4.12.3. Expanded Incident coverage

As IIMS is not tied to fixed deployed infrastructure, but can have info added from hand-held portable clients, the expanded incident coverage allows for incidents to be quickly reported and updated from roads without any traffic cameras or covered by other more traditional incident management systems.

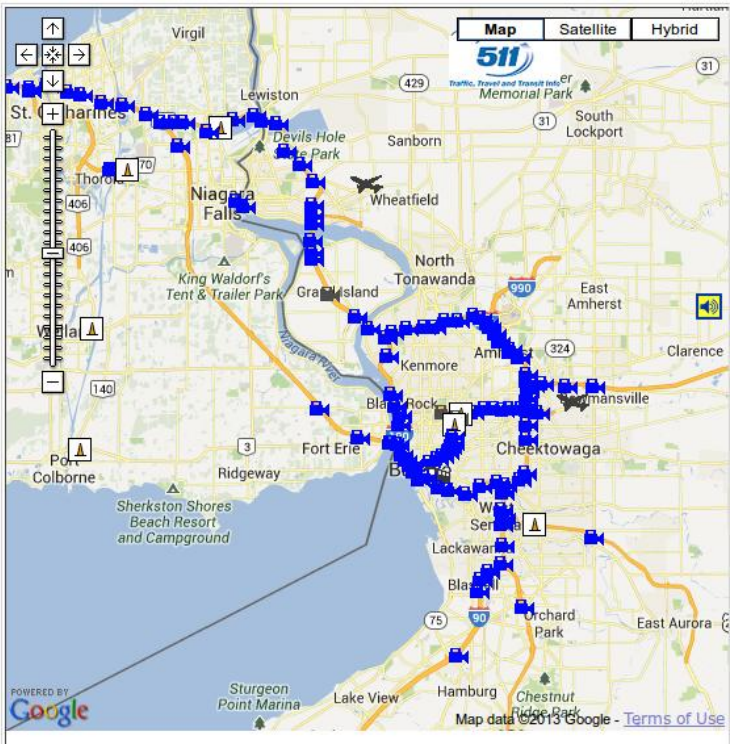


Figure 4.12.3-1: NITTEC Surveillance Coverage

Traffic incident coverage in WNY is currently limited to covering the freeway systems where the fixed-in-place CCTV cameras have coverage. Figure 4.12.3-1, a screen-shot from NITTEC's traffic map, shows the extent of the current coverage. Several of the other main arterials within Buffalo, such as the Scajaquada Expressway, Main Street, Niagara Falls Boulevard, and Sheridan Drive currently have no CCTV coverage. IIMS would enable incident coverage and provide the TOC access to better information on incidents for detection, verification, and management.

The hand-held clients for Black Berry, Android, and in the near future iOS, will allow users on any road to report, update, and close incidents. This expanded coverage is especially useful on

streets off the main commuter roads, and in areas without ITS infrastructure. Also as the system is expanded throughout rural New York, other cities and smaller communities which may have no CCTV coverage will reap the benefits in very significant ways.

4.12.4. Integration with other systems, for coordination and cooperation

The main idea of IIMS is to integrate the existing incident management systems so that they work seamlessly together providing additional benefit: IIMS serves as a go-between and information gathering role for the other systems, and provides translation services between systems, increasing the communication and cooperation of participating agencies.

The NYSTA's CARS and Tiburon CAD software, NITTEC's Crossroads, and the NYSDOT's RSDA software will all benefit from the mobile data collection abilities of the hand-held applications. Once setup IIMS can be configured to send information collected by employees of a particular agency to push that information to the agency's other software systems through the communication control module over the I3B middle-ware bridge in industry standards such as the IEEE 1512 family of standards.

Maintenance information gathered by NYSDOT employees using IIMS will be able to be pushed directly into RSDA. Disabled vehicles reducing roadway capacity located by the NYSDOT HELPS vehicles can be pushed to NITTEC and tow operators. Thruway incidents can be sent to the Tiburon CAD system operated by NYSTA. All of theses agencies benefit from having the

mobile device input capability inherent in IIMS to expand their existing reach and functionality.

Since NITTEC is already connected with the NY511 information system, this will allow all incident information to be used in preparing 511 updates to be sent out to the traveling public and other transportation organizations.

4.12.5. Archived Data: Research and Reports

The data collected by the system will be a rich resource for future research into incident characteristics in the WNY region. This data will also be useful for reviewing the performance of incident management in the region.

Reports generated from the archived data in the system on incident detection time, response time, breakdown of agency involvement, and overall incident duration among many others have already been developed in the NYC region, and others can be developed using basic database queries. This will be a critical source of information for future incident management training and inter-agency coordination improvement, as well as for internal reports at the participating agencies. Benefits from this have already been reported in NYC where IIMS has been used by many agencies to manage incidents on the freeway system.

