Guidance Report

Camera Phone Proof-of-Concept Project

Submitted to:

Intelligent Transportation System (ITS)
Joint Program Office (JPO)
United States Department of Transportation (USDOT)

30 July 2007

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Executive Summary

This guidance report is a compilation of documents created during the Camera Phone Proof-of-Concept (POC) Project. The goal of this effort is to improve incident management and response activities in the event of a traffic incident or other emergency situations that affect traffic operations. The project has two main objectives - first to demonstrate the feasibility of using commercial cellular phones equipped with cameras to capture and deliver traffic incident imagery that is useful to follow-on responders, such as tow companies, HAZMAT remediation services, health departments, or highway repair teams. The second objective is to assess the value of these images to follow-on responders based on improvements in time, safety, and efficiency while responding to and clearing traffic incidents.

The Camera Phone POC Project was conducted in partnership with the University of Maryland's Center for Advanced Transportation Technology (UMD-CATT) and coordinated with the Capital Wireless Information Net (CapWIN) Program[1]. The United States Department of Transportation (USDOT) Intelligent Transportation Systems (ITS) Joint Program Office (JPO) and the Federal Highway Administration (FHWA) Office of Operations managed the technical tasks, which were performed by UMD-CATT and Noblis, Inc. (formerly Mitretek Systems, Inc.). Independent evaluation of this project was provided by Science Applications International Corporation (SAIC).

Project Background

Municipalities throughout the United States continue to encounter increased levels of traffic congestion. This congestion is often caused by a variety of roadway incidents, including automobile crashes, HAZMAT spills, and disabled vehicles. In many cases, these incidents produce conditions that result in secondary accidents further exacerbating congestion and creating dangerous situations for the responders attempting to clear the incident or manage traffic through the incident scene.

During a traffic incident, emergency response agencies (e.g., law enforcement, fire, rescue, and safety service) often require additional assistance from follow-on responders in order to clear the incident from the roadway. While first responders can use cellular phones, radios, or dispatcher services to call for assistance, they typically do not have the ability to exchange detailed imagery to the follow-on responders. Although closed circuit television (CCTV) cameras have been deployed and cover large segments of the road network in many metropolitan areas, there are many regions without such coverage. In addition, specific details that would be useful to follow-on responders may not be visible to CCTV operators due to vehicle positioning or the CCTV camera resolution. As a result, follow-on responders may arrive at the incident scene without the proper equipment (e.g., tow trucks, HAZMAT transporters) or the personnel required to address the situation quickly and efficiently. In many of these cases, follow-on responders must to return to their station or call for additional support in order to get the right equipment to the scene. This results in longer incident duration, thereby worsening traffic congestion, increasing the potential for secondary incidents, and prolonging a hazardous situation.

[1] The Capital Wireless Information Net (CapWIN) program is a partnership between the States of Maryland and Virginia, and the District of Columbia to develop an interoperable first responder data communication and information-sharing network. http://www.capwin.org

Project Overview & Chronology

The Camera Phone POC Project examines the utility of capturing and distributing incident scene imagery to towing and recovery providers, HAZMAT remediation contractors, and other follow-on response organizations using commercial cellular phones and services.

The following summarizes the efforts from the Camera Phone POC Project and the anthology of documents comprising this guidance report. This collection of materials provides valuable insight on the design, development, deployment, and operation of camera phone systems to be used within the public safety or transportation domains. It also presents the benefits and limitations of such systems for those desiring to implement similar capabilities.

- **The Operational Concept**

  The Camera Phone *Proof-of-Concept Project - Operational Concept* document identifies the general processes, roles and responsibilities, and flows of information that illustrate how this project was expected to improve incident management and response activities. The general concept suggests that at some point during a traffic incident, first-responders might decide they require additional assistance from other response organizations not yet on the scene, such as towing and recovery companies, HAZMAT remediation companies, highway repair crews, etc. In addition to notifying their dispatcher via radio, they can also take pictures of the incident scene and send the images directly to the appropriate follow-on responders, who might be located at central dispatching facilities or in the field.

  It is expected that incident imagery will help follow-on responders establish a better understanding of the incident, which will allow them to better define their operational procedures and select the most appropriate equipment or personnel before leaving for the incident scene. Consequently, this should allow follow-on responders to arrive at the incident scene with the proper resources, resulting in accelerated incident remediation and reduced traffic congestion.

- **The Participants**

  With CapWIN coordinating the Camera Phone POC project, testing activities were conducted in the Washington D.C. metropolitan area. The users selected to participate in the POC study were selected from existing CapWIN members, and included personnel from the Virginia Department of Transportation (VDOT), the Virginia State Police (VSP)[2], and several local commercial towing and recovering providers. During the initial phase of this project, these participants were involved in the definition of user needs, which were subsequently organized into a specification used to identify the appropriate technologies for this POC.

- **The Technical Requirements**

  The *Camera Phone Proof-of-Concept Project – Technical Requirements Specification* document defines the mobile devices and the communication services needed to support this project. Specifications are categorized by the following functions: taking a photograph, composing a multimedia message (digital picture with text and/or audio annotation),

[2] VSP helped establish the concept but was not able to participate in the field study due to limited resources

distributing a multimedia message, receiving a multimedia message, and reviewing the multimedia message. This document also identifies optional specifications, which are not critical to the POC but address new attributes of the devices and services used in multimedia messaging and could provide significant enhancement to a camera phone system used in subsequent operational deployments.

The specification does not stipulate system performance requirements (e.g., message latency), although the goal for this concept system is for the field user to be able to take a digital picture, compose a multimedia message, and begin the appropriate distribution process for that message in one minute or less. There are no technical security requirements (e.g., user authentication, message encryption) in this conceptual phase of the study. Institutional and administrative security issues are addressed via the existing policies of the participating agencies.

- **The System Description**

  The *Camera Phone Proof-of-Concept Project – System Description* document provides a basic explanation of the systems and technologies employed during the Camera Phone POC Project. While the description of most components is generic, there is sufficient information to gain an understanding of the systems used for commercial multimedia messaging services (MMS).

  The *System Description* document also describes the specific mobile devices (e.g., camera phones) and wireless services that were selected for use with the Camera Phone POC Project. A marketplace survey was used to identify commercial products and services that met the *Technical Requirements Specification.* From this list, those that met the budget, schedule and availability constraints were considered for selection.

  Infrastructure components include Internet email and web servers, which may be part of the network service provider's system, or may be part of the organization's in-house IT infrastructure. While UMD-CATT leveraged existing CapWIN computer/network infrastructure to the maximum extent possible, some additional hardware and services were required to carry out this project.

- **The Evaluation Plan**

  The *Camera Phone Proof of Concept Project - Evaluation Strategy White Paper* presents the objectives and areas of concentration for the evaluation of this project. The focus is to qualitatively assess the benefits realized by the use of camera phones to improve response capabilities for traffic incidents or emergency situations. This includes user satisfaction, system performance, system functionality, value, and other institutional and technical issues**.** Methods used to collect information for this evaluation include field observation, user interviews, archived picture/message assessment, and archived incident data.

- **The Operational Procedures**

  The *Camera Phone Proof-of-Concept Project – Operational Procedures* document describes the actions required to operate the POC system. Procedures are classified as either "domain" or "technical". Domain procedures identify the proper instance and protocol for users to employ the messaging system (e.g., under what conditions should a police officer consider

using the messaging system), while technical procedures identify the proper operation and use of the system.

To facilitate participation, the operational procedures are summarized in the two-page *Camera Phone Proof-of-Concept Project – Quick Reference Guide.* In addition, a *Camera Phone Proof-of-Concept Project – Training Guide* was created, and UMD-CATT conducted a two-hour training class for those participating in the study.

- **Monitoring and Support**

  The *Camera Phone Proof-of-Concept Project - Readiness Report* was intended to describe the readiness of all systems and participants at the beginning of the demonstration/test period for this project. As the hardware distribution and user training continued beyond the kickoff date, this document expanded to cover both the status of systems and participants at the start of the demonstration/test period, and the status of the systems after completing user training and hardware distribution.

  A user debriefing was held at the end of the demonstration/test period. Two briefings were presented to the project participants. The *USDOT Camera Phone Proof-of-Concept Project Technical Issues Overview* detailed to the users specific technical issues encountered during the evaluation. The *Camera Phone Proof of Concept Project Evaluation Update* described to the users the evaluation strategy, evaluation status, summary of usage, and preliminary findings.

- **The Evaluation (Lessons Learned)**

  The operational improvement provided by the new system and the anecdotal experiences of the participants was documented in the *Camera Phone Proof-of-Concept Project – Lessons-Learned Report*, which has been posted in the USDOT ITS Lessons Learned database (www.benefitcost.its.dot.gov). This report identifies insights with regard to using such a system for incident and emergency management practices, including:

  - Capturing and sending an image may not be the immediate concern for first responders
  - Users will need to be trained to take pictures without exposing themselves to additional risk by unnecessary exposure at the roadside
  - Audio annotations of the pictures offer valuable detail for follow-on responders
  - Operators should understand the diverse needs and experiences of users when several agencies are involved as stakeholders

  Potential success areas also exist in ITS customer satisfaction. Unexpectedly, users find it relatively easy to navigate and easy to transmit images and audio clips.

  The Camera Phone POC Project serves as a means to promote the USDOT's broader Intelligent Transportation Systems (ITS) goals of improving safety and mobility in road travel. Used to their fullest potential, camera phones in service for incident management can assist with relaying information which may have an impact on the type of equipment, route of approach, and subsequent responder training.

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Camera Phone Proof-of-Concept Project

Operational Concept

UNIVERSITY OF MARYLAND

Center for Advanced Transportation Technology

Camera Phone Proof-of-Concept Demonstration Project

Operational Concept

Task Order No. 62
Contract No. 971218-8999

CapWIN
Capital Wireless Integrated Network
Building a Bridge in Transportation and Public Safety Communications

Sponsor:
Maryland State Highway Administration
Intelligent Transportation Systems Division
7491 Connelley Drive
Hanover, Maryland

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FINAL

Introduction

This proof-of-concept (POC) project will examine the utility of capturing and distributing on-scene imagery to towing and recovery providers, HAZMAT remediation contractors, and other follow-on response organizations in real time. Service providers need this information to correctly size and configure their response to the scene, which may be launched from a considerable distance. Such imagery may, for example, contain detailed pictorial information about disabled vehicles, spilled cargo, spills, and other situations. Follow-on responders are typically called upon to provide services after the incident has been stabilized, with the major risks controlled and contained by emergency response organizations (law enforcement, fire and rescue, and emergency medical services). Their services are still critical to clearing a traffic incident; facilitating their response shortens the duration of the incident, and reduces traffic congestion.

This POC will demonstrate the capability to capture and transmit imagery with equipment such as commercial-off-the-shelf (COTS) cellular telephone cameras. The purpose is to facilitate the response of follow-on resources to incidents. This POC has two key demonstration objectives:

1. The first is to capture and transmit traffic incident scene imagery with low cost, COTS handheld equipment and corresponding wireless services.
2. The second objective is to deliver those images to follow-on response agencies via low-cost COTS options and determine the value of the images to those responders. The evaluation service will be performed under a separate contract.

Operational Concept Summary

The overall flow of the operational concept for this POC is as depicted in Figure 1. At some point during an incident, on-scene responders may decide that they require additional assistance from other response organizations not yet on the scene, such as towing and recovery companies, hazmat remediation companies, highway repair crews, etc. For the purpose of the POC, the following agencies will participate in the role of on-scene responders:

- Virginia Department of Transportation, Northern Virginia District
- Virginia State Police, Division 7

In the event that a Trooper on scene determines that, for example, a wrecker is needed and notifies dispatch to send the needed resources, the Trooper will capture and send imagery of the situation to a predetermined group. The Trooper may, after collaborating with an on scene VDOT Safety Service Patrol (SSP) operator, task VDOT with capturing and sending on-scene imagery.

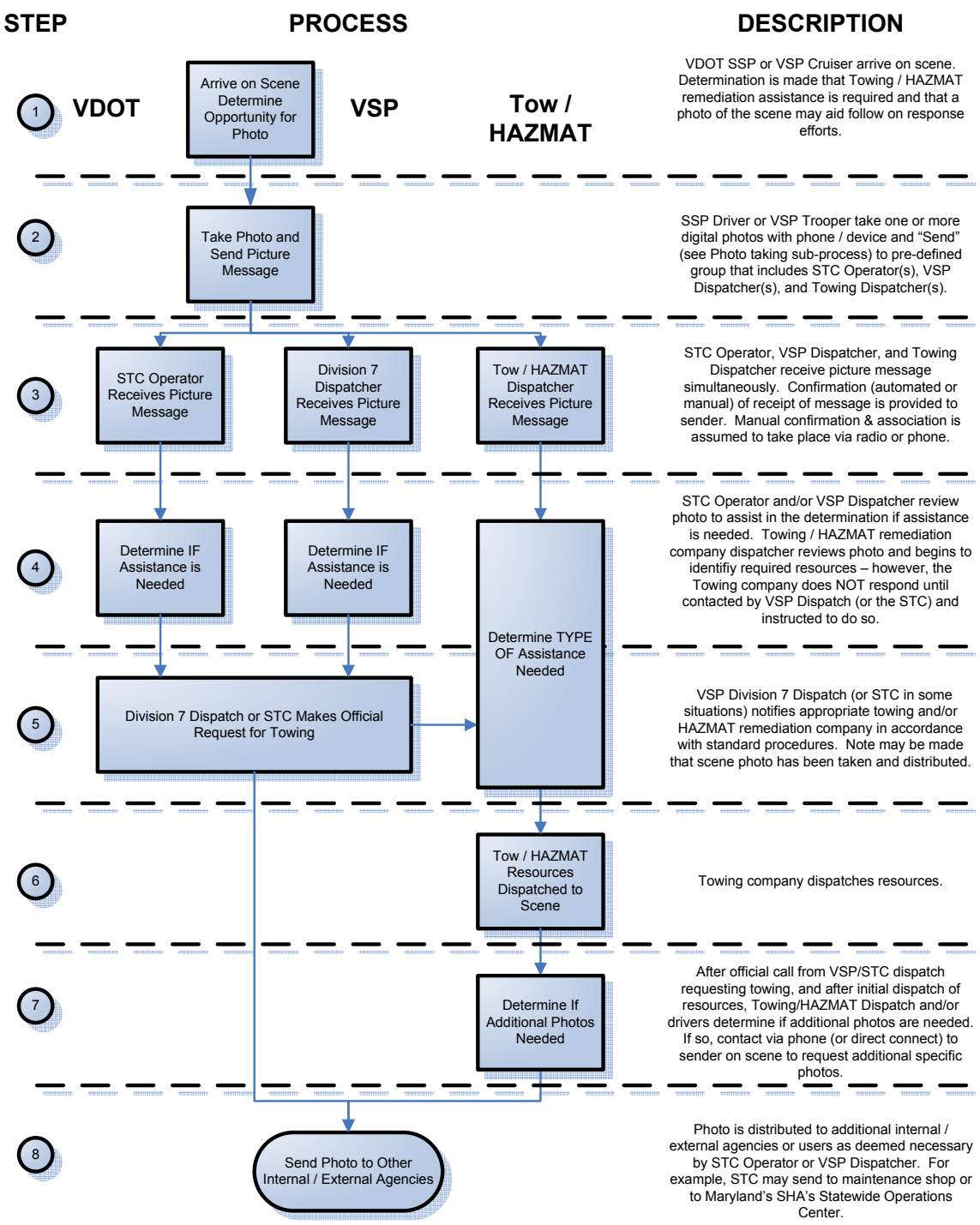

Figure 1 - High Level Operational Concept Flow Diagram

The capturing and sending of on scene imagery will be kept as simple as possible and will be similar to the process depicted in figure 2. The goal of this concept system is for the field user to be able to take a picture, compose a message, and begin the appropriate distribution process for that message in 1 minute or less.

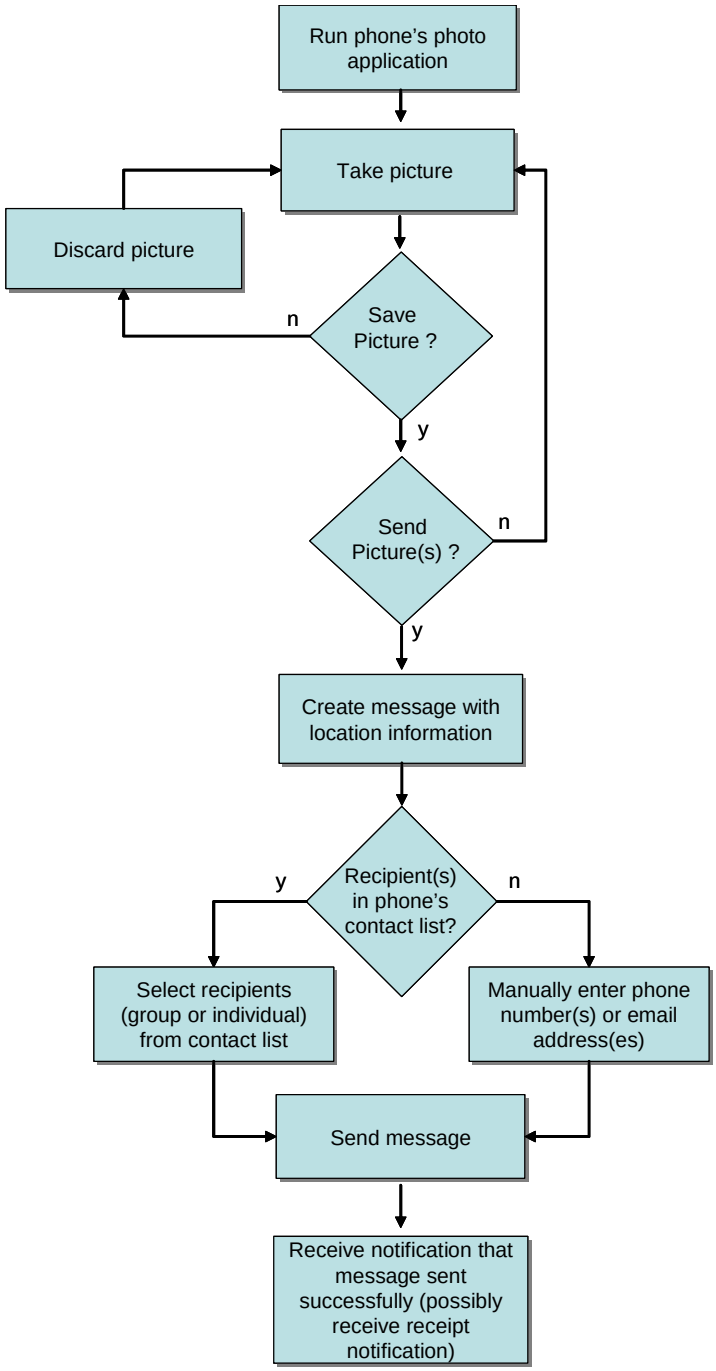

Figure 2 - Generic Picture Phone Usage Flow Diagram

The predetermined group that will receive the images sent from the scene will include, at a minimum:

- VSP Division 7 Dispatch
- VDOT Smart Traffic Center (STC) Operators
- Tow / HAZMAT Remediation
    - Redmen's: dispatch and individual tow operator(s)
    - Henry's: dispatch
    - Willow Springs: dispatch

Others may be added to this group for the purposes of evaluation and related proof-of-concept analysis.

Note: While scene images will be sent directly to the participating towers, they will NOT respond unless requested to do so by VSP Division 7 dispatch per standard operating procedures.

After receiving a request to dispatch resources, the responding tow / HAZMAT remediation company may use his or her phone to contact the sender at the scene to request additional photos that might assist in determining the appropriate level of required resources. VDOT STC operators may forward images to other internal departments or external agencies that they believe may benefit from having scene images for secondary response support. Table 1 indicates the estimated # of devices needed for the POC.

Table 1 – User/Device Association

Description	#Devices	Notes
VSP Area 9: • 5 Troopers • 3 Shift Supervisors	8	Patrol responsibility for I-66 from intersection with I-495 to Fairfax/Prince William County line and for I-495 from intersection with I-95 to MD State line.
VSP Area 45: • 5 Troopers • 3 Shift Supervisors	8	Patrol responsibility for I-395 inside Capital Beltway to DC line; I-66 from I-495 to DC line; and Dulles Toll Rd from I-66 to Fairfax/Loudoun County line.
VSP Area 48: • 5 Troopers • 3 Shift Supervisors	8	Patrol responsibility for I-95 from Prince William/Fairfax County line to MD State line.
VSP Division 7 Dispatch	5	Internet access and external email services do not exist at dispatch terminals within this facility. Commercial mobile radio services (CMRS) might be required to provide temporary connectivity for the desktop systems. Possible limited CMRS signal coverage at terminal locations.
VDOT SSP	-	VDOT SSP Operators currently use Motorola i860 picture phones with Nextel service
VDOT STC	5	VDOT STC has internet access and email services, but the workstations used by operators may not. Some VDOT STC personnel currently use Motorola i860 picture phones with Nextel service. Other STC personnel may require devices to participate.
Henrys	-	Dispatcher has desktop access to Internet
Redmans	3	Preference is for operators to receive images directly
Willow Springs	1	Dispatcher has desktop access to Internet
Total	27-37	Exact number depends on use of devices by dispatchers. Note: this does not include additional devices that may be required for R&D, test, and evaluation.

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Guidance Report

Camera Phone Proof-of-Concept Project

Technical Requirements Specification

CAMERA PHONE PROOF-OF-CONCEPT PROJECT

TECHNICAL REQUIREMENTS SPECIFICATION – PHASE I

FINAL

31 May 2005

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I. OVERVIEW

A. BACKGROUND

The Camera Phone Proof-of-Concept Project will examine the utility of capturing and distributing incident scene imagery to towing and recovery providers, HAZMAT remediation contractors, and other follow-on response organizations. The premise of the project is that if this information is supplied in a timely fashion, the responders can correctly size and more rapidly configure their response to the scene from remote dispatch facilities. A faster and properly calculated response will shorten the duration of the incident and reduce traffic congestion.

The purpose of this project is to facilitate the response of follow-on resources to incidents. This project has two key demonstration objectives. The first is to capture and distribute traffic incident scene imagery with relatively inexpensive and commercially available equipment and services. The second is to determine the value of this information to the noted responders.

This project will proceed in multiple phases. This phased approach will allow the demonstration to advance in manageable steps from simpler and smaller scale deployments in the initial phase (i.e., Phase I) to more technically complex and broader scenarios in the later phases. This document identifies the technical requirements specifications for Phase I of the Camera Phone Proof-of-Concept Project.

B. DEFINITIONS

Commercial Mobile Radio Service (CMRS): An FCC designation for mobile wireless service offered by any carrier or licensee whose wireless network is connected to the public switched telephone network (PSTN) and/or is operated for profit. These companies include the traditional cellular and Personal Communications Systems (PCS) providers, such as Verizon Wireless, Sprint, Cingular, and T-Mobile.

Note: *Nextel Communications is not a CMRS provider, but an Enhanced Specialized Mobile Radio (ESMR) provider. Traditionally, ESMR providers cater to business and industrial customers and have systems with either no connection or limited connection to the PSTN. These companies also operate in a different frequency bands than the cellular and PCS providers. However, Nextel has full connection to the PSTN and the operational distinction between Nextel and other CMRS providers has disappeared.*

Short Messaging Service (SMS): The transmission of short text messages to and from a mobile phone, fax machine, and/or IP address. Messages must be no longer

than 160 alphanumeric characters and contain no images or graphics. Once a message is sent, it is received by a provider's Short Message Service Center (SMSC), which must then deliver it to the appropriate mobile device.

Multimedia Message Service (MMS): A store-and-forward method of transmitting graphics, video clips, sound files, and short text messages over wireless networks using the Wireless Application Protocol (WAP). Providers deploy special servers, dubbed MMS Centers (MMSCs) to implement the offerings on their systems.

Quick Text: Text messages commonly used in SMS and MMS conversations, for example entering the word "hello" or a phone number. Quick text message are variable in length depending on the capabilities of the device. Quick text messages are stored in the device and can be retrieved automatically with various short cut mechanisms.

Field Users: These individuals are responsible for creating and distributing digital imagery from the field (e.g., the scene of an incident). During Phase I, these users will include Virginia State Police Officers, VDOT Safety Service Patrol Officers, and field personnel from select towing and recovery companies.

Center Users: Personnel stationed at a fixed facility (e.g., the VDOT STC or the VSP dispatch facility). These individuals are recipients of the digital imagery supplied by field users. During Phase I, these users will include Virginia State Police Dispatchers, VDOT Smart Traffic Center (STC) Operators, and dispatchers from select towing and recovery companies.

Fixed Center Users: Center Users that rely on fixed communication services (e.g., wireline Internet access) and fixed computing resources (e.g., desktop computer)

Mobile Center Users: Center Users that rely on mobile communication services and mobile computing resources (e.g., PDA)

Note: *The distinction between fixed and mobile center users is required during initial implementation since some participating agency facilities do not have dedicated Internet access.*

Note: *Mobile Center Users may include project oversight officials from the VSP.*

C. SCOPE

The functional requirements for the camera phone proof-of-concept system are categorized as follows.

- Field User takes a digital photograph
- Field User composes a multimedia message (digital picture, with text and/or audio annotation)
- Field User distributes a multimedia message
- Field User(s) and/or Center User(s) receive the multimedia message (recipients may subsequently redistribute the message)
- Field User(s) and/or Center User(s) view the picture, listen to the audio, and/or read the text from a multimedia message

For Phase I of this project, technical specifications are limited to the mobile devices and the communication services needed to support these basic functions.

Specifications identified as ***"optional"*** are not critical to Phase I of the proof-of-concept project. Many of these items are new attributes of the devices and services used in multimedia messaging and could provide significant enhancement to a camera phone system used in later phases of this study or in subsequent operational deployments. Some optional specifications may become mandatory for subsequent phases of this project.

This specification does not include a system architecture or system design parameters; these factors are addressed in the System Description Document. This specification also does not stipulate system performance requirements (e.g., message latency), although the goal of this concept system is for the field user to be able to take a digital picture, compose an MMS message, and begin the appropriate distribution process for that message in 1 minute or less. There are also no technical security requirements (e.g., user authentication, message encryption) in this conceptual phase of the study. Institutional and administrative security issues will be addressed via the existing policies of the participating agencies. Additional specifications (e.g., performance, security, environmental) will be amended to this document as required for subsequent phases of this project.

II. TECHNICAL REQUIREMENTS

A. FIELD USER

The following specifies the devices and communication services required for the field users during Phase I of this project**.**

1. DEVICE

a) General Requirements

Mobile phone capable of digital photography and use with a CMRS available in the Washington DC Metropolitan Area.

Note: *Some unspecified attributes of a mobile phone are implicit, such as the ability to support PSTN voice services. Such attributes are not listed in this specification.*

Furthermore, some attributes of mobile phones might be significant for an operational deployment but are not relevant during Phase I of this conceptual study. These include physical attributes such as size, weight, and durability of the device; and functional attributes such as battery life, talk time, standby time, ring tones/mode, locking mechanisms, and programmable software. Such attributes are not identified in this specification, but may be specified for subsequent phases of this project.

b) Specific Requirements

(1) Photography

(a) Picture Color: Device shall be able to take a color picture (no specification on color gamut or saturation)

(b) Picture Format: Device shall create pictures in either the JPG or GIF format.

(c) Picture Resolution

(i) Device shall create pictures with a minimum resolution of 640 x 480 pixels (VGA)

(ii) **Megapixel Resolution** ***(optional****: Different receiving devices may not be able to accommodate the increased resolution of these images****)***

(d) Low Light Operation / Flash: ***(optional)***

Note*: An LED strobe light ("flash") or a pixel binning capability can help performance in low light operations, but these features are not yet available on many devices. In addition, low-light performance can vary greatly between different camera models and different resolution settings.*

(e) Storage: Device shall be able to temporarily store pictures taken with this device. *There is no storage capacity requirement during Phase I of this project.*

(2) Message Composition

The following services shall be supported by the device

(a) Short Messaging Service (SMS)

(b) Multimedia Messaging Service (MMS)

(i) Device and/or device's MMS client application shall be able to include at least one picture in an MMS message

(ii) Device and/or device's MMS client application shall be able to annotate an MMS message picture as described in the "Picture Annotation", Section III.B.1.(3).

(3) Picture Annotation

(a) Text Annotation

(i) Text Entry: Device and/or device's client application(s) shall have some mechanism for entering the text of an MMS message. *There is no specification on text entry method (e.g., T9, keyboard) during Phase I of this project.*

(ii) Quick Text Entry ***(optional)***

(iii) Speech-to-Text Entry ***(optional)***

(b) Voice Annotation ***(optional)***

(i) Device and/or device's client application(s) shall have the mechanisms to record audio files in the WAVE or MP3 sound file format and attach such audio files to an MMS message.

(4) Message Distribution

(a) Recipient List: Device and/or device's client application(s) shall allow the user to select a single MMS message recipient from the device's address book. This selection will subsequently result in the distribution of the MMS message to the entire target recipient list.

Note: *The implementation of the distribution list might be accomplished by various methods, including lists stored in the device, with the CMRS carrier, and/or on an email server.*

(5) Message Receipt

(a) Device shall be able to receive MMS and SMS messages

(b) Device and/or device's client application(s) shall be able to notify user (audio and/or vibration) upon receipt of an SMS or MMS message.

(6) Viewing Message Picture

(a) Color Display Device shall have at least one color display

(i) Display Type: LCD

(ii) Display Size: Minimum 1.75" diagonal

(iii) Display Resolution: Minimum 160 x 120 pixels

(b) Zoom Capability *(optional:* *zoom – up to the native resolution of the display – while viewing a received picture****)***

(7) Playback Message Audio

(a) Speakerphone *(optional)*: Device shall have a speakerphone and shall be capable of playing audio files in WAVE or MP3 sound file format

(8) Read Message Text

(a) Display: Device and/or device's client application(s) shall be capable of displaying inline or attached text from MMS messages

(b) Display Languages: English

(9) Other Attributes

(a) Functional

(i) Video recording and/or playback ***(optional)***

(ii) GPS function ***(optional)***

(b) Accessories: Belt clip or similar apparatus for user to carry device on a belt

2. SERVICES

a) General Requirements

CMRS in the Washington, D.C. metropolitan area capable of supporting MMS

b) Specific Requirements

(1) Service(s) shall be compatible with associated Field User device(s)

(2) Multimedia Messaging Service (MMS)

(a) Sending a Message: Provider's MMS shall allow user device to send an MMS message to an individual recipient or multiple recipients

(b) Forwarding a Message: Provider's MMS shall allow user device to forward an MMS message to an individual recipient or multiple recipients

(c) Confirmation of Message Delivery to Recipient Device (*optional*: *Some providers offer this function within their own network or within networks based on similar systems (e.g., GSM))*

(d) Allowing User Device to Retrieve Previous MMS Messages *(optional)*

Note: *MMS messages are often removed from providers MMS server after retrieved by the user.*

(3) Voice Service: Minimal service plan for circuit switched cellular voice with access to the PSTN

(4) Short Messaging Service (SMS) *(optional)*

Note: *Provider may use SMS in support of MMS, but user is not required to have separate SMS plan.*

B. FIXED CENTER USER: The following specifies the devices and communication services required for the Fixed Center Users during Phase I of this project.

Note: *Provisions for the Fixed Center Users' computing and communication resources are outside scope of this project. Fixed Center Users will rely on existing computing and communication resources. The following specifications identify minimal requirements for these resources. This specification does not address all needs associated with the network administration, security, or use of these resources. Fixed Center Users will relay on their individual agency's policy and administration regarding such issues.*

1. DEVICE

a) General Requirements

Desktop, laptop, or tablet computer with access to the Internet and an email server.

b) Specific Requirements

(1) Message Composition

(a) Email client

(i) Computing resource will have a client application capable of composing an email message with picture and audio attachments

(b) Audio Recording *(optional: Computing resource with soundcard and ancillary equipment for recording an audio file in WAVE or MP3 sound file format)***

(2) Message Distribution

(a) Recipient List: Email client will allow the user to select a single message recipient from the client's address book. This selection will subsequently result in the distribution of the message to the entire target recipient list.

Note: *The implementation of the distribution list might be accomplished by various methods, including lists within the user's address book, lists on a local email server, and/or lists on an external Internet email server.*

(3) Message Receipt

(a) Computing resource and email client will be able to receive email messages from the Internet

(b) Email client will be able to notify user (audio and/or visual) upon receipt of an email message

(4) Viewing Message Picture

(a) Computing Resource Display: Computing resource will have a color display with a minimum resolution of 640 x 480 pixels (VGA).

(5) Playback Message Audio

(a) Speakers: Computer resource will have speakers and a soundcard capable of playing audio files in WAVE or MP3 sound file format.

(6) Read Message Text: *N/A. Inherent feature of email client*

(7) Other Attributes

(a) Functional

(i) Video recording and/or playback ***(optional)***

2. SERVICES

a) General Requirements

Internet access and email service

b) Specific Requirements

(1) Internet Service

(a) **Dedicated Service:** Fixed center computing resource(s) will have dedicated access to the Internet *(Dial-up service(s) will not support the concept system).*

(b) Internet access mechanisms (hardware or software) should not block or restrict messages from field or center users.

(c) Internet access mechanisms (hardware or software) should not filter or restrict any attachments to messages from field or center users.

(2) Email Service

(a) Fixed center computing resources will have access to an email server, either within the local network or via an external service provider.

(b) Email Server

(i) Email sever will be able to send and receive messages to and from the Internet.

(ii) Email server and fixed center computing resources will be able to exchange email messages with audio and picture attachments.