Combined with the data warehouse being built in cooperation between SUNY Buffalo and NITTEC, this stored data can be used in future incident research for identifying the relationship

between incident, roadway, and weather characteristics, and to enhance incident management strategies and response times.

The research and report generation capabilities provided by IIMS will have benefits greater than just the direct benefits provided in reduced incident duration.

4.13. Preparing for Future Deployment

Going forward, preparing for deployment in the WNY region, there are several steps necessary to consider: the organization with which to deploy the IIMS, where to deploy IIMS's infrastructure physically, and how to ensure the continued work and commitment to using IIMS among incident management agencies in the area.

4.13.1. Possible Organizations to lead the Test Deployment of IIMS

Following the collection of feedback from potential users, it was clear that Amherst Police Department (APD) and NYSDOT are the best candidates for a western New York pilot deployment of the application. NITTEC could provide added support from an operations standpoint since it does not have responders of its own. Each organization has showed interest in using the application and feel that it would be useful. Also, both have a user base which would be using the application in different ways, allowing a larger scope of analysis of its effectiveness.

Despite some concerns from each organization, the majority are easily addressable in modifications made to the application. Therefore, it is recommended that these organizations are offered the ability to use the application in earnest as a pilot demonstration of the IIMS applications effectiveness in western New York.

As mentioned above, NITTEC could serve as an excellent facilitator and coordinator of the deployment effort. This is due to the relationships already in place in NITTEC for incident management and the proven track record of agencies working together in the WNY Transportation Incident Management group at NITTEC.

4.13.2. Candidate Geographic Location

Just as IIMS was deployed first to Staten Island in NYC, selecting a smaller area in the Buffalo area to test the deployment and work through any issues would allow a more focused testing of the system, while building buy-in from those using the system. Clarence NY on the outskirts of Buffalo could be a good location to test the use in a more targeted environment, but other towns or villages could also serve as test deployment sites. Specifically, the fact that Amherst Police Department has expressed an interest in using IIMS may suggest selecting Amherst as a candidate deployment site. Amherst however is significantly bigger than Clarence, and therefore the deployment may be more complex. Clarence is located on the outskirts of Buffalo and has a population of 30,654 as of the 2010 census (Clarence New York, 2013) providing a good sized area to test the implementation and roll out of IIMS.

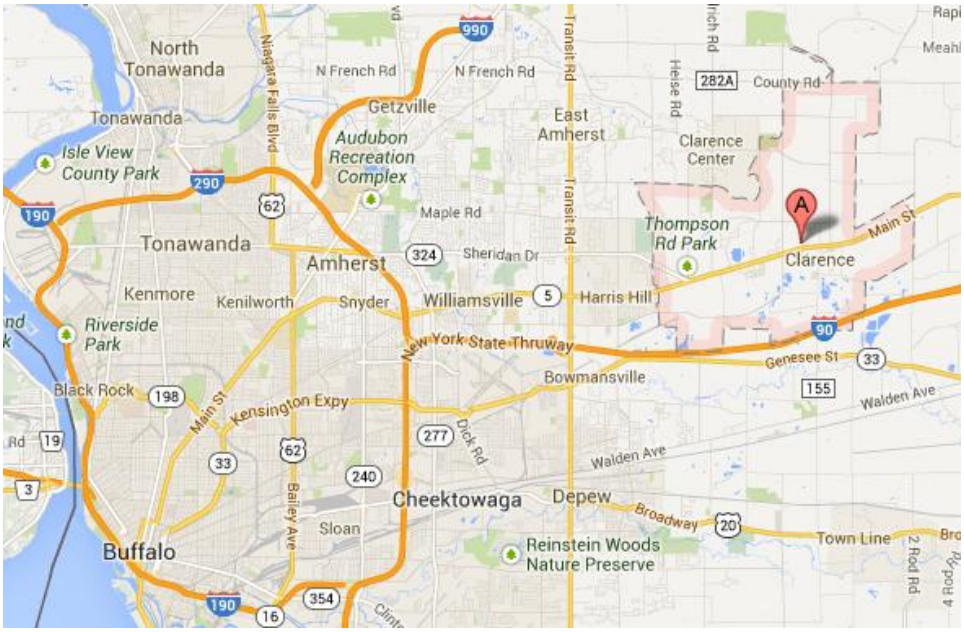


Figure 4.7.1-1: Town of Clarence, New York

The town would be able to use the system for traditional traffic incidents, weather events, and maintenance. Selecting one town versus deployment across the entire area allows any issues or questions of the town about the system to be addressed, whereas a larger deployment would swamp the resources of those deploying the system.