(iii) Email server should not filter or restrict any attachments to messages from field or center users

****** Agency policy must allow computing resources to exchange email messages with audio and picture attachments.***

(c) Message Delivery Confirmation *(optional:* *Confirmation of message delivery to recipient device****).***

Note: *Email client can be configured to request message delivery and message read confirmation.*

C. MOBILE CENTER USER *(OPTIONAL)*: The following specifies the devices and communication services required for the Mobile Center Users during Phase I of this project.

During Phase I, the following devices and services will be used to support Center Users located at agency facilities that do not yet have dedicated Internet access, or they will be used to support project oversight officials from the VSP. These resources will be used for receipt and display of MMS messages from field users, and forwarding messages to additional recipients. These resources are not intended to support digital photography or message composition during Phase I of this project, although they might have such capabilities.

1. DEVICE

a) General Requirements

PDA with access to the Internet and an email server.

Note: *Some attributes of a PDA, such as size, weight, battery life, keyboard, etc., might be significant for an operational deployment, but they are not relevant for the purpose of the PDA during Phase I of this conceptual study. Therefore, such attributes are not identified in this specification.*

b) Specific Requirements

(1) Message Receipt

(a) PDA shall be able to receive MMS and SMS messages, or it shall have a client application capable of receiving an email message with picture and audio attachments.

(b) PDA and/or PDA's client applications shall be able to notify user (audio and/or vibration) upon receipt of an SMS, MMS, or email message.

(2) Message Distribution

(a) Recipient List: PDA and/or PDA's client applications shall allow the user to select a single message recipient from a local address book. This selection will subsequently result in the distribution of the message to the entire target recipient list.

Note: *The implementation of the distribution list might be accomplished by various methods, including lists stored in the PDA or with the CMRS carrier, lists within the user's email address book, lists on the local email server, and/or lists on an external Internet email server*

(3) Viewing Message Picture

(a) Color Display PDA shall have at least one color display

(i) Display Type: LCD

(ii) Display Size: Minimum 3" diagonal

(iii) Display Resolution: Minimum 320 x 240 pixels

(b) Zoom Capability *(optional: zoom – up to the native resolution of the display – while viewing a received picture**)***

(4) Playback Message Audio

(a) Speakers: PDA shall have speakers and shall be capable of playing audio files in WAVE or MP3 sound file format.

(5) Read Message Text

(a) Display: PDA and/or PDA's email client application shall be capable of displaying inline or attached text from email messages, or PDA and/or PDA's MMS client application shall be capable of displaying inline or attached text from MMS messages

(b) Display Languages: English

(6) Other Attributes

(a) Functional

(i) Video recording and/or playback ***(optional)***

(b) Accessories: Belt clip or similar apparatus for user to carry PDA on a belt

2. SERVICES

a) General Requirement

Internet access and email service

b) Specific Requirements

(1) Internet Service

(a) Dedicated Service: PDA shall have dedicated access to the Internet via one of the CMRS packet data networks available in the Washington, DC metropolitan area.

(2) Messaging Service

(a) PDA message client application shall have access to the corresponding message server of the selected CMRS provider (i.e., the PDA's email client shall have access to the CMRS provider's email server and/or the PDA's MMS client shall have access to the CMRS provider's MMS server)

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Guidance Report

Camera Phone Proof-of-Concept Project

System Description

CAMERA PHONE PROOF-OF-CONCEPT PROJECT

SYSTEM DESCRIPTION DOCUMENT – PHASE I

FINAL

15 August 2005

TABLE OF CONTENTS

SECTION **PAGE**

I. INTRODUCTION

A. PURPOSE & SCOPE

This document provides an elementary description of the messaging system used during phase I of the Camera Phone Proof-of-Concept Project. It does not contain the detail of a formal system design document – in part because the details of commercial systems are not publicly available and are proprietary in nature. While the description of most components is generic, there is sufficient information to gain an understanding of the general system design of commercial MMS systems.

It should be noted that some system constraints are a function of specific user devices and provider service options.

B. ORGANIZATION OF DOCUMENT

- Project Background
- MMS System Primer
- MMS System for Phase I of the Camera Phone Proof-of-Concept Project

C. REFERENCES

The following documents provide additional reference for the Camera Phone Proof-of-Concept project.

- Operational Concept Description Document – Phase I
- Technical Requirements Specification – Phase I
- Operational Procedures Document – Phase I

D. DEFINITIONS

Commercial Mobile Radio Service (CMRS): An FCC designation for mobile wireless service offered by any carrier or licensee whose wireless network is connected to the public switched telephone network (PSTN) and/or is operated for profit. These companies include the traditional cellular and Personal Communications Systems (PCS) providers, such as Verizon Wireless, Sprint, Cingular, and T-Mobile.

Note: *Nextel Communications is not a CMRS provider, but an Enhanced Specialized Mobile Radio (ESMR) provider. Traditionally, ESMR providers cater to business and industrial customers and have systems with either no connection or limited connection to the PSTN. These companies also operate in a different frequency bands than the cellular and PCS providers. However, Nextel has full connection to the PSTN and the operational distinction between Nextel and other CMRS providers has disappeared.*

Short Message Service (SMS): The transmission of short text messages to and from a mobile phone, fax machine, and/or IP address. Messages must be no longer than 160 alphanumeric characters and contain no images or graphics. Once a message is sent, it is received by a provider's **Short Message Service Center (SMSC)**, which must then deliver it to the appropriate mobile device.

Short Message Service Center (SMSC): A network element in a provider's network that routes and delivers SMS messages

Multimedia Messaging Service (MMS): A store-and-forward method of transmitting graphics, video clips, sound files, and short text messages over wireless networks using the Wireless Application Protocol (WAP). Providers deploy special servers, dubbed **Multimedia Messaging Service Centers (MMSC)** to implement the offerings on their systems.

Multimedia Messaging Service Center (MMSC): A network element in a provider's network that routes and delivers MMS messages

Internet Email Server: A network element in a provider's or organization's network that routes and delivers email messages

Simple Mail Transfer Protocol (SMTP): A client/server protocol utilized for email transmission across the Internet. Used by client applications to send email messages to email servers. It is also utilized for sending email messages between email servers (sending server acts like a client in this instance).

Post Office Protocol (POP): A communication protocol utilized by email client applications to retrieve email messages from an email server

Internet Message Access Protocol (IMAP): A communication protocol utilized by email client applications to retrieve email messages from an email server

HyperText Transport Protocol (HTTP): A request/response protocol between clients and servers. It is the primary method used to convey information on the World Wide Web.

Wireless Application Protocol (WAP): A protocol suite for applications that use wireless communication

Wireless Session Protocol (WSP): A protocol in the WAP suite – best thought of as a compressed version of HTTP

Internet Service Provider (ISP): A company that provides individual users and/or other organizations/companies access to the Internet. With access to the Internet, users can browse the World Wide Web (WWW), send, and receive e-mail, etc. ISPs that serve large companies often provide a direct connection from the company's

networks to the Internet. ISPs themselves are connected to one another through Network Access Points (NAPs).

Wireless Internet Service Provider (WISP): An ISP providing its services via wireless networks

Network Service Provider (NSP): A company that provides Internet access to ISPs. Often referred to as backbone providers, NSPs offer direct access to the Internet backbone and the Network Access Points (NAPs).

Network Access Point (NAP): A public network exchange facility where Internet Service Providers (ISPs) can connect with one another in peering arrangements. The NAPs are a key component of the Internet backbone. They are also the points of most Internet congestion.

Field Users: These individuals are responsible for creating and distributing digital imagery from the field (e.g., the scene of an incident). During Phase I, these users will include Virginia State Police (VSP) Officers, VDOT Safety Service Patrol Officers, and field personnel from select towing and recovery companies.

Center Users: Personnel stationed at a fixed facility (e.g., the VDOT STC or the VSP dispatch facility). These individuals are recipients of the digital imagery supplied by field users. During Phase I, these users will include Virginia State Police Dispatchers, VDOT Smart Traffic Center (STC) Operators, and dispatchers from select towing and recovery companies.

Fixed Center Users: Center Users that rely on fixed communication services (e.g., wireline Internet access) and fixed computing resources (e.g., desktop computer)

Mobile Center Users: Center Users that rely on mobile communication services and mobile computing resources (e.g., PDA)

> ***Note:*** *The distinction between fixed and mobile center users is required during initial implementation since some participating agency facilities do not have dedicated Internet access.*
>
> ***Note:*** *Mobile Center Users may include project oversight officials from the VSP.*

II. BACKGROUND

The Camera Phone Proof-of-Concept Project will examine the utility of capturing and distributing incident scene imagery to towing and recovery providers, HAZMAT remediation contractors, and other follow-on response organizations. The premise of the project is that if this information is supplied in a timely fashion, the responders can correctly size and more rapidly configure their response to the scene from remote dispatch facilities. As suggested in Figures SD-1 and SD-2, a faster and properly calculated response will shorten the response time to an incident, which can subsequently shorten the duration of the incident and reduce traffic congestion.

Figure SD-1 represents a common dispatching scenario for towing and recovery services. In this instance, a VSP officer uses radio communication – typically some form of land mobile radio (LMR) – to request services from the Division 7 Dispatch Center and relay information about the incident scene.

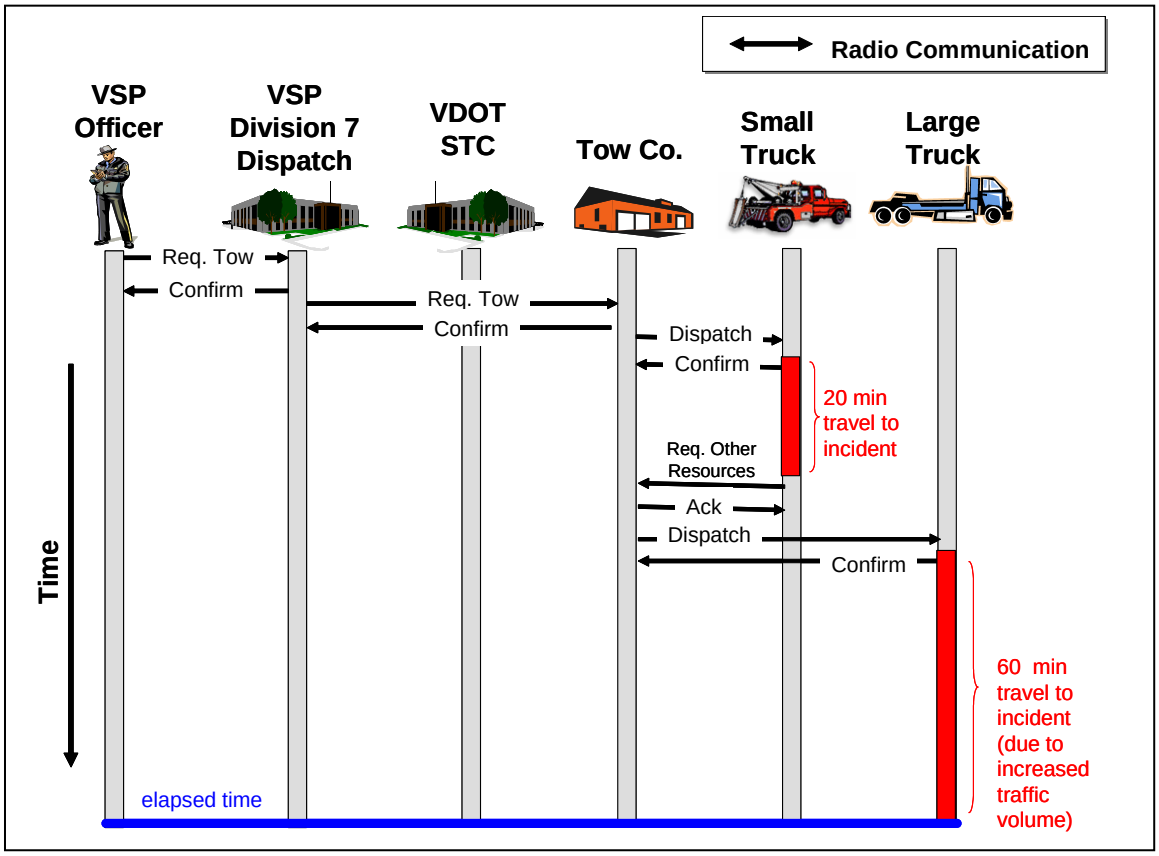

Figure SD-1, Baseline Operations - VSP Field User

The Division 7 Dispatch requests service from the appropriate towing company, which subsequently dispatches a truck. After arriving at the incident scene, it is determined that different/additional resources are required. Due to developing traffic congestion, it can take significantly longer for these new resources to arrive at the scene.

Figure SD-2 illustrates a similar scenario, including a modified flow of information and potential time-savings when supplementing radio communication with MMS messages.

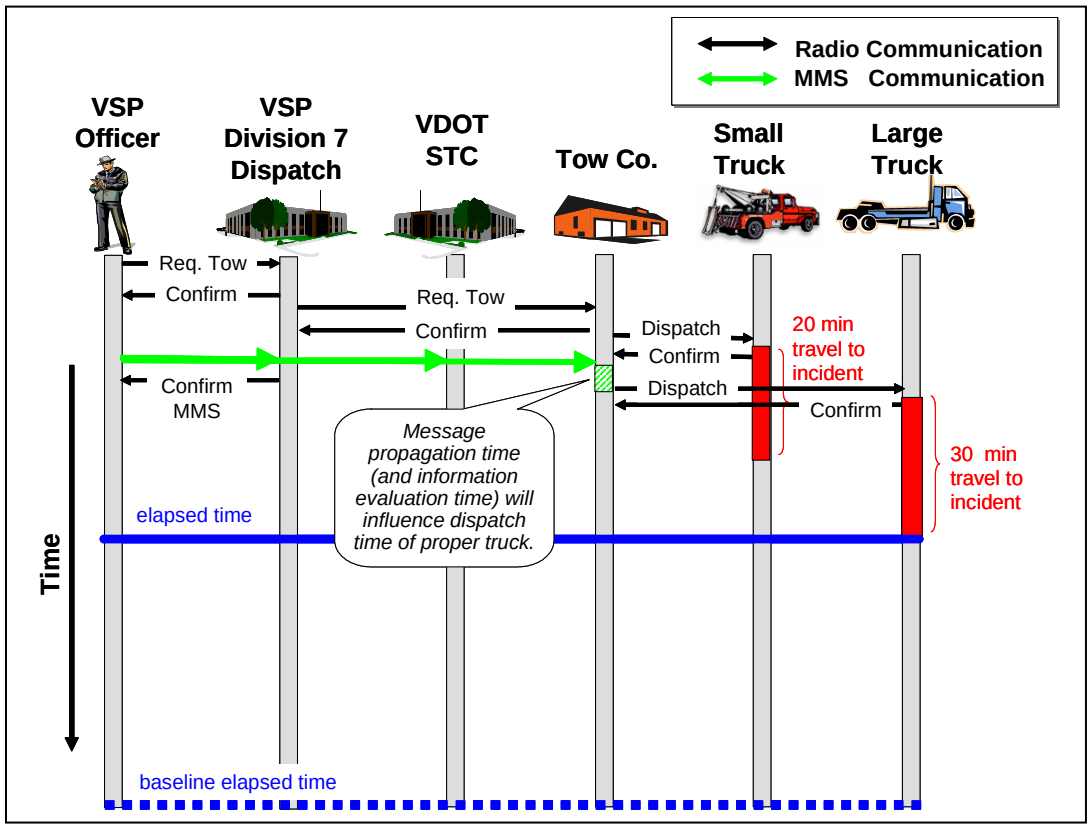

Figure SD-2, Enhanced Operations - VSP Field User

In addition to requesting services using radio, the VSP officer uses a picture phone to assemble an annotated image (or images) of the incident scene. This multimedia information is then distributed among a predefined group of users. In this case, this would include users at the VSP Division 7 Dispatch Center, the VDOT STC, and the participating towing company dispatch facilities. The towing companies are the initial benefactors; they now have much more information with which to determine the proper resources for a response. The difference in elapsed time between scenarios (i.e. with and without MMS) could be significant.

The inclusion of MMS within this scenario is not intended to eliminate radio communication – only augment it. Since radio communication is still employed (and required) as part of the dispatch process, an initial dispatch of towing services may have occurred before the MMS message is composed, distributed, and analyzed. However, if an additional towing dispatch will eventually be required, the MMS system may enable a more timely and adequate response.

Note: *While messages will be sent directly to the participating towing companies, they will not respond unless requested to do so by VSP Division 7 dispatch per standard operating procedures.*

This scenario may be applicable for other field users (such as VDOT SSP), with possible variations to the radio dispatch procedures.

The purpose of this project is to facilitate the response of follow-on resources to incidents. This project has two key demonstration objectives. The first is to capture and distribute traffic incident scene imagery with relatively inexpensive and commercially available equipment and services. The second is to determine the value of this information to the noted responders.

This project will proceed in multiple phases. This phased approach will allow the demonstration to advance in manageable steps from simpler and smaller scale deployments in the initial phase (i.e., Phase I) to more technically complex and broader scenarios in the later phases. This document provides a high-level description of the messaging system used during Phase I.

III. MMS SYSTEM PRIMER

The communication infrastructure used to send and receive MMS messages will introduce various degrees of latency (i.e., the amount of time it takes for a message to traverse the network) and compatibility/consistency issues (i.e., the ability to receive a similar message by all users). These impacts will differ among service providers, location, time of day, and other parameters, and can be particularly apparent when sending messages between providers. The purpose of this primer is to provide an overview of major MMS communication infrastructure components and the process of sending and receiving an MMS message.

A. MMS INFRASTRUCTURE COMPONENTS

1. MMSC – Multimedia Messaging Service Center

Primary server utilized for MMS Messaging. Routes and delivers MMS messages. It can be viewed as having three primary components:

a) MMS Server

Core component of the MMSC – contains, tracks, routes, and stores the MMS messages within the carrier's network

b) MMS Web Server

MMS Server module (or separate server) that sends and receives MMS messages to and from end user devices (phones, PDAs) within a carrier's network, as well as between carriers. It sends MMS messages and images via HTTP and/or WAP (or, more accurately, replies to requests for MMS messages with the requested message/image). In addition, it can send notifications of new/incoming MMS messages to end user devices via WAP/WSP "PUSH".

c) MMS Email Gateway

MMS Server module (or separate server) that sends and receives MMS messages to and from the Internet (via email). It converts the messages between the internal MMS/WSP/WAP format (within a carrier's network) and the Internet-standard SMTP format.

There are MMSC implementations by multiple vendors, including Nokia, NowMMS, Exomi, and Lucent.

2. SMSC – Short Message Service Center

Primary server utilized for SMS Messaging. Routes and delivers SMS messages, both within a carrier's network and between carriers (when authorized between carriers).

Notifications of new MMS messages can be delivered via SMS (and therefore via the SMSC). While technically MMS messages can be delivered via SMS, it is never implemented this way in practice.

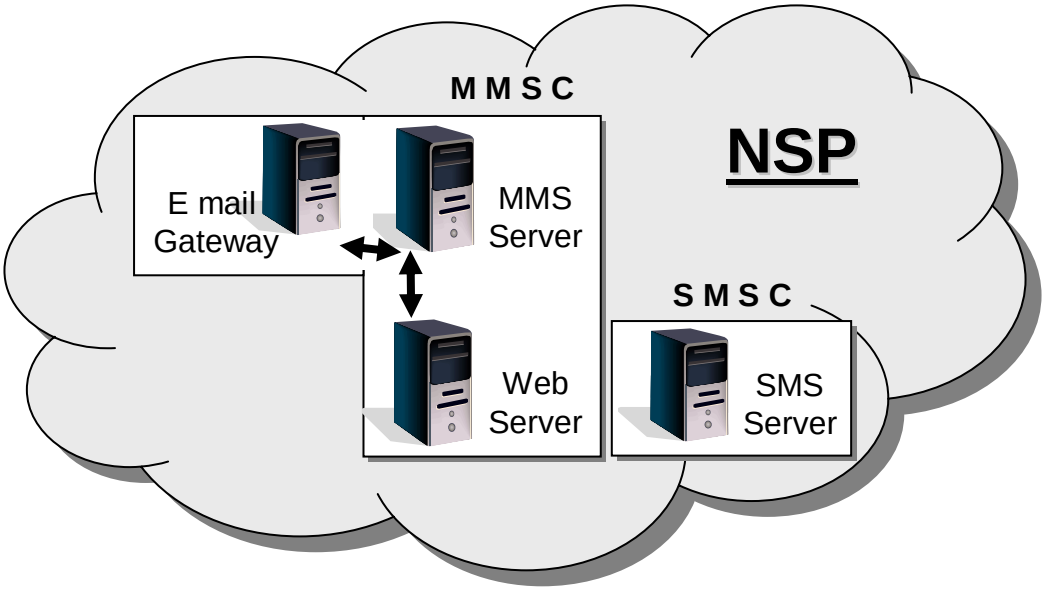

Figure SD-3, MMS Infrastructure Components

B. MMS MESSAGE CONTENT

MMS messages can contain digital photographs, graphics, video clips, audio files, and/or short text messages. The content of any specific MMS message will depend on the features and capabilities of the source device – either camera phone or computer – and the service provider messaging system design, in particular, any conversion that occurs when the carrier sends messages to users on other networks.

C. MMS MESSAGE EXCHANGE

During the exchange of an MMS message between two end users, the MMS message will travel through a number of infrastructure components. This exchange can include multiple handoffs, as well as multiple conversions (e.g., converting to and from SMTP). Each of the steps in the message exchange introduces delays into the final delivery of the MMS message.

The five scenarios examined in this document are messaging between (1) two phones on the same provider network, (2) two phones on two different provider networks, (3) one phone on a provider network and one desktop computer on the Internet, (4) one desktop computer on the Internet and one phone on a provider network, and (5) one desktop computer on the Internet to another desktop computer on the Internet.

1. MMS Message Exchange: Intra-Provider – Phone-to-Phone

This scenario involves the sending of an MMS message by one camera phone to another camera phone on the same provider. The infrastructure architecture for

this scenario includes the MMSC components (e.g., MMS Server and MMS Web Server) and SMSC components of one provider, as shown in figure SD-4.

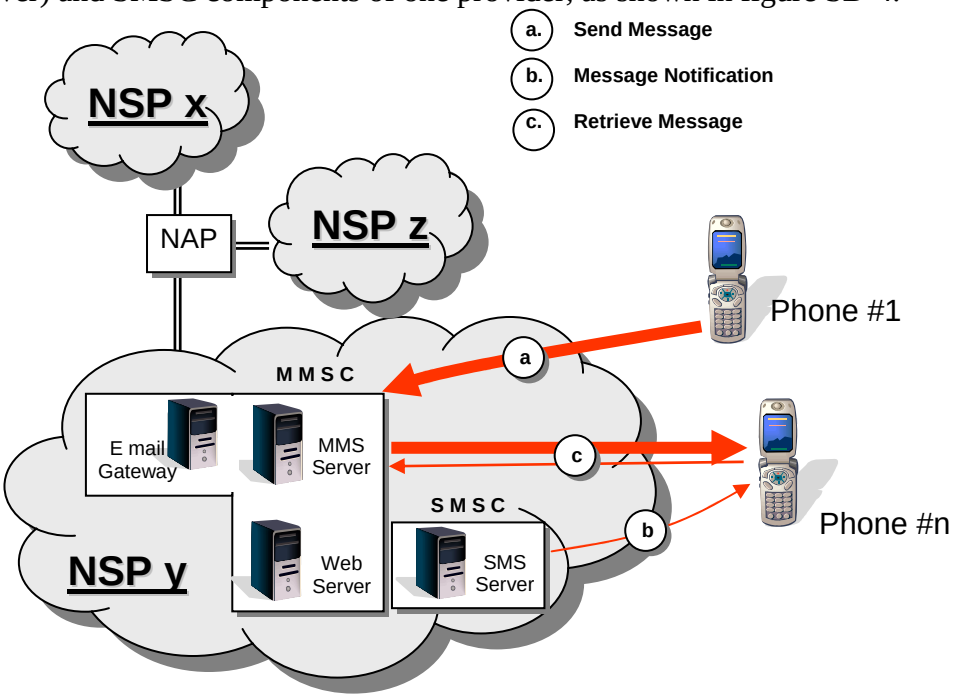

Figure SD-4, Intra-Provider MMS Message Exchange

a) Communication: Phone to MMSC (Send Message)

After the MMS message is composed and assembled/encoded by the user equipment (i.e. camera phone), the phone transmits the entire MMS message via an HTTP "POST" to the MMSC, as illustrated in Figure SD-5, below. Upon successful receipt, the MMSC replies to the phone within the open connection with an HTTP "OK" message.

b) Communication: MMSC to Phone (Message Notification)

After receiving an MMS message that is destined for one of the users on its network, the MMSC temporarily makes it accessible (i.e., publishes it) on a web server internal to the MMSC with a private URL specific to that particular MMS message. If the target phone is currently available on the network, the MMSC sends a WAP/WSP "PUSH" notification or an SMS notification to that phone, including the private URL in the notification.

Upon receiving a notification, most phones will notify the user of an incoming MMS message (e.g., ring, vibration). After alerting the user, some phones are configured to immediately retrieve the message from the MMSC ("immediate delivery") – other phones/configurations will wait for the user to manually ask for the retrieval of the MMS message by the phone from the MMSC ("deferred delivery").

c) Communication: Phone to MMSC (Retrieve Message)

To retrieve the message from the MMSC, the destination phone makes an HTTP "GET" request to the MMSC (via its MMS Web Server component) on the specified temporary private URL. The MMSC responds to the request with the actual content (text and multimedia attachments) of the MMS message. After successfully downloading the message, the destination phone makes a new HTTP "POST" to the MMSC with an acknowledgement of the receipt of the MMS message; the MMSC subsequently replies with an HTTP "OK".

Depending on the provider's system and the configuration of the relevant devices, the MMSC might use a WAP/WSP "PUSH" to notify the source phone (origin of the message) that the MMS message was received by the destination phone.

The MMS message is typically available at the private URL on the MMSC's web server until either the destination phone acknowledges receipt of the message or until a provider-specified timeout, whichever occurs first.

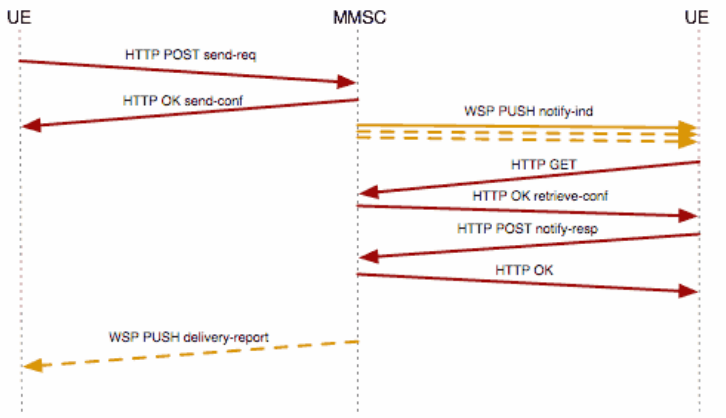

Figure SD-5, Sequence Diagram: Intra-Provider MMS Message Exchange

2. MMS Message Exchange: Inter-Provider – Phone-to-Phone

This scenario involves the sending of an MMS message by one camera phone to another camera phone on a different provider network. The infrastructure architecture for this scenario is an extension of the Intra-provider scenario. It includes the MMSC components of each provider, as shown in Figure SD-6.

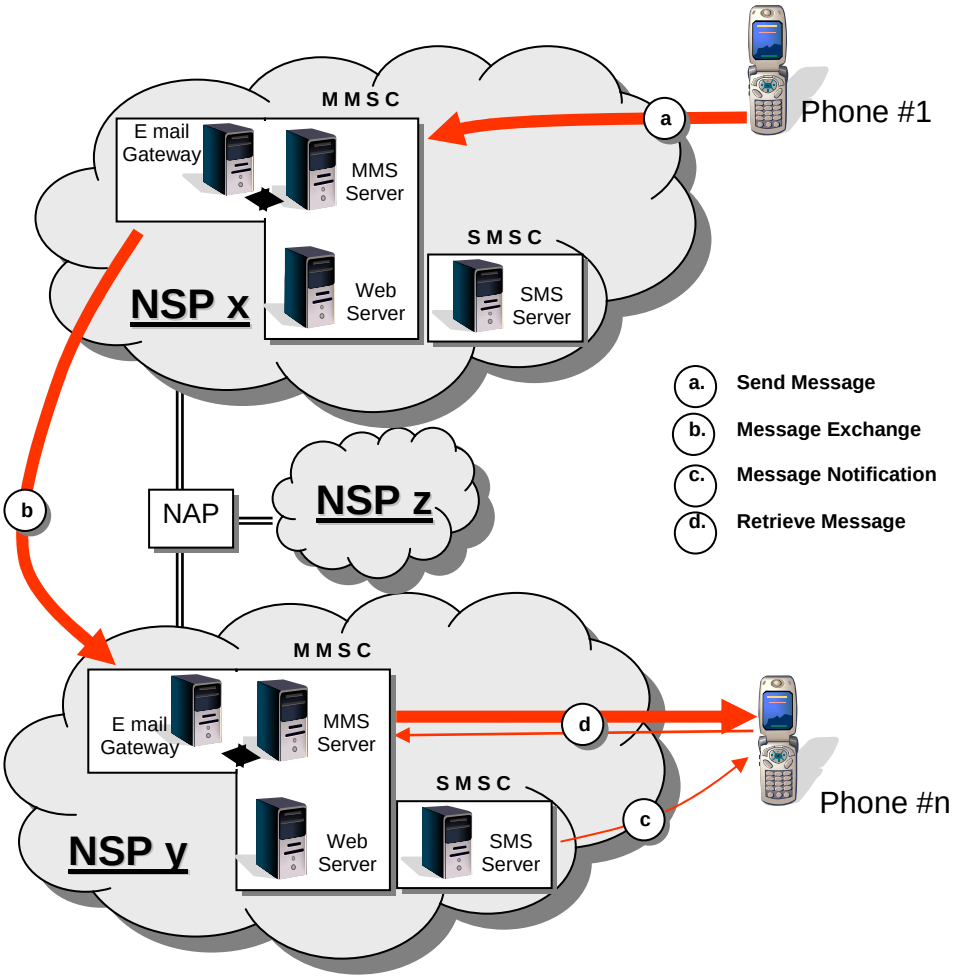

Figure SD-6, Inter-Provider MMS Message Exchange

a) Communication: Phone to MMSC (Send Message)

This step operates in the same manner as with intra-provider communication.

b) Communication: MMSC to MMSC (Message Exchange)

When an MMSC receives an MMS message for a phone outside of its network, it contacts that carrier's MMSC and transmits the MMS message to that MMSC. This transmission can be performed via HTTP or via SMTP, depending on the agreements between the carriers and the settings of each carrier's MMSC.

c) Communication: MMSC to Phone (Message Notification)

This step operates in the same manner as with intra-provider communication.

d) Communication: Phone to MMSC (Retrieve Message)

This step operates in the same manner as with intra-provider communication.

Note: Notification to the sending phone of message delivery typically works between GSM-based providers, but not between CDMA providers, nor between a GSM provider and a CDMA provider.

3. MMS Message Exchange – Internet – Phone-to-Computer

This scenario involves the sending of an MMS message by one camera phone to a non-phone user's Internet email address. The infrastructure architecture for this scenario is an extension of the Intra-provider scenario. It includes the MMSC components of one provider and the destination user's Internet Email Server, as shown in Figure SD-7.

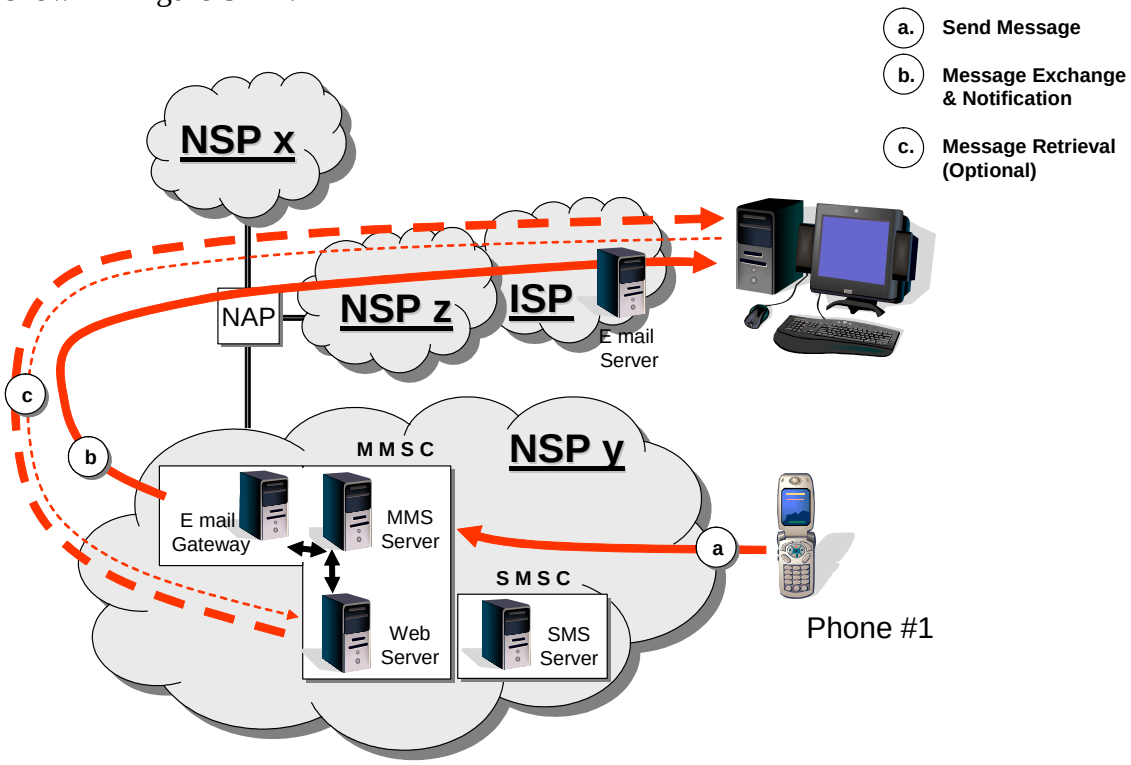

Figure SD-7, Phone-to-Computer Internet MMS Message Exchange

a) Communication: Phone to MMSC (Send Message)

This step operates in the same manner as with intra-provider communication.

b) Communication: MMSC to Internet Email Server (Message Exchange)

The MMS Email Gateway (typically an internal module of the MMSC) converts the MMS message from its WSP/WAP message components into a single SMTP message. This SMTP message could contain text with encoded image/video/multimedia attachments, or text with a unique private URL back to the sending MMSC's MMS Web Server – similar to the process described previously in Intra-Provider Message

Notification. The sender listed within the new outgoing SMTP message is typically in the following format:

phonenumber@emailgatewayhost.wirelesscarrier.com

This is a valid email address – typically, the MMS email gateway will also receive email for this address, converting it into an MMS message, sending it to the specified phone.