The stakeholders of the initial deployment would be primarily the town highway department, town security department, and the Erie County Sheriff. Clarence does not have its own police department though, and therefore the state police patrolling the town may be included depending on the interest level. Reaching out to them and explaining the purpose and use of IIMS, also casting a vision for the benefits provided by the system will be critical to a successful deployment.

4.13.3. Proposed Sample Memorandum of Understanding (MOU) / COC

In the past NITTEC has worked to develop a Memorandum of Understanding between NYSDOT, NYS Police, and the Towns of Amherst and Tonawanda regarding incident management of I290 and I990. The MOU had provisions to apply best practices, find and apply new technology to reduce response time, and to meet together following exceptionally large incidents to discuss and look for opportunities to improve the inter-agency response among other things. See Appendix D for details.

Though this MOU got held up by the legal departments of the agencies, a Commitment of Cooperation (COC), also available in Appendix B, was agreed to between the agencies to work towards 18 strategies that would enhance TIM in WNY.

An initial COC agreed to by the agencies towards working out data sharing differences, working on integration into existing services, and using the IIMS mobile and web clients where they can, will be a critical first step in working towards further expansion and usage of IIMS in WNY. To ensure the greatest success in deployment it will be necessary for the IM agencies in the area to commit to working out differences and to integrating IIMS in their day-to-day operations.

Additionally it is important to come up with a way to continue the maintenance of the system in an ongoing way. The deployment in NYC has run into some issues with funding running out for maintenance causing the system to be unusable. As mentioned in section 4.5.1 with cost being a

potential obstacle, it will be important for the agencies to determine a way to share the expense of the system in a way that allows the system to be well maintained and is not burdensome to any one of the agencies.

The following is a proposed possible COC for the TIM agencies in the WNY region to consider:

IIMS - WNYTIM

Commitment of Cooperation for the use of Integrated Incident Management System in WNY Incident Management

The undersigned members of the Niagara International Transportation Technology Coalition WNY Incident Management Committee in recognition of their joint responsibility to support the National Unified Goal for Traffic Incident Management as outlined in their commitment of cooperation, commit to work together to implement, integrate, and use Integrated Incident Management (IIMS) in their operations where feasible, and to work to determine a way to fund the ongoing maintenance of the system. IIMS is a flexible Incident Management System developed to enhance integration, communication, and management of transportation incidents through better inter-agency coordination.

IIMS provides enhanced response to: Reduce Traffic Congestion. Safer, more efficient traffic

incident management will reduce congestion by reducing incident duration and preventing secondary incidents.

Increase Responder Safety. Improved incident management reduces responder risk by improving traffic control at incident scenes and reducing incident duration and risk exposure.

This COC encourages individuals, agencies and organizations to work together to implement and integrate IIMS in their operations for improved incident management through the following five strategies:

1. Integrate IIMS with existing agency systems and programs
2. Use IIMS clients to enhance incident reporting capabilities in the field
3. Work to use IIMS where applicable in operations
4. Provide feedback on capabilities and usefulness of IIMS
5. Work together to fund the maintenance of the system

The signatories to this commitment of cooperation agree to pursue the IIMS implementation strategies when providing services for managing incidents on the regional transportation network.

Commitment of Cooperation for the use of IIMS in Traffic Incident Management

This Commitment of Cooperation, together with any appendices, attachments, schedules or exhibits, constitutes the entire understanding between the parties and there are no other oral or extrinsic understandings of any kind between the parties. This Commitment of Cooperation may not be changed or modified in any manner except by a subsequent writing, duly executed by the Policy Membership.

In WITNESS WHEREOF, the parties hereto executed this Commitment of Cooperation on the date first above written. This document may be executed in several counterparts that, when taken together, shall constitute one and the same instrument.

Member Agency **Name/Title:**_____

Signature: _____ **Date:**_____

5. CONCLUSIONS AND FUTURE RESEARCH

In this report, the existing state of IIMS was researched, requirements of potential users in the WNY region were determined, potential obstacles, applications, and benefits to deployment were determined, and future work to be done was outlined.

5.1. Conclusions

The main conclusions are:

1) For the user functional requirements, many of them including, filtering of incidents and different access levels, multiple platform requirements, and archival video and incident data, are already in place or planned for the near future. The requested added map overlays for highway advisory radio, PVMS, and mile markers would add substantial value to IIMS web client and may be included in subsequent updates. Offline incident creation and updates will be critical in areas with flaky reception. Additionally the ability to view incident information in the field on mobile devices is greatly desired by the representatives in the focus group, and also finally integration with existing systems, which is really the primary requirement of IIMS.