The MMSC then connects to the recipient's Internet Email Server. The communication between the MMS email gateway and the Internet email server is simply a typical SMTP exchange between two Internet SMTP servers. The originating server (in this case, the MMS Email Gateway) connects to the receiving server, identifies itself (using the SMTP "HELO"/"EHLO" message), identifies the sender and receiver of the incoming message (using the SMTP "MAIL FROM" message with the "sender" address of the source phone, and the SMTP "RCPT TO" message using the destination email address), and transmits the converted/SMTP-encoded MMS message (using the SMTP "DATA" message).

c) Communication: Computer to Internet Email Server / MMSC (Retrieve Message)

The destination computer contacts its Internet Email Server using POP, IMAP, or other email retrieval mechanisms, and retrieves the incoming SMTP-encoded email message. As previously determined by the sending MMSC, the email message may contain the entire MMS message, or a link back to the MMSC for message retrieval.

If the entire MMS message was included within the email message, the text of the MMS message is displayed to the user within the user's email client application. Depending on the email client application settings (and the source carrier's SMTP encoding settings), the multimedia attachments (images, video, etc.) may be displayed in-line with the text, or may be shown as clickable attachments to the message.

If only the text portion of the MMS message was included in the email message, a link to the full MMS message (including the multimedia content) is supplied within the email message. The user can then click on that link – when doing so, that URL is opened within the email application or within a web browser (depending on the application's settings), and the full MMS message is displayed. This is similar to the process described previously in Intra-Provider Retrieve Message – the primary difference being that the retrieved message is formatted for a standard web browser instead of a phone display.

4. MMS Message Exchange – Internet – Computer-to-Phone

This scenario involves the sending of an MMS message by an Internet-based computer to a camera phone. The infrastructure architecture for this scenario is an extension of the Intra-provider scenario and the Phone-to-Computer Internet scenario. It includes the MMSC components of one provider and the destination user's Internet Email Server, as shown in Figure SD-8.

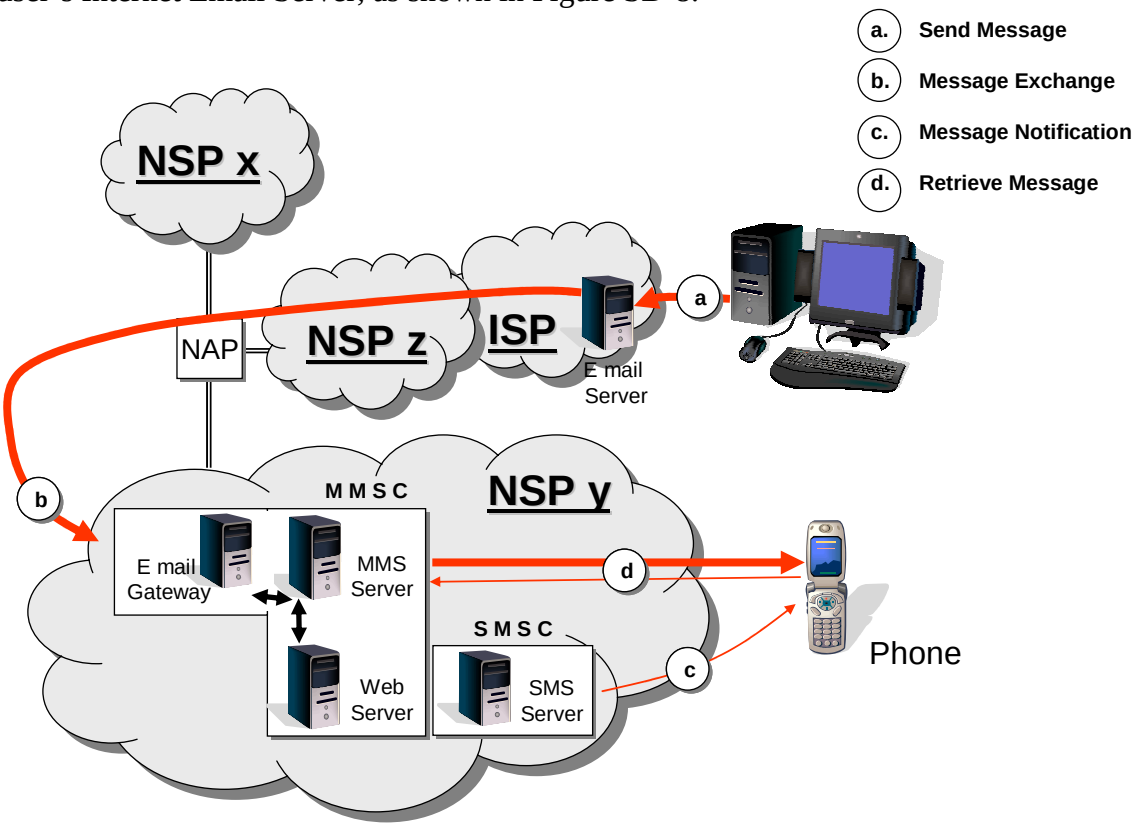

Figure SD-8, Computer-to-Phone Internet MMS Message Exchange

a) Communication: Computer to Internet Email Server (Send Message)

The desktop computer user's email application transmits the message to the Internet Email Server. This is done in a manner specific to the email application and Internet Email Server associated with the desktop computer.

b) Communication: Internet Email Server to MMSC (Message Exchange)

This is the inverse of the exchange detailed in the Phone-to-Computer scenario. The Internet Email Server communicates with the MMS Email Gateway – which emulates a standard SMTP-based Internet Email Server for incoming traffic – and sends the SMTP-encoded MMS message to the MMSC.

c) Communication: MMSC to Phone (Message Notification)

This step operates in the same manner as with intra-provider communication.

d) Communication: Phone to MMSC (Retrieve Message)

This step operates in the same manner as with intra-provider communication.

5. MMS Message Exchange – Internet-Only – Computer-to-Computer

This scenario involves the sending of an MMS message (or, more accurately, an email message with multimedia attachments) by an Internet-based computer to another Internet-based computer. The infrastructure architecture for this scenario is an extension of the Internet components of the previous scenarios.

a) Communication: Computer to Internet Email Server (Send Message)

This step operates in the same manner as with the computer-to-phone Internet communication.

b) Communication: Internet Email Server to Internet Email Server (Message Exchange)

This step operates in the same manner as with the computer-to-phone Internet communication.

c) Communication: Computer to Internet Email Server (Retrieve Message)

This step operates in the same manner as with the phone-to-computer Internet communication.

IV. MMS SYSTEM: CAMERA PHONE PROOF-OF-CONCEPT PROJECT

This section describes the MMS system used in the camera phone proof-of-concept project. This system includes a specific instance of the basic MMS communication infrastructure described in the MMS SYSTEM PRIMER. Details of the providers' system components are proprietary – and therefore unknown. User infrastructure components include Internet email servers and Internet Web servers, which may be part of the network service provider's system, or may be part of the organization's in-house IT infrastructure. The project-specific system also includes a project-standard message composition, as well as a particular organizational message flow.

The users of this system include field users, fixed center users, and mobile center users.

Field Users: These individuals are responsible for creating and distributing digital imagery from the field (e.g., the scene of an incident). During Phase I, these users will include Virginia State Police (VSP) Officers, VDOT Safety Service Patrol Officers, and field personnel from select towing and recovery companies.

Center Users: Personnel stationed at a fixed facility (e.g., the VDOT STC or the VSP dispatch facility). These individuals are recipients of the digital imagery supplied by field users. During Phase I, these users will include Virginia State Police Dispatchers, VDOT Smart Traffic Center (STC) Operators, and dispatchers from select towing and recovery companies.

Fixed Center Users: Center Users that rely on fixed communication services (e.g., wireline Internet access) and fixed computing resources (e.g., desktop computer)

Mobile Center Users: Center Users that rely on mobile communication services and mobile computing resources (e.g., PDA)

Note: *The distinction between fixed and mobile center users is required during initial implementation since some participating agency facilities do not have dedicated Internet access.*

Note: *Mobile Center Users may include project oversight officials from the VSP.*

The following subsections describe the project-specific system infrastructure and user/device associations, message composition, and system message flow. Information is current as of the release of this document.

A. PROJECT SPECIFIC SYSTEM INFRASTRUCTURE AND USER/DEVICE ASSOCIATIONS

This section details the project-specific MMS system infrastructure, as well as the devices associated with each of project's users. These project-specific details are exemplified in Figure SD-9.

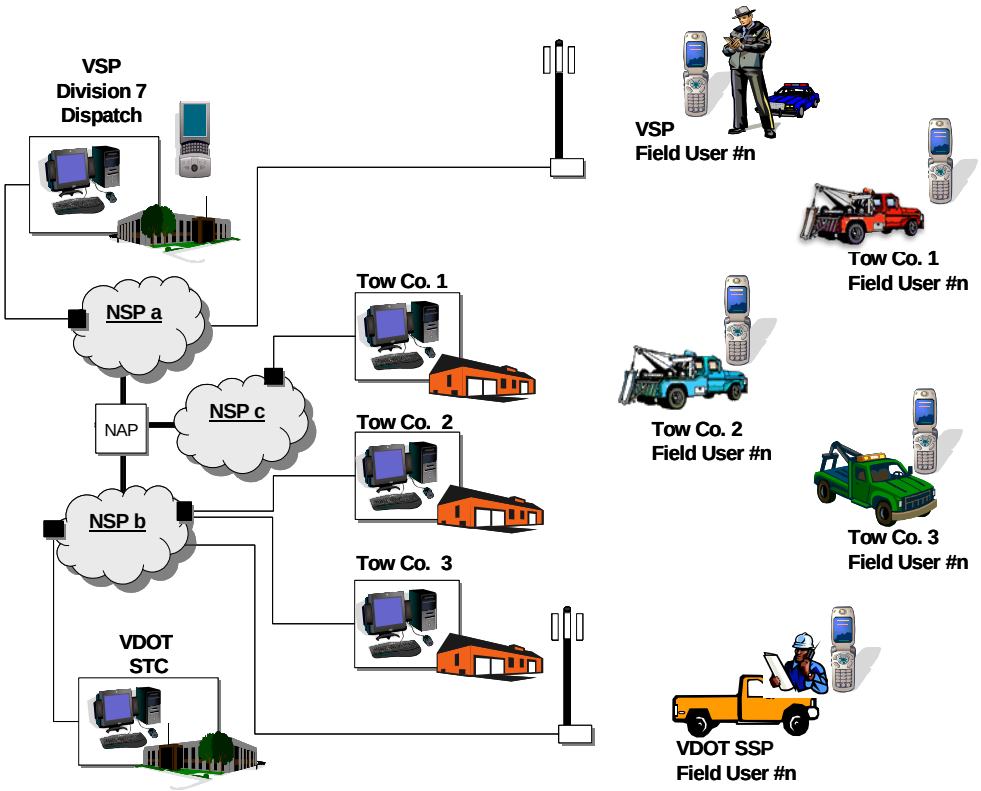

Figure SD-9, Project-Specific MMS System Deployment and Device Associations

The specific numbers and types of MMS equipment and services are currently unknown. Equipment will include more than one device, and service will include more than one provider (providers could include Nextel, Verizon Wireless, Cingular, Sprint, and/or T-Mobile).

1. Field Users

As of the release of this document, the camera phone(s) and service(s) to be used by the "Field Users" have yet to be determined (i.e., phones and services are TBD and therefore details of these system components are unknown). In addition, it should be noted that for any group of field users, the end user devices could be different phones with different service plans.

a) VDOT SSP Officers

- End User Device
  - Camera Phone & Service: **TBD**
    - Type 1 (phone & service)
    - Type 2 (phone & service)
    - and/or Type 3 (phone & service)

b) VSP Officers

- End User Device
  - Camera Phone & Service: **TBD**
    - Type 1 (phone & service)
    - Type 2 (phone & service)
    - and/or Type 3 (phone & service**)**

c) Towing Company A Drivers

- End User Device
  - Camera Phone & Service: **TBD**
    - Type 1 (phone & service)
    - Type 2 (phone & service)
    - and/or Type 3 (phone & service)

d) Towing Company B Drivers

- End User Device
  - Camera Phone & Service: **TBD**
    - Type 1 (phone & service)
    - Type 2 (phone & service)
    - and/or Type 3 (phone & service)

e) Towing Company C Drivers

- End User Device
  - Camera Phone & Service: **TBD**
    - Type 1 (phone & service)
    - Type 2 (phone & service)
    - and/or Type 3 (phone & service)

2. Fixed Center Users

Fixed Center Users rely on existing infrastructure at their respective locations. The following information is based upon initial discussions and meetings with the respective organizations, and may not reflect the detailed specifics or the current status of the organizational centers (due to changes in infrastructure and/or changes in Internet security policy).

a) VDOT STC

- Infrastructure
  - Internet Service: Yes *(ISP and speed unknown)*
  - Internet Email Server: Unknown *(may be in-house or ISP-based)*

- End User Device
  - Desktop PC: Yes *(unknown hardware and email client)*

b) VSP Division 7 Dispatch Center

- Infrastructure
  - Internet Service: No *(building has connectivity, however dispatch center is barred due to organizational security policies)*
  - Internet Email Server: None accessible from center network

- End User device
  - Desktop PC: Yes, but cannot access the network *(nor can it be connected to any wireless network due to security policies)*

See Mobile Center Users, below. VSP D7D could be a Mobile Center User if there is no Internet access/service available for use.

c) Tow Company A Dispatch

- Infrastructure
  - Internet Service: Yes *(ISP and speed unknown)*
  - Internet Email Server: Unknown *(probably ISP-based)*

- End User device
  - Desktop PC: Yes *(unknown hardware and email client)*

d) Tow Company B Dispatch

- Infrastructure
  - Internet Service: Yes *(ISP and speed unknown)*
  - Internet Email Server: Unknown *(probably ISP-based)*

- End User device
  - Desktop PC: Yes *(unknown hardware and email client)*

e) Tow Company C Dispatch

- Infrastructure
  - Internet Service: No *(open to the possibility of getting Internet connectivity for the center)*
  - Internet Email Server: None *(will probably be ISP-based if center gets Internet service)*

- End User device
  - Desktop PC: Yes, but does not have Internet connectivity *(unknown hardware)*

See Mobile Center Users, below. One towing company may be a Mobile Center User if there is no Internet access/service available for use.

3. Mobile Center Users

Mobile Center Users rely on CMRS to provide Internet connectivity. Connectivity will depend on signal strength within the center of issue.

a) VSP Division 7 Dispatch Center

- Infrastructure
  - Internet Service: Yes *(via CMRS, data rate determined by device and service)*
  - Internet Email Server: Yes *(CMRS -based)*

- End User Device
  - PDA: Specific device **TBD** (If *PDA can do MMS directly, it operates like a camera phone – otherwise, it works like a desktop utilizing an email server]*
    - *Can potentially sync with desktop in order to transfer (and view) image on desktop's larger screen – however, security policy may prohibit such a connection.*

See Fixed Center Users, above. VSP D7D could be a Fixed Center User if there is Internet access/service available for use.

b) Towing Company C Dispatch

- Infrastructure
  - Internet Service: Yes *(via CMRS, speed determined by device and service)*
  - Internet Email Server: Yes *(CMRS -based)*

- End User Device
  - PDA: Specific device **TBD***(If PDA can do MMS directly, it operates like a camera phone – otherwise, it works like a desktop utilizing an email server)*

See Fixed Center Users, above. The Towing Company without Internet service may have service installed, and therefore would become a Fixed Center User.

B. PROJECT SPECIFIC MESSAGE COMPOSITION

This section describes the specific message composition of MMS messages to be used during this project.

1. Message Content / Payload

Each message will include text indicating the location of the incident. This text could be located above or below any image within the message, or in the subject line of the message.

Each message should include at least one image. While some devices/carriers can include multiple images per message, these multi-image messages may not display correctly on other devices and/or may involve additional viewing procedures, and so should be avoided for the purposes of this phase of the project. In addition, while it is possible to send a message that does not include any image (or multimedia attachment – i.e. just send text), this should only be done as a follow-up to a previous message that included an image incident.

Note: *Follow-up messages should be sent upon request. Secondary messaging that is not requested, or messaging that occurs too frequently, may disrupt or confuse the dispatch process.*

2. Message Destination / Group Lists

Each message will be addressed to a single destination, which will be an address book entry programmed within the device and/or with the device's carrier. This entry may be a list of destination addresses – stored on the device or with the carrier. This entry also may be a single email address for a mailing list hosted on an Internet Email Server. Sending to this entry will distribute the message to all the devices in the project.

While different sub-groups may be created within the distribution lists (e.g. VSP Users, Towing Company B Users, VSP Commanders, Verizon Users, etc.), this is beyond the scope of Phase I of the project – the core scenario is the sending of each message to all devices.

3. Composition Process

The composition process will vary with the selected devices and carrier service offerings. Details of the process will be identified in the Operational Procedures Document.

C. PROJECT SPECIFIC MESSAGE FLOW

This section describes the specific message flow of MMS messages utilized during this project. Definitions and associations previously outlined in the document help provide a mapping between the project-specific entities.

Table SD-1 outlines the message exchange for all users in the project-specific system – based upon initial discussions and estimates. As the user devices and carriers are still TDB, the information within this table is preliminary.

	Field Users					*Center Users*				
	VDOT SSP	VSP Ofc.	TowA Drvr	TowB Drvr	TowC Drvr	VDOT STC	VSP D7D	TowA Disp.	TowB Disp.	TowC Disp.
VDOT SSP	AE	AE	AE	AE	AE	P	AE	P	P	AE
VSP Officers	AE	AE	AE	AE	AE	P	AE	P	P	AE
TowingA Drivers	AE	AE	AE	AE	AE	P	AE	P	P	AE
TowingB Drivers	AE	AE	AE	AE	AE	P	AE	P	P	AE
TowingC Drivers	AE	AE	AE	AE	AE	P	AE	P	P	AE
VDOT STC	C	C	C	C	C	*	C	I	I	C
VSP D7 Dispatch	AE	AE	AE	AE	AE	P	*	P	P	AE
TowingA Dispatch	C	C	C	C	C	I	C	*	I	C
TowingB Dispatch	C	C	C	C	C	I	C	I	*	C
TowingC Dispatch	AE	AE	AE	AE	AE	P	AE	P	P	*

Message Exchange: A = intrA-provider, E = intEr-provider
P = Phone-to-computer, C = Computer-to-phone, I = Internet-Only

Table SD-1, Project-Specific Message Exchange

We can examine how Table SD-1 applies to the "Enhanced Operations – VSP Field User" scenario depicted in Figure SD-2. Utilizing a camera phone, the VSP Officer transmits an MMS message to three locations. For the first destination, VSP Division 7 Dispatch (a PDA Phone), the MMS message is exchanged via either the Intra-Provider scenario ("A") or Inter-Provider scenario ("E"). For the second destination, the VDOT STC, the MMS message is exchanged via the Phone-to-computer scenario ("P"). For the third destination, TowingA Dispatch, the MMS message is exchanged via the Phone-to-computer scenario ("P").

D. FUTURE PLANS

Phase I of this study relies on provider resources (e.g. MMSC, Email Servers, etc.), for many message handling functions, and therefore many message handling capabilities (send, store, distribute) are limited to the provider's implementation. Based upon the results of this current phase, Phase II might involve the development and use of messaging servers (such as an MMSC) owned and operated by CapWIN in order to optimize and customize message handling.

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Guidance Report

Camera Phone Proof-of-Concept Project

Evaluation Strategy

Camera Phone Proof of Concept Project - Evaluation Strategy White Paper

Final Draft

Contract #: DTFH61-02-C-00061
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Department of Transportation

Submitted by:
Science Applications International Corporation
1710 SAIC Drive, M/S T1-12-3
McLean, VA 22102

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Table of Contents

1.0 Introduction

The Camera Phone Proof of Concept project consists of a joint partnership between the FHWA and the University of Maryland's Center for Advanced Transportation Technology (UMD-CATT). The goal of this project is to improve incident management and response activities in the event of a traffic incident or other emergency situations that affect traffic operations. This project will consist of two main objectives - first to demonstrate the feasibility of using commercial off-the-shelf (COTS) wireless telephones equipped with cameras to capture and deliver traffic incident imagery that is useful to follow-on responders, such as tow companies, HAZMAT remediation services, health departments, or highway repair teams. Secondly, to assess the value of these images to follow-on responders based on improvements in time, safety, and efficiency while responding to and clearing traffic incidents. This project will be coordinated with UMD-CATT's ongoing Capital Wireless Information Net (CapWIN) program and will be implemented in the Washington D.C. Metropolitan (Metro) Region.

2.0 Project Background

Throughout the United States, many areas have seen increased levels of traffic congestion. Not surprisingly, traffic incidents (and emergency situations) which further increase traffic congestion are a daily occurrence. These incidents include automobile crashes, HazMAT spills, disabled vehicles, and other situations that limit traffic flow. In many cases, these traffic incidents produce conditions that result in secondary crashes (further exacerbating congestion) and create dangerous situations for responders attempting to clear the incident or manage traffic through the incident scene. It is therefore imperative that incidents be cleared from the roadway as quickly as possible.

During a traffic incident, emergency response agencies (e.g., safety service patrol, law enforcement, fire and rescue) often require additional assistance from follow-on responders in order to clear the incident from the roadway. While emergency responders can use wireless telephones, radios, or dispatcher services to call for assistance, they typically do not have the ability to transmit detailed incident imagery directly to the follow-on responders. Although CCTV cameras have been deployed and cover large segments of the road network serving the Metro Region, many segments remain without coverage. In addition, specific details that would be useful to follow-on responders may not be visible to CCTV operators due to vehicle positioning or CCTV resolution limitations. As a result, follow-on responders may arrive at the incident scene without the proper equipment (e.g., tow trucks, HAZMAT transporters) or personnel required to address the situation quickly and efficiently. In many of these cases, follow-on responders are forced to return to headquarters or call for additional support in order to get the right equipment to the scene. This results in increased incident duration, causing longer traffic delays and prolonging the hazardous situation. The inability to clear incidents quickly and efficiently continues to put pressure on Washington's roadways.

3.0 Project Summary

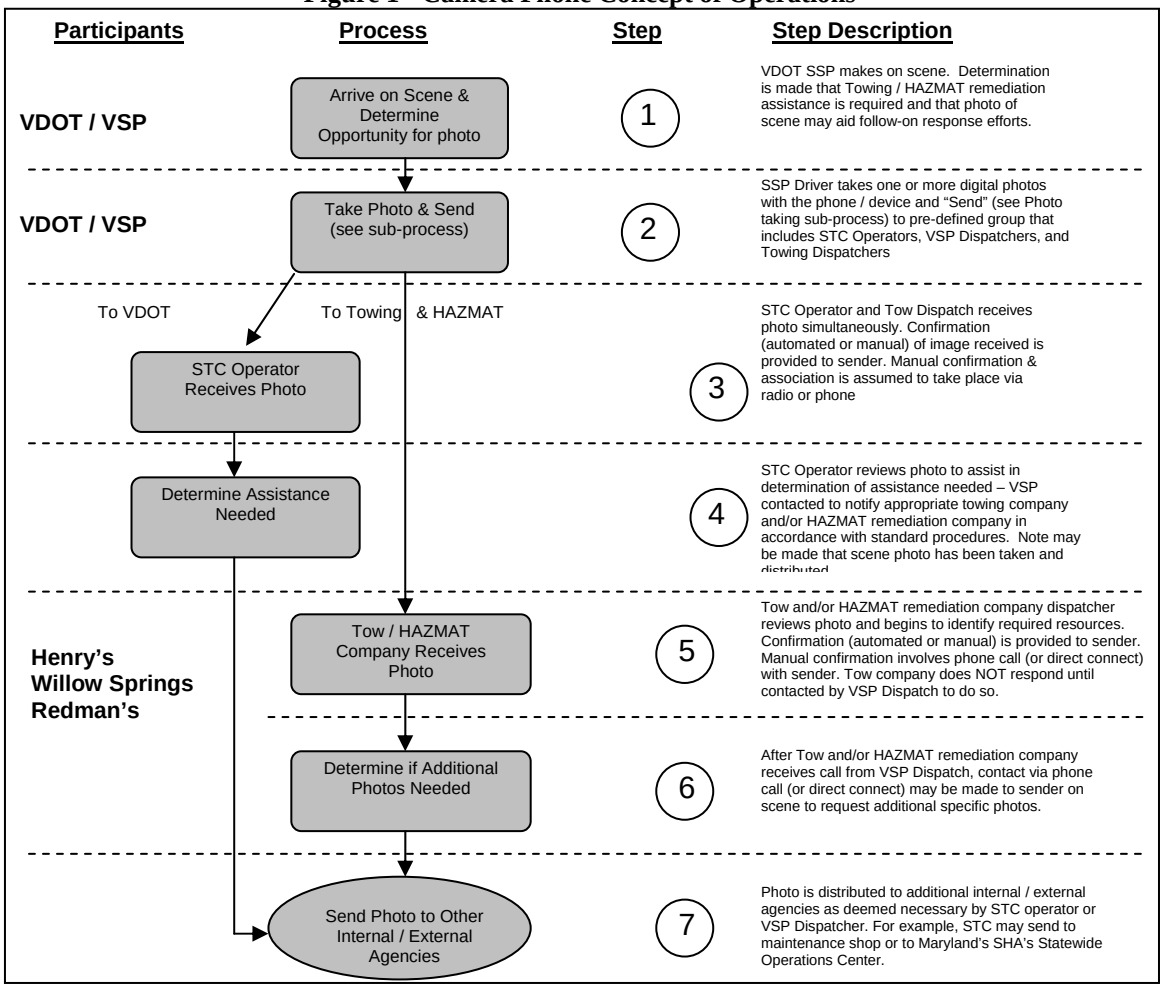
In order to address these challenges, FHWA and UMD-CATT will distribute between 20 and 40 COTS wireless camera telephones (i.e., camera phones) depending on the number of individuals taking part in the proof of concept project. Current participants in this project will include the Virginia Department of Transportation (VDOT), the Maryland State Police, nad and several local commercial towing and recovering services. Each camera phone will employ wireless picture phone technology that will enable participating agencies to take and transmit digital photos to one another. Each camera phone will be used by emergency response agencies to take detailed pictures of traffic incident scenes and then transmit those images directly to their dispatcher and the appropriate follow-on responders. Typical COTS camera phones are equipped with VGA (video graphics array) cameras with 640x480 resolution and digital zoom features. They may also be equipped with Enhanced Data rates for GSM Evolution (EDGE) data communications capabilities, resulting in improved transmission times and reliability. As a result, follow-on responders will then be able to receive these images on their own compatible camera phones or on any computer with an internet connection. It is expected that incident imagery (which may also include short video clips) will help follow-on responders have a greater understanding of the incident, which will allow them to better define their operational procedures and select the most appropriate equipment or personnel before leaving for the incident scene. Consequently, this should allow follow-on responders to arrive at the incident scene with the proper resources in hand, resulting in an accelerated incident remediation process.

3.1 Operational Concept

The concept of operations (CONOPS) for the Camera Phone Proof of Concept project identifies the processes, roles and responsibilities, policies and data flows that illustrate how this project is expected to improve incident management and response activities. The CONOPS serves as a road map for the Evaluation Team in developing their evaluation strategy. In order to provide a comprehensive and accurate assessment of this project, the Evaluation Team will review several areas represented in the CONOPS, including the technical and operational aspects that are incorporated throughout the proof of concept project.

Figure 1 illustrates the initial CONOPS that was developed during July 2005. It is expected that this CONOPS will be modified after all project participants have been identified. At a recent stakeholder meeting held on April 5, 2006, the final CONOPS was still in development. Once completed, the updated CONOPS will be reflected in the final Evaluation Strategy document.

Figure 1 - Camera Phone Concept of Operations



4.0 Project Timeline

The schedule presented in Table 1 illustrates the activities that will take place during Phase I of the proof of concept project and the evaluation. The evaluation will be conducted in two phases. During Phase I, lessons learned will be documented and posted to the Lessons Learned Database maintained by the Joint Program Office. These will be posted on a monthly basis throughout the project. During Phase II, a Case Study will be developed in draft and final versions.

Table 1 - Project Schedule and Milestones – Phases I and II[1]

Tasks	Target Dates (s)
Obtain Phones	Week of July 10 2006
Develop Training Materials	Week of July 10 2006
Configure Phones & Schedule Training	Week of August 7, 2006
Distribute Phones and Training Materials	Week of August 7, 2006
Proof of Concept Duration	August through October, 2006
Evaluation Phase I - Documentation of Lessons Learned	August through October, 2006
Evaluation Phase II – Development of Case Study[2]	Draft – January 15, 2006 Final – February 15, 2007

5.0 Evaluation Approach

This section presents the core objectives and areas of concentration for the evaluation.

The main focus of the Evaluation Team is to qualitatively assess the benefits realized by the use of wireless camera phones to improve response capabilities for traffic incidents or emergency situations. The following assessment areas are included in the evaluation:

- **User Satisfaction** - The evaluation will assess end-user perceptions on the feasibility of using camera phones to improve incident clearance times. The evaluation will also examine end-user perceptions regarding overall benefits for incident management and potential next steps for future applications of this technology.

- **Operational Procedures -** The evaluation will determine how camera phones were used to improve incident management and response activities. The evaluation will determine how the camera phones were integrated into the existing operational/incident response activities and assess how varying weather conditions, time of day, or other factors affect the ability of end-users to capture/transmit high quality images. In addition, this evaluation area will include assessments of when and under what conditions the camera phones were utilized. End-user perceptions of efficiency gains or enhancements provided as a result of using camera phones will also be evaluated.

- **Technology Functionality -** The evaluation will assess the effectiveness of the technology used throughout the camera phone proof of concept. Specifically, the evaluation will assess image quality, equipment reliability and usability, speed of service, and web server imagery.

[1] As currently planned, Phase II of the evaluation will be conducted once the Phase II project plan is approved, pending available funding. The Camera Phone Project Management Team has indicated that many of the activities initially planned for Phase II of the project have already been completed.
[2] Pending availability of funding.

- **Safety Improvement -** The evaluation will assess end-user perceptions of how the use of camera phones can improve levels of safety during traffic incident remediation. The evaluation will also determine if the camera phones reduce roadway exposure for response personnel, queue length, and secondary accidents.

- **Institutional and Technical Issues -** The evaluation will identify any issues, either technical or institutional, that were encountered throughout the project (and not addressed in other evaluation areas). The Evaluation Team will examine the effect of these issues on the project and describe how they were addressed.

The evaluation objectives are designed to measure key aspects of this project and will prove valuable in determining if wireless camera phones can be used to improve the efficiency of incident response activities.

6.0 Data Collection Techniques

This section describes the data collection methods that will be used to collect information for this evaluation. The Evaluation Team recommends that several overlapping methods be employed in order to provide a comprehensive examination and to address each evaluation area from multiple perspectives.

Field Observations. The Evaluation Team will conduct field observations to assess the functionality and effectiveness of using camera phones during incident management and response activities. This will require the Evaluation Team to ride along with project participants and document how the camera phones were used during incident operations. This will provide the Evaluation Team with a first-hand account of how incident operations are carried out. In addition, field observations may provide additional details about the types of situations or conditions that were present when/if camera phones are used during the field observations. The Evaluation Team will work with UMD-CATT staff and project participants to schedule field observations.

User Interviews. The Evaluation Team will work with UMD-CATT staff and project participants to identify and schedule the appropriate personnel to be interviewed. This will include developing survey instruments or questionnaires. Interviews will be conducted in person, by email, or by telephone. At the conclusion of each interview, the evaluator will prepare summary notes that detail each interview. Summary notes will then be forwarded to the interviewee for final comments and to ensure accuracy.

Archived incident images. Project participants will have the ability to store images on their camera phones or personal computers (via internet connections). As a result, the Evaluation Team will work with UMD-CATT staff and project participants to analyze sample images that may determine which factors (image quality, time of day, weather conditions, etc.), if any, influence incident management and response activities.

Operating procedures and other documentation. The Evaluation Team will work with UMD-CATT and project participants to determine if the operating procedures, as defined in the CONOPS, can be modified in order to achieve optimal performance. This will

include a "before and after" analysis to determine if the camera phone improves upon the existing operating procedures and communication processes used by project participants. The Evaluation Team will also meet with project participants to document how the camera phones were used and identify the types of conditions or variables (e.g., weather, time of day) that affected the ability of the camera phone to enhance incident response activities.