2) Identified obstacles to deployment included cost and availability of hardware to agency personnel, and difficulties of sharing sensitive data between agencies. This will require more work between the agencies to resolve, possibly including a commitment of cooperation to work

to resolve the differences. Also failure to integrate the legacy systems will keep the full potential of the system from being reached.

3) Potential applications and future benefits from the system were found to include highway maintenance tracking, work zone notification and confirmation, expanded incident coverage, integration with existing software used by the agencies, and the available archived data for use in research and incident report generation.

4) That NITTEC would be an ideal location for the deployment of IIMS server infrastructure and that to ensure continued growth and use of IIMS a Commitment of Cooperation should be developed and agreed to. A good candidate for initial deployment is the Town of Clarence NY in Erie County due to the limited size which allows a more focused use and implementation of the system. The stakeholders there would include the town highway department, security department and Erie County Sheriff office.

5.2. Future Research

Continuation of this research will be advisable as further improvements are made in IIMS, and the system is deployed and used in the field, to further evaluate the usefulness and potential enhancements to the system.

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APPENDICES

TABLE OF APPENDICES

APPENDIX A

April 3rd, 2013 Focus Group Meeting

University at Buffalo
The State University of New York

April 3rd 2013, IIMS WNYTIM meeting - notes

Attendees:	Organization:	Phone:	Email:
Adel Sadek	(UB CSEE)	716-645-4367	asadek@buffalo.edu
Carl Hempel	(UB CSEE)	845-332-0550	carlhemp@buffalo.edu
Paul Russ	(GDIT)	716-243-4021	paul.b.russ@gdit.com
Sam Christian	(NYSTA)	716-635-6236	samuel.christian@thruway.ny.gov
Jeremy Lefort	(NYSTA)	716-635-6280	jeremy.lefort@thruway.ny.gov
Kevin Murphy	(AMHERST PD)	716-689-1355	kmurphy@apdny.org
Carl Fischer	(AMHERST PD)	716-689-1355	cfischer@apdny.org
Mike Schneller	(NYSDOT)	716-864-1225	mschneller@dot.ny.gov
Dave Christopher	(NYSDOT)	716-663-3476	dave.christopher@dot.ny.gov

Discussed:

1) IIMS Overview Presentation
    a) Amherst PD interested in video access for incident response training, problem with privacy concerns
    b) Would like to see location tied to mile markers.
2) Hand-held Client Demonstration
    a) More options in “Road closure” dropdown
    b) Want read access on mobile (next phase?)
3) Web-Client Demonstration
4) Feedback and Q&A
    a) Have we tried integrating it with other systems - YES (SMART, CARS). Integrating with existing systems would help NYSTA. Also looking at integrating with NYSDOT RSDA.
    b) Lots of questions about information sharing, liability, privacy, etc. Possibility of restricting access of some users (eg. tow companies) to certain information - big concern of NYSTA.
    c) Filtering to have more targeted reporting, viewing for agencies
    d) The more agencies using IIMS the more value there is to all.
    e) Application is owned by the state, where to install it?
    f) Web-application being ported to Adobe Air - work better on mobile, 3-4 months may have update.
    g) NYSDOT uses android, rolling out more. Amherst PD uses iPhone.
    h) Everyone agrees on it’s utility - how to implement?
5) Questionnaire

a) How useful would IIMS be to your organization?
    i All agreed it would be very beneficial, NYSTA may be hesitant given existing applications provide similar service.
b) What features would you like to see in IIMS to make it more useful to you?
    i Inclusion of detour routes, highway advisory radio signal, VMS, status of services.
    ii Integration with crossroads
    iii Ability to read/access incidents from smart-phones
    iv iPhone app.
c) What are some potential applications you can see your organization using IIMS for?
    i NYSTA for construction projects, incidents, traffic delay
    ii NITTEC for collecting incident and maintenance information, situational awareness.
    iii NYSDOT for maintenance followups, immediate accurate incident reports, work zone notification and confirmation
    iv More frequent updates to dispatch, NITTEC, or TOC
d) What obstacles do you see, to your organization using IIMS?
    i NYSTA cost for hardware/software, many aspects already covered by other apps.
    ii Legal red tape on sharing information.
    iii Users not wanting to use it
e) How likely would your organization be to use IIMS?
    i NYSTA depends on expense
    ii NITTEC and NYSDOT likely
    iii Amherst PD will try it

6) Next Steps & Wrap-up
    a) Who is paying the bill? Needs to be outlined in concept of operations. Need to work on MOU between agencies.
    b) How to handle issues around privacy, information sharing, FOIL requests, red tape.

APPENDIX B

Meeting Notes for August 14, 2015 Focus Group Meeting

&

The 2015 Upstate NY ITE Meeting Feedback

MEETINGS DETAILS

Stakeholder Application Interest Meeting
Meeting Time: 8/14/15 1:00 PM – 3:00 PM
Location: 133 Ketter Hall, University at Buffalo North Campus, Amherst, NY

Attendees:

- Andrew Bartlett (University at Buffalo)
- Scott Preston (Amherst PD)
- Mike Smith (NITTEC)
- Richard Jones (NYSDOT)

Discussion Points:

- Introduction to IIMS smartphone and web applications
- Discussion about usefulness to individual organizations
    - NYSDOT: relevant fields for emergency maintenance, code thruway or expressway incidents with mile markers as opposed to addresses, other features of the app were currently available to them already, liked real-time photos/videos
    - Amherst PD: reduction in time to report incidents/easier, also liked real-time photos/videos, needed non-android support
    - NITTEC: agreement with other points, privacy concerns, additional hardware integration concerns
- Plan to send installation guide to users and survey to collect feedback

2015 ITE NY Upstate Annual Meeting Presentation
Presentation Time: 10/1/15 10:00 AM – 11:30 AM
Location: Hilton Garden Inn, Buffalo, NY
Presenter: Andrew Bartlett (University at Buffalo)

Presentation Outline:

- IIMS
    - Current IIMS
    - Need for Change
- IIMS Mobile and Web Application
    - Features
    - Advantages & Disadvantages
- Future
    - Preliminary Feedback
    - Deployment and Use

Full presentation included as a separate document (IIMS_Presentation.pdf)

APPENDIX C

Short Survey used after the August 14, 2015 Focus Group Meeting

APPLICATION FEEDBACK SURVEY

Personal Information

Name
Email
Organization

Usefulness of the IIMS App

How useful would the IIMS application be to your organization?

- □ Very useful
- □ Somewhat useful
- □ Not very useful
- □ Not useful at all

Which features of the application would be most useful? (Check all that apply)

- □ Easy and efficient incident reporting
- □ Reduced maintenance and expansion costs
- □ Incident pictures and video taken in real-time
- □ Ability to view active nearby incidents in real-time
- □ Other

Which features (if any) would NOT be useful to your organization? (Check all that apply)

- □ Easy and efficient incident reporting
- □ Reduced maintenance and expansion costs
- □ Access to incident pictures and video taken in real-time
- □ Ability to view active nearby incidents in real-time
- □ Other

What features could be added to the application to make it more useful? (Check all that apply)

- □ Integration of detour resources
- □ Further hardware support (iOS/Blackberry)
- □ Access to CCTV and traffic volume information
- □ Weather/condition information
- □ Prediction of incident magnitude
- □ Associating freeway incidents with mile marker locations
- □ Additional indecent types (e.g. emergency maintenance, special events)
- □ Additional incident information fields
- □ Other

What are some potential applications of IIMS for your organization? (Check all that apply)

- □ Work zone notification/confirmation
- □ Road/roadside maintenance
- □ Expanded incident coverage
- □ Integration with other systems for coordination and cooperation
- □ Archived data: research and reports
- □ Other

What possible obstacles do you see to your organization using IIMS? (Check all that apply)

- □ Cost
- □ Privacy/legal issues concerning private information
- □ Integration with older systems
- □ Available hardware
- □ User training/acceptance
- □ Other

What features could be added to the IIMS app to help overcome these obstacles or make IIMS more useful?

Apart from making changes to the app, what (if anything) could be done to overcome these obstacles or make IIMS more useful?

Final Thoughts

How likely would your organization be to use IIMS?

- □ Likely
- □ Possibly, if some changes are made
- □ Unlikely

Additional thoughts on the IIMS app from your organization's perspective

APPENDIX D

Past Example MOUs and COC

INTERAGENCY MEMORANDUM OF UNDERSTANDING
BETWEEN THE NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE POLICE, TOWN OF AMHERST AND TOWN OF TONAWANDA

Regarding

HIGHWAY INCIDENT MANAGEMENT ON INTERSTATE 290 (THE YOUNGMANN MEMORIAL HIGHWAY) AND INTERSTATE 990 (THE LOCKPORT EXPRESSWAY)

This memorandum of understanding by and between the parties named above is to provide guidance for personnel representing these agencies and municipalities relative to highway incidents on these facilities to promote responder and public safety, provide for the safe and orderly flow of traffic and to restore the roadway to full capacity as soon as possible following an incident.