Archived Incident Data. CAPWIN and VDOT currently archives traffic data/details for incidents in which camera phones were used by CapWIN and VDOT personnel to aid in the incident response process. As a result, the Evaluation Team will work with CapWIN and VDOT personnel to acquire and review archived incident data. This data will be used by the Evaluation Team to document the camera phone's usage and examine the types of incidents or conditions (e.g., weather, time of day) that were present at the time of the incident. In addition, the examination of archived incident data may also help identify best practices or illustrate the abilities and limitations of camera phone technology.

Several types of incident data will be studied and documented, including:

- How the camera phone was used
- The type of incident that was involved (traffic accident, HAZMAT spill, etc.)
- The location of the incident
- The time of day in which the incident occurred (day vs. night)
- The type of weather conditions that were present during the incident

7.0 Project Deliverables

An important aspect of this evaluation will be to document the lessons learned as they unfold throughout this project. All lessons learned will be submitted to the United States Department of Transportation (US DOT) Intelligent Transportation System (ITS) Joint Program Office for inclusion into their Lessons Learned database after they have been validated by project participants and the Evaluation Team.

At the end of each phase of the project, a Benefits and Lessons Learned Report will be prepared. This report will summarize lessons learned, identify specific benefits, and document best practices. In addition to the Benefits and Lessons Learned Report, the Evaluation Team will develop a Case Study of the project as the primary Phase II deliverable. The development of the Case Study will allow the Evaluation Team to illustrate the benefits of using camera phones for incident management and response to project stakeholders or transportation communities. The Case Study will also provide potential end-users with a "real-world" example of how camera phones were used to improve incident management and response activities and will provide direct feedback on the experiences or findings that were encountered by current end-users. As a result, the Evaluation Team may be able to address the following questions with a greater sense of accuracy and detail:

- How was the camera phone used to improve the incident management and response activities during the incident?
- How much time was saved throughout the incident management and response process as a result of using camera phones?
- Was the camera phone reliable during incidents?
- Did the camera phone improve levels of safety during incidents?
- Was the camera phone easy to use?

The Case Study will provide an in-depth look at the value and role of camera phones during incident response operations. In addition, the case study will allow the Evaluation Team to collect critical information that may be used to further support the evaluation of this project. It is anticipated that the case study will be executed during Phase II of this evaluation.

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Guidance Report

Camera Phone Proof-of-Concept Project

Operational Procedures

CAMERA PHONE PROOF-OF-CONCEPT PROJECT

OPERATIONAL PROCEDURES DOCUMENT – PHASE I

FINAL

30 July 2006

TABLE OF CONTENTS

I. INTRODUCTION

A. PURPOSE AND SCOPE

This document describes operational procedures for the messaging system used during phase I of the Camera Phone Proof-of-Concept Project. The operational procedures are classified as either "domain" procedures or "technical" procedures.

Domain procedures identify the proper instance and protocol for users to employ the messaging system (e.g., under what conditions should a Virginia State Police officer consider using the messaging system). This document identifies fundamental domain procedures that have been approved by the agencies/users participating in this study[1]. Agency specific additions and exemptions to these procedures are under consideration.

Technical procedures identify the proper operation and use of the messaging system. Technical procedures will vary with device and service, and are not dependant on the user/agency employing the system.

B. ORGANIZATION OF DOCUMENT

- Project Background
- Operational Procedures – Domain
- Operational Procedures – Technical
- Future Plans

C. REFERENCES

The following documents provide additional reference for the Camera Phone Proof-of-Concept project.

- Operational Concept Description Document – Phase I
- Technical Requirements Specification – Phase I
- System Description Document – Phase I

[1] Domain procedures identified in this draft document are currently under review by the agencies/users participating in the study. Subsequent versions of this document will include formally approved procedures.

D. DEFINITIONS

Commercial Mobile Radio Service (CMRS): An FCC designation for mobile wireless service offered by any carrier or licensee whose wireless network is connected to the public switched telephone network (PSTN) and/or is operated for profit. These companies include the traditional cellular and Personal Communications Systems (PCS) providers, such as Verizon Wireless, Sprint, Cingular, and T-Mobile.

Note: *Nextel Communications is not a CMRS provider, but an Enhanced Specialized Mobile Radio (ESMR) provider. Traditionally, ESMR providers cater to business and industrial customers and have systems with either no connection or limited connection to the PSTN. These companies also operate in a different frequency bands than the cellular and PCS providers. However, Nextel has full connection to the PSTN and the operational distinction between Nextel and other CMRS providers has disappeared.*

Short Message Service (SMS): The transmission of short text messages to and from a mobile phone, fax machine, and/or IP address. Messages must be no longer than 160 alphanumeric characters and contain no images or graphics. Once a message is sent, it is received by a provider's **Short Message Service Center (SMSC)**, which must then deliver it to the appropriate mobile device.

Multimedia Messaging Service (MMS): A store-and-forward method of transmitting graphics, video clips, sound files, and short text messages over wireless networks using the Wireless Application Protocol (WAP). Providers deploy special servers, dubbed **Multimedia Messaging Service Centers (MMSC)** to implement the offerings on their systems.

Field Users: These individuals are responsible for creating and distributing digital imagery from the field (e.g., the scene of an incident). During Phase I, these users will include Virginia State Police (VSP) Officers, VDOT Safety Service Patrol Officers, and field personnel from select towing and recovery companies.

Center Users: Personnel stationed at a fixed facility (e.g., the VDOT STC or the VSP dispatch facility). These individuals are recipients of the digital imagery supplied by Field Users. During Phase I, these users will include Virginia State Police Dispatchers, VDOT Smart Traffic Center (STC) Operators, and dispatchers from select towing and recovery companies.

Fixed Center Users: Center Users that rely on fixed communication services (e.g., wireline Internet access) and fixed computing resources (e.g., desktop computer)

Mobile Center Users: Center Users that rely on mobile communication services (e.g., CMRS) and mobile computing resources (e.g., PDA)

Note: *The distinction between fixed and mobile Center Users is required during initial implementation since some participating agency facilities do not have dedicated Internet access.*

Note: *Mobile Center Users may include project oversight officials from the VSP.*

II. BACKGROUND

The Camera Phone Proof-of-Concept Project will examine the utility of capturing and distributing incident scene imagery to towing and recovery providers, HAZMAT remediation contractors, and other follow-on response organizations. The premise of the project is that if this information is supplied in a timely fashion, the responders can correctly size and more rapidly configure their response to the scene from remote dispatch facilities. As suggested in Figures OP-1 and OP-2, a faster and properly calculated response will shorten the response time to an incident, which can subsequently shorten the duration of the incident and reduce traffic congestion.

Figure OP-1 represents a common dispatching scenario for towing and recovery services. In this instance, a VSP officer uses radio communication – typically some form of land mobile radio (LMR) – to request services from the Division 7 Dispatch Center and relay information about the incident scene.

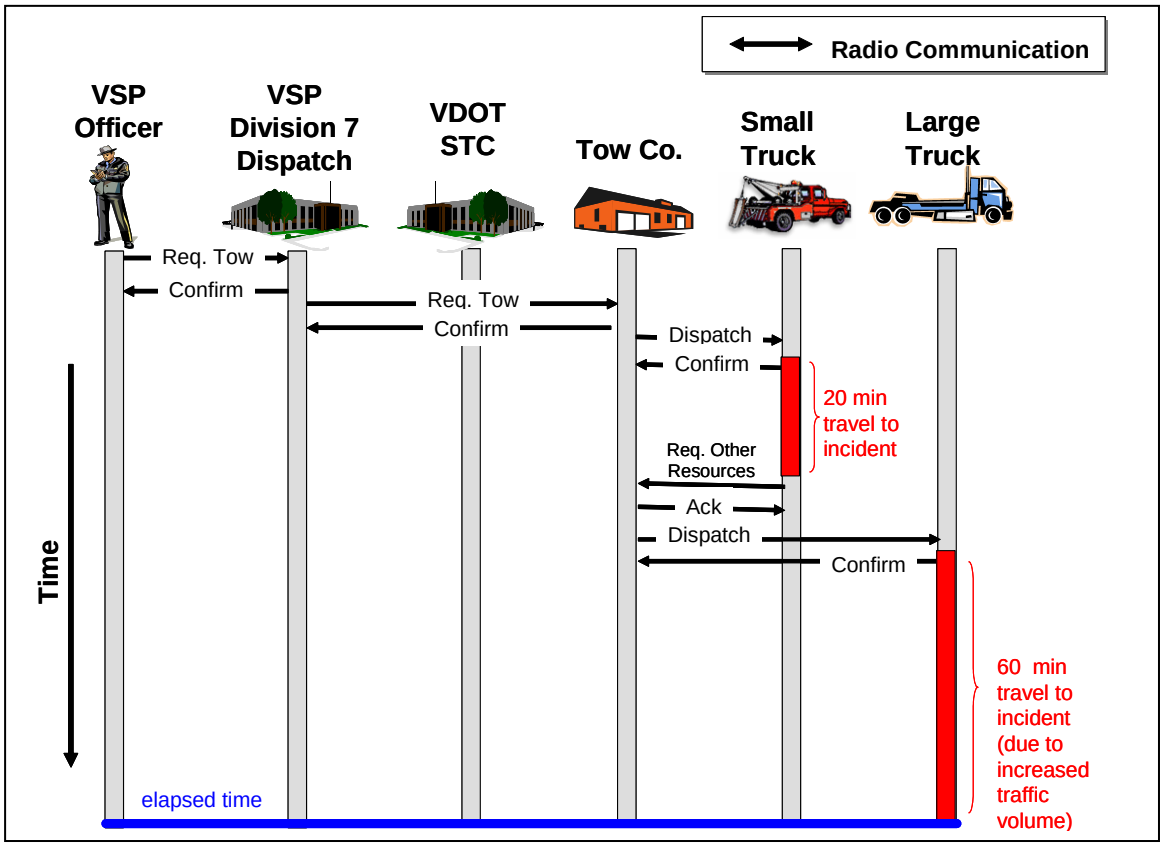


Figure OP-1, Baseline Operations - VSP Field User

The Division 7 Dispatch requests service from the appropriate towing company, which subsequently dispatches a truck. After arriving at the incident scene, it is determined that different/additional resources are required. Due to developing traffic congestion, it can take significantly longer for these new resources to arrive at the scene.

Figure OP-2 illustrates a similar scenario, including a modified flow of information and potential time-savings when supplementing radio communication with MMS messages.

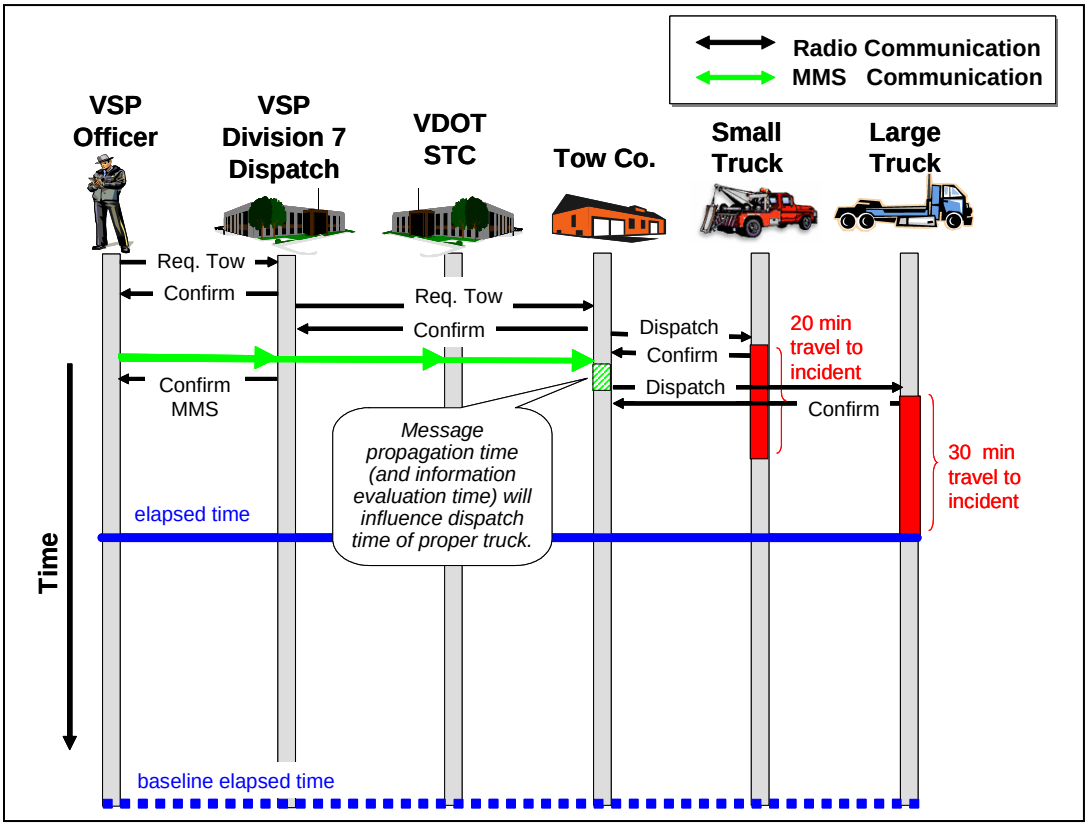


Figure OP-2, Enhanced Operations - VSP Field User

In addition to requesting services using radio, the VSP officer uses a picture phone to assemble an annotated image (or images) of the incident scene. This multimedia information is then distributed among a predefined group of users. In this case, this would include users at the VSP Division 7 Dispatch Center, the VDOT STC, and the participating towing company dispatch facilities. The towing companies are the initial benefactors; they now have much more information with which to determine the proper resources for a response. The difference in elapsed time between scenarios (i.e. with and without MMS) could be significant.

The inclusion of MMS within this scenario is not intended to eliminate radio communication – only augment it. Since radio communication is still employed (and required) as part of the dispatch process, an initial dispatch of towing services may have occurred before the MMS message is composed, distributed, and analyzed. However, if an additional towing dispatch will eventually be required, the MMS system may enable a more timely and adequate response.

Note: *While messages will be sent directly to the participating towing companies, they will not respond unless requested to do so by VSP Division 7 dispatch per standard operating procedures.*

This scenario may be applicable for other Field Users (such as VDOT SSP), with possible variations to the radio dispatch procedures.

The purpose of this project is to facilitate the response of follow-on resources to incidents. This project has two key demonstration objectives. The first is to capture and distribute traffic incident scene imagery with relatively inexpensive and commercially available equipment and services. The second is to determine the value of this information to the noted responders.

This project will proceed in multiple phases. This phased approach will allow the demonstration to advance in manageable steps from simpler and smaller scale deployments in the initial phase (i.e., Phase I) to more technically complex and broader scenarios in the later phases. This document describes operational procedures for the messaging system used during Phase I.

III. OPERATIONAL PROCEDURES

Operational procedures for the messaging system are guided by five primary actions:

- **Photography**: Field User takes a digital photograph
- **Message Composition**: Field User composes a multimedia message (digital picture, with text and/or audio annotation)
- **Message Distribution**: Field User distributes a multimedia message
- **Message Receipt**: Field User(s) and/or Center User(s) receive the multimedia message (recipients may subsequently redistribute the message)
- **Message Assessment and Response**: Center User(s) review incoming messages to determine the proper resources for towing and recovery efforts, HAZMAT remediation, or any other response activities. Field User(s) are able to view the picture, listen to the audio, and/or read the text from a multimedia message, but response is left to the Center User(s) during this initial phase of the study.

Each of these actions has both domain- and technically-specific components.

Note: *These five actions are also used in the construct of the Technical Requirements specification document*

A. DOMAIN PROCEDURES

Domain procedures identify the protocol for using the messaging system.

Note: *The following domain procedures have been approved by the agencies/users participating in this study[2]. However, it should be noted that differences among the agencies' policies might require changes to these procedures at any time during the study.*

1. Photography

Required: At least one (1) picture is required for the initial message. This picture is referred to as the "primary picture".

Note*: The initial multimedia message is defined as the first such message from a given user associated with each incident.*

Since the goal of this initial study is to improve response time for towing and recovery services, the vehicles involved in an incident are likely to be the main subject matter. Visual information (i.e., the picture) should be relevant to the recipients (e.g., VSP, VDOT, and towing dispatchers). The vehicle(s)

[2] Domain procedures identified in this draft document are currently under review by the agencies/users participating in the study. Subsequent versions of this document will include formally approved procedures.

and relevant surroundings should fill the picture frame in order to transmit as much information as possible.

Optional: Additional pictures of the incident can be taken and might include:

- Incident vehicle(s) along side other subjects (people, first responder vehicles, etc.) in order to provide relative size and context
- Hazmat signs / markers / placards
- Make/model indicators
- License plates

These photographs can be attached to the initial message, or be sent as follow-up messages, depending on both the capabilities of the mobile device and the formal domain procedures for this study.

Note: *Safety should never be compromised during photography.*

2. Message Composition

Required:

1. The initial multimedia message shall include the primary picture (refer to section III.A.1)

2. The initial multimedia message shall have a text annotation that includes the towing company **zone code** and a **location identifier** that are associated with the scene of the incident.