WHEREAS, traffic congestion is a growing problem nationwide, especially on controlled access highways which carry the highest traffic volumes, and

WHEREAS, when congestion increases, so do the costs – in wasted time, fuel and money, missed schedules and late deliveries, increased air pollution and road rage, and

WHEREAS, national studies have shown that about 60% of all congestion is related to incidents (e.g. crashes, stalled vehicles, debris, special events, road work) rather than inadequate roadway capacity, and

WHEREAS, national studies have shown that up to 20% of all collisions on controlled access highways are secondary, attributable to an earlier incident that has not been fully cleared, and

WHEREAS, emergency responders are especially at risk at the scene of incidents on high speed, controlled access roadways, and

WHEREAS, safety, mobility and reliability are the most important aspects of highway user perception of the transportation system, and

WHEREAS, travel time reliability in the Buffalo metropolitan area is currently among the best in North America and this is being used as a marketing tactic to entice businesses to locate here, and

WHEREAS, the Town of Tonawanda, Town of Amherst, New York State Police and New York State Department of Transportation have responsibilities for the safe operation of Interstate 290 and Interstate 990.

NOW, THEREFORE, BE IT AGREED THAT:

These agencies and municipalities will work together on highway incident management to alleviate the problems associated with incidents by developing policies and procedures that emphasize the URGENT AND SAFE CLEARANCE of highway incidents.

Emergency Response Personnel Responsibilities

1) The municipal police agencies will conduct investigations in as expedient a manner as possible considering the severity of the incident. Investigators will work diligently to minimize traffic delays and will utilize electronic survey equipment to speed the collection of required data. When possible non-critical aspects of an investigation shall be conducted away from the immediate scene or at another time when the impact on traffic would be less.

2) Agencies will assess reported incidents and will advise motorists to move vehicles from travel lanes if possible.

3) At the scene of non-injury collisions, police officers will quickly relocate vehicle(s) from the travel lanes and conduct investigations as far from the roadway as practical.

4) Police officers will assess the situation when arriving on scene and advise dispatchers of the severity and expected duration of the incident. Dispatchers will advise the Niagara International Transportation Technology Coalition (NITTEC) Traffic Operations Center of the pertinent information so that traveler advisories can be issued. Periodic updates of the situation on the scene will be supplied to NITTEC to keep the public information current.

5) Police officers will encourage and assist other emergency responders in clearing incident scenes as soon as possible after their respective duties have been performed so as to reduce distractions for motorists (rubber-necking) and restore the roadway to more normal conditions. Police officers will work to minimize the impacts on traffic during peak travel periods and may consider delaying some operations until after the peaks.

6) When one or more lanes of a controlled-access highway are blocked, police dispatchers will call for a wrecker capable of removing the vehicle or cargo as quickly as

possible. If the "zone wrecker" does not have the capability to quickly clear the roadway, police dispatchers will call for the closest wrecker that has the needed capability. The police dispatcher will determine the estimated time of arrival (ETA) and advise the responders at the scene.

7) If the owner of a vehicle or the cargo blocking a roadway requests that a specific towing company be contacted to remove the vehicle or cargo, police officers will only approve the request if there is reason to believe that the requested company can respond as quickly as other available towing companies with comparable equipment.

8) Police officers will not allow a lane to be blocked for the sole purpose of transferring non-hazardous cargo from one vehicle to another unless no other reasonable alternative is available.

9) In the enforcement of state laws and regulations, police officers will try to minimize the impacts on traffic, especially during peak commuting periods, and will not block or restrict lanes except as necessary for safety.

NYSDOT Responsibilities

1) NYSDOT will install reference markers, signs and other approved markings as requested by police agencies to allow quicker location of incidents and to facilitate investigation and reporting of incidents.

2) NYSDOT will install Intelligent Transportation System devices on these highways to assist in the rapid detection and verification of incidents and the timely notification of the traveling public.

3) NYSDOT will utilize variable message signs, highway advisory radio and other public and media notifications to advise motorists of the status of the highways and current incidents.

4) When incidents are expected to remain in place for more than one hour, NYSDOT will assist in establishing temporary detours and associated traffic control in accordance with departmental policies and procedures.

5) NYSDOT will acquire and maintain trailers with traffic control equipment to facilitate the timely implementation of lane closures and detours when needed. Emergency response trailers may be available for deployment to those incidents which are expected to be long in duration (greater than 2 hours) if staff and resources are available.

6) When requested, NYSDOT will provide space, if available, for emergency storage of vehicles, cargo or debris outside of the safety clear zone to facilitate prompt reopening of the roadway.

7) NYSDOT will strive to minimize the traffic impacts of highway construction and maintenance and will consult with police agencies about ways to accomplish that objective.

8) NYSDOT will promote the quick clearance of highway incidents by participating in a public information campaign to advise motorists of post-accident procedures.

9) NYSDOT will erect signs at strategic locations on controlled access highways advising motorist that, following non-injury crashes, vehicles should be driven to the shoulder.

Shared Responsibilities

1) All of the parties hereto will utilize the Incident Command Structure and work together at incident scenes to promote urgent clearance, safety for motorists and emergency responders, and thorough investigations as required by the circumstances.

2) All of the parties hereto will utilize the latest policies and procedures from the National Manual of Uniform Traffic Control Devices and will regularly train their personnel in the current state of the practice.

3) All of the parties will meet periodically as part of the Niagara International Transportation Technology Coalition (NITTEC) Incident Management Team to discuss experiences with incident management and to work toward improvements. Working sessions will be held to discuss incident management and related issues.

4) The responsible agencies will meet for a de-briefing within ten (10) working days following any incident that requires complete closure of an Interstate highway (in one or both directions of travel) for more than three (3) hours and following any incident that requires closure of one or more lanes for more than six (6) hours. The purpose of the meeting will not be to find fault or to assign blame but to identify opportunities for improvements in procedures, training or allocation of resources. A one-page report will be prepared jointly by the representatives forwarded through the chain-of-command in each of the agencies.

5) All of the parties will actively promote the idea of "quick clearance" and will seek the cooperation of other law enforcement and emergency response agencies, trucking companies, towing operators, and the news media throughout New York.

6) All of the parties will work together to advise motorists that, following a non-injury accident on a controlled-access highway, motorists should steer their vehicles out of the travel lanes and stop at a safe location on the shoulder.

7) Responsible agencies will position emergency equipment at incident scenes so as to minimize the impacts on traffic flow and to avoid blocking or restricting lanes unnecessarily. Further, the parties will limit the use of emergency lights if practical at incident scenes to minimize distractions to motorists. The parties will also encourage other emergency responders to position their equipment and use emergency lights in the same manner.

8) All of the parties will work together to identify and apply new technologies and new operating procedures that might reduce the time required to respond to incidents and restore roadways to normal operating conditions as soon as possible.

9) For incidents involving hazardous material, all of the parties will work together with the New York State Department of Environmental Conservation and HAZMAT response teams. Once public safety has been assured, the priority will shift to restoring the roadway to full capacity as soon as possible.

10) Police agencies will notify the NITTEC Traffic Operations Center of any situation that calls for closing any lane(s) of an Interstate highway for more than thirty (30) minutes and consult with NYSDOT in advance about alternatives to minimize the impact of traffic.

11) The parties hereto understand that damage to vehicles or cargo may occur as the result of clearing the roadway on an urgent basis. Reasonable efforts should be made to avoid such damage, but the priority will be to restore full roadway capacity in an expedient manner.

12) All of the parties will advise their personnel of this Agreement and promote implementation at every level of their organization.

IN WITNESS WHEREOF, the parties have affixed their signatures, the Town of Tonawanda on the _____ day of _____, 2010; Town of Amherst on the _____ day of _____, 2010; New York State Department of Transportation on the _____ day of _____, 2010; and New York State Police on the _____ day of _____, 2010.

TOWN OF AMHERST
By _____ Supervisor
TOWN OF TONAWANDA
By _____ Supervisor
NEW YORK STATE POLICE
By _____ Troop A Major
NEW YORK STATE DEPARTMENT OF TRANSPORTATION
By_____ Regional Director

Commitment of Cooperation for Traffic Incident Management

The undersigned members of the Niagara International Transportation Technology Coalition WNY Incident Management Committee acknowledge a joint responsibility for a commitment of cooperation to support the National Unified Goal for Traffic Incident Management. The National Unified Goal (NUG) for Traffic Incident Management is a unified national policy developed by major national organizations representing traffic incident responders.

Collaborative Traffic Incident Management programs and practices provide enhanced response to:

- Reduce Traffic Congestion. Safer, more efficient traffic incident management will reduce congestion by reducing incident duration and preventing secondary incidents.
- Increase Responder Safety. Improved incident management reduces responder risk by improving traffic control at incident scenes and reducing incident duration and risk exposure.

The NUG encourages individuals, agencies and organizations to work together for improved responder safety; safe, quick clearance; and prompt, reliable, interoperable communication through the following 18 strategies:

1. TIM Partnerships and Programs
2. Multidisciplinary NIMS and TIM Training
3. Goals for Performance and Progress
4. TIM Technology
5. Effective TIM Policies
6. Awareness and Education Partnerships
7. Recommended Practices for Responder Safety
8. Move Over/Slow Down Laws
9. Driver Training and Awareness
10. Multidisciplinary TIM Procedures
11. Response and Clearance Time Goals
12. 24/7 Availability
13. Multidisciplinary Communications Practices and Procedures
14. Prompt, Reliable Responder Notification
15. Interoperable Voice and Data Networks

16. Broadband Emergency Communications Systems
17. Prompt, Reliable Traveler Information Systems
18. Partnerships with News Media and Information Providers

The signatories to this commitment of cooperation agree to pursue the NUG strategies when providing services for managing incidents on the regional transportation network.

Commitment of Cooperation for Traffic Incident Management

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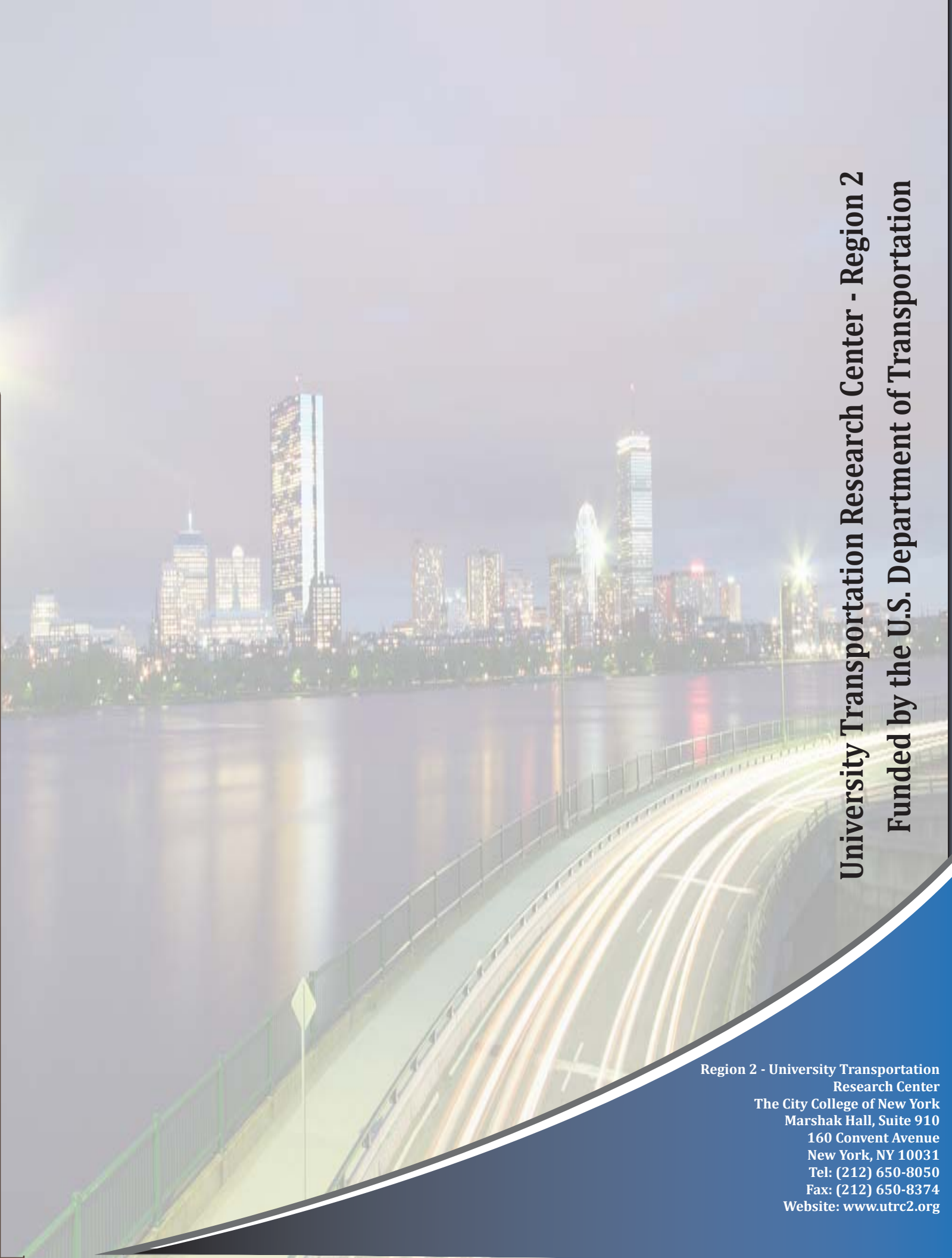
Member Agency **Name/Title:**_____

Signature: _____ **Date:**_____



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Region 2 - University Transportation
Research Center
The City College of New York
Marshak Hall, Suite 910
160 Convent Avenue
New York, NY 10031
Tel: (212) 650-8050
Fax: (212) 650-8374
Website: www.utrc2.org