   Note: *There is no specification on text entry method during Phase I of this project; therefore, text can be entered by T9, keyboard, and/or speech-to-text mechanisms available on the select mobile device.*

   Zone codes, as represented in Table OP-1, are used by the towing companies to identify the general location of an incident.

Table OP-1, Towing Zone Codes

Zone Code	Description
A7	Sector A7 – Alexandria; bound by I395, Rt. 7 and…
B1	…
C1	…

Location identifiers can vary and might comprise the closest intersection (e.g., 495 @ Rt. 50), the closest milepost (e.g., MP5 Rt. 66), a block address (e.g., 4200 block of Rt. 7), or other designators.

Note: *<u>Under consideration</u> - There may be preferences to require only the towing zone codes, instead of both the zone code and the location identifier. While this would simplify the text entry process, it would also significantly limit the incident location information.*

Initial Message

Required:
- Primary picture
- Text: Zone Code & Location ID

Example:

X3; Rt22@MP7

This example does not represent the display characteristics of any specific device. It represents message content only.

Optional: Additional information may be provided in the form of secondary pictures and supplemental annotations. This information can be provided in either the initial message or subsequent messages relating to the same incident.

Additional information might address:
- The number of vehicles involved
- The make/model of vehicles involved
- More detailed location information

Initial Message

Required:
- Primary picture
- Text: Zone Code & Location ID

Example:

X3; Rt22@MP7

****

Optional:
- Secondary picture(s)
- Additional Text Annotation(s)
- Additional Voice Annotation(s)

Example:

Single vehicle in median; departed Rt22 S; Rt22 S Closed left lane; Guardrail debris Rt22 N; Rt22 N closed 2 left lanes

Subsequent Message(s)
(same incident)

Required:
- none

****

Optional:
- Secondary picture(s)
- Additional Text Annotation(s)
- Additional Voice Annotation(s)

Example:

Renault Megane Coupe. 4 passengers; 1 injured seriously.

(audio attachment)

These examples do not represent the display characteristics of any specific device. They represent message content only.

Supplemental annotations may be text or audio. If the mobile device is capable of audio recording, voice annotations can be used to provide detailed information that is difficult to capture via text.

Note: *The ambient noise level at the incident scene must be low enough such that the attached audio will be intelligible to the intended recipients.*

3. Message Distribution

During Phase I of this project, all messages from Field Users will be delivered using a master distribution list. The master distribution list will include:

- All participating Center Users from VSP, VDOT, and the three towing companies.
- Select Field Users from VSP, VDOT, and the three towing companies.
- Select project oversight officials from CapWIN, VSP, and VDOT
- Select system evaluators from Mitretek Systems and SAIC.

Note: *A single entry reference to the master distribution list (i.e., a master contact) will be loaded into each device prior to conducting the field study. During subsequent phases of this project, more specific distribution lists (e.g., VSP or VDOT personnel only) can be employed.*

Note: *Under Consideration – The following issues impact the composition of the master distribution list. These matters are under consideration for the distribution list to be used in the concept system; however, they are of more significance when establishing distribution lists for operational deployments.*

- *The cost of sending a message: Providers will often charge differently for messaging services, some may treat a message using master distribution list as "one" message. Others might charge based on the number of subsequent messages "forwarded" to each user on the master distribution list. Some providers offer unlimited messaging; some do not.*

- *The need for Field Users to receive all messages: It might be that Field Users do not need to receive all the messages submitted by other Field Users. If a particular Field User does need to receive a specific message, perhaps it is better that the message is forwarded by the appropriate Center User. This would eliminate unnecessary message traffic.* ***Note:*** *Mobile Center Users are not considered Field Users, although they may be out "in the field". See Definitions in section I.D*

Note: ***Message Redistribution (i.e., Forwarding a Message)***
Depending on the composition of the master distribution list, some users might not receive particular messages. It is likely that some users – principally Center Users – will want to pass certain messages to others… for further evaluation, for oversight, etc. If so, message-forwarding guidelines will need to be established. These guidelines can be inserted at this point in the document.

4. Message Receipt

When participating in this study, users must have their messaging system equipment operating and prepared to receive multimedia messages. This equipment must also be configured to provide adequate notification upon the receipt of any multimedia message (i.e., users should be aware of any incoming message at the time of receipt).

a) Visual Notification

The equipment (both mobile device and computer) must provide visual indication when receiving a new message. Minimally, this should be a new message indicator icon somewhere on the screen. Preferably, this should be a persistent pop-up window that requires the user to acknowledge receipt of the message (acknowledge to the recipient's equipment, not to the original sender).

b) Audible Notification

A mobile device must provide audible indication when receiving a new message. If a computer has configured audio, it must also provide audible indication when receiving a new message.

If the mobile device is set to a "silent mode", it should provide physical indication when receiving a new message arrival (i.e. vibrate mode).

Note*: Audio and visual message notification mechanisms will be set on each device prior to conducting the field study*

5. Message Assessment and Response

For this project, the primary message recipients are Center Users associated with the three towing companies participating in this study, and the VSP District 7 and VDOT STC dispatchers. During Phase I of this study, these Center Users are responsible for message assessment and response. Field User(s) will be able to review multimedia messages and subsequently advise others about the incident, but assessment and response is a Center User task.

Note: *Although Mobile Center Users may be out "in the field", they are not considered Field Users. Mobile Center users may be responsible for assessment and response. See user definitions in section I.D.*

a) Acknowledgement

During Phase I of this study, users are not required to acknowledge receipt of a multimedia message using the multimedia messaging system. Radio communication used during the standard/existing dispatch process should be used to acknowledge receipt of a multimedia message.

b) Allocating / Re-allocating Resources

All incoming messages, including picture(s) and annotations, should be reviewed by the agency/personnel responsible for allocating and/or re-allocating resources. These individuals will determine the proper resources for towing and recovery efforts, HAZMAT remediation, or any other response activities.

The design of this project is such that it should not negatively impact current response and recovery operations. Resources should be allocated and dispatched to incident scenes in the same method used before the multimedia messaging system was employed (i.e., using same dispatch process and the same radio communications). As a general rule, dispatchers should not wait for the receipt of the multimedia message before initial resource allocation.

When the analysis of a multimedia message warrants re-allocation of resources dispatched to an incident scene (e.g., a larger tow truck, a HAZMAT crew), the relevant personnel should be notified of the changes using the standard dispatch procedures (e.g., radio)[3].

[3] For the purpose of evaluating the concept system, and perhaps as a means of non-repudiation during subsequent operation use, any such re-allocation should be recorded.

c) Requesting Additional Messages and Forwarding Messages

Depending on the incident and the information supplied in the initial multimedia message, recipients – typically the Center Users – might choose to request additional multimedia messages from the Field Users – either the user providing the initial message, or other users responding to the incident.

During phase I of this study, this request (of other Field Users) should be made by radio communication. It is possible to make this request by replying to, forwarding, or generation a new message using the multimedia messaging system. However, radio communication is recommended to simplify the process during this initial phase of this study.

As those responsible for message assessment and response, the Center User(s) might wish to forward multimedia messages to others that did not receive the message. If so, refer to Message Re-distribution guidelines in sectionIII.A.3.

d) Mapping the Incident

***Note**: Mapping will depend on the resources and capabilities of the Center Users. This feature might be developed as part of the Phase II research efforts, or of it may be established in subsequent phases of this study*

The designated Center User[4] should map the incident using the "Required Information" provided in the initial message. The zone code can be used to highlight a map region. The location identifier can be used to pinpoint the nearest intersection, identifying that location on the zone-highlighted map.

When available, GPS data should be used to create an exact map of the scene. GPS data may be obtained from the picture itself – some phones may embed GPS metadata (EXIF / ITPC) within the picture image. Alternatively, GPS data might be obtained from carrier services – some carriers offer a fleet tracking service, where (from a website or API) one can obtain the GPS location of a specific mobile device.

[4] As testing is currently defined, Center User at the VDOT STC are to receive information regarding all incidents reported with the concept system. For this initial study, it is recommended that these users be designated as those responsible for mapping activities.

B. TECHNICAL PROCEDURES

Technical procedures identify the proper operation and use of the messaging system. Technical procedures will vary with device and service, and are not dependant on the user/agency employing the system.

Note: *As of the completion of this version of the document, the final selection of devices/services to be used during Phase I of this study was not yet complete. Information pertaining to the use of the Motorola i860 is used to exemplify the technical procedures. The i860 is currently used by VDOT and might therefore be one of the devices used in Phase I of this study. Similar information may be provided for other field devices as they are selected for use in the study, and/or may be provided in other project documentation.*

1. Field User Devices

This section addresses the primary technical procedures (photography, message composition, distribution, and receipt) for each of the following Field User devices. These devices meet technical specifications and were approved by the participants in the study. This is not an exhaustive list of devices/services, and other options might be added to subsequent versions of this document, or in subsequent phases of this study. Most of these devices will become discontinued in a short period, yet similar devices with presumably better performance and capabilities will replace them in the market.

Note: *Several devices and services options from various providers are currently under evaluation for use during subsequent phases of this study*

a) Motorola i860 (Nextel/Sprint)

The Motorola i860 was Nextel's first picture phone. This unit was introduced in October of 2004. This unit meets all the technical specification requirements for this study, but was selected primarily because many of the prospective VDOT participants already have and use this device.

(1) Photography

When the phone is opened, the user is presented with the main menu.

1 Press the "OK" button to select the camera application by default

2 Frame the target and press the "Capture" soft button (top left, as labeled on the screen) to capture the picture.

*** Refer to Section III.A.1 (domain procedures for photography)*

3 At this point, the picture is ready to be sent, saved, or discarded. If the picture should be re-taken, press the "Discard" soft button (top right, as labeled on the screen) to return to the previous screen (Step 2).

(2) Message Composition (and Distribution)

Depending on the device, part of the message distribution process (e.g., selecting message recipients) might be integrated with the message composition process. This is the case for the Motorola i860.

1 When viewing a captured picture, press the "Send" soft button. This will save the picture and take you to the Create Message screen

2 While the "To:" field is highlighted, press the "Contacts" soft button. This will take you to the Contacts screen

*** The Contacts list will be created in each device prior to field-testing

3 Scroll to the contact identified as “Master” and press the “OK” button. This will select the Master distribution list as a recipient of the message.

4 Press the “Done” soft button. This will return you to the “Create Message” screen with the Message field highlighted

Note: If a sub menu appears before having the option to select the “Done” soft button, select the appropriate entry on the submenu, press “OK”, and then press the “Done” soft button.

5 Press “OK” to bring up the message text entry screen

6 Enter text using the number keys (either using T9, or using repeated pressing of a digit to bring up the corresponding letter) and press “OK”. This will return you to the Create Message screen with the entered text displayed in the Message field

Note: *The process defined in Step 3 of messages composition and distribution (above) will deliver the message to an independent email server (i.e., not associated with any service provider). This independent server will subsequently distribute the message among all the participants associated with the contact name, in this instance, all users associated with the ‘Master’ contact. This is currently the easiest method for mass MMS distribution among various mobile and fixed users with different devices and service options. The method might introduce latency and message convergence (interoperability) issues. However, as part of an on-going technical evaluation, these performance issues will be addressed in order to establish an optimal method for both data entry and message delivery. For example, it might be possible to create mass distribution lists on individual phones, thus eliminating the need for the independent email server. However, this requires additional system maintenance. Furthermore, this might be only part of the solution. The most appropriate method(s) may be incorporated into later versions of this document.*

(3) Message Distribution

1 To send the message from the Create Message screen, press the "Send" soft button. You will be given an indication screen while the message is being uploaded, then another indication screen after the message has been sent.

(4) Message Receipt

The i860 can receive an MMS message when closed or open.

1 When a multimedia message arrives, a message tone will chime, and the external display will indicate that a New Message has arrived. The external display will also identity the sender.

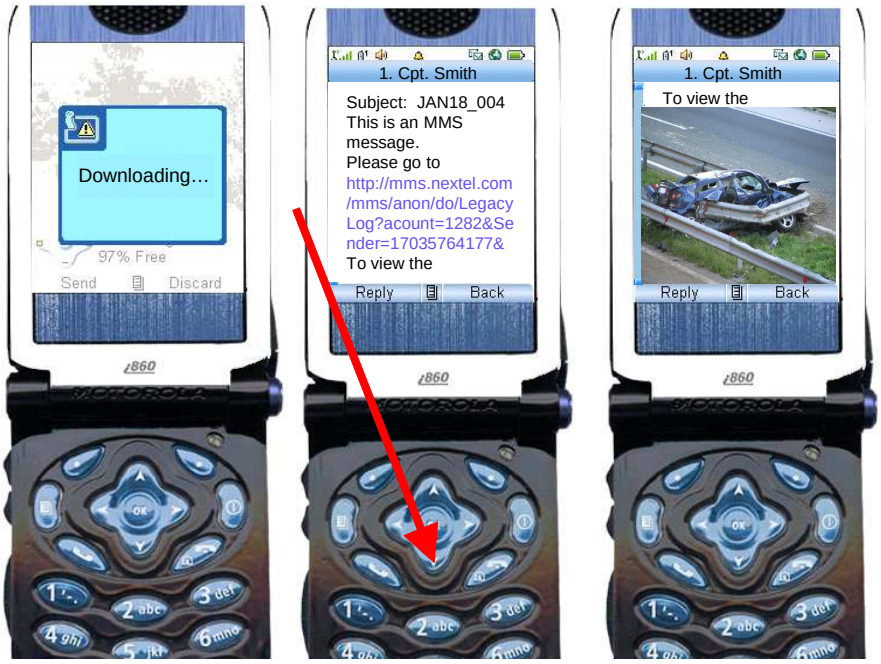
When opened, the internal display will indicate that a New Message has arrived and identify the name of the sender, the image name, and the size of the image. **Note**: The image name is set by the sending device; often, it is automatically named with the current date.

2 To read the message, press the "Read" soft button

3 If it has not already done so, the phone will then finish downloading the incoming message.

The start of the incoming message will be displayed. Since the Master distribution list is external to the MMS system, the message may contain a large URL near the top of the message (used to retrieve the message via a web browser). If the image or incident text does not appear on the first screen, press the down arrow button in order to scroll down the message.

After scrolling down one screen, the incident text and image should be displayed.



***Note**: During Phase I of this study, it is not required to acknowledge receipt of a multimedia message using the multimedia messaging system. Radio communication used during the standard/existing dispatch process should be used to acknowledge receipt of a multimedia message.*

(5) Message Assessment and Response

During Phase I of this study, message assessment and response is the responsibility of Center users (i.e., towing company, VSP D7, and/or the VDOT STC dispatchers) and is therefore not relevant to the i860. The i860 is being used as a Field User device.

Field users responding to received MMS messages should use standard dispatch procedures (e.g., radio). Refer to the domain procedures identified in section III.A.5.

b) Other Devices: The Motorola i580 and the LG VX5200

Note: *As of the release of this document, it is expected that some VDOT users will use the new Motorola i580 (pictured below, left) during the initial phase of this study. It is also expected that many of the non-VDOT users will use the LG VX5200 (pictured below, right) during the initial phase.*

Technical procedures may be provided for these devices in a revision of this document.

2. Center User Devices

This section addresses the primary technical procedures (message composition, distribution, receipt, and assessment and response) for each of the following Center User devices. This is not an exhaustive list of devices/services, and other options might be added to subsequent versions of this document, or in subsequent phases of this study. Most of the Mobile Center User devices will become discontinued in a short period, yet similar devices with presumably better performance and capabilities will replace them in the market.

a) Fixed – Desktop Computer w/ Email Application (Microsoft Outlook)

These instructions were developed based on an assumption that many Fixed Center Users utilize Microsoft Outlook as an email client on desktop computer systems.

(1) Photography

Not applicable during Phase I of this study.

(2) Message Composition

Message composition is performed as the user would for a normal email message. The destination email address should be a pre-configured address book entry for the project's Master distribution list email address. Images are added to the message as attachments.

(3) Message Distribution

The message is distributed by sending the email message to the Master distribution list (and/or an individual recipient, if desired). This process is performed as the user would for a normal email message.

(4) Message Receipt

MMS messages are received as email messages. When an incoming email message is received, Outlook typically plays a message notification sound and displays an envelope icon in the lower right of the taskbar. Clicking on this icon will display the new incoming message.

The message should contain the sending user's phone email address, the text entered in by the sending user, and the image taken of the incident scene. Depending on the carrier, the image may appear inline with the text, or as a clickable attachment (which the center user would then need to open to view the image). The message may also contain a clickable url to the sending carrier's website (to be used in case the image is not viewable).

***Note**: During Phase I of this study, it is not required to acknowledge receipt of a multimedia message using the multimedia messaging system (and in this specific instance, an email reply). Radio communication used during the standard/existing dispatch process should be used to acknowledge receipt of a multimedia message.*

(5) Message Assessment and Response

During Phase I of this study, message assessment and response is the responsibility of Center users (i.e., towing company, VSP D7, and/or the VDOT STC dispatchers).

Center users responding to received MMS messages should use standard dispatch procedures (e.g., radio). Refer to the domain procedures identified in section III.A.5.

As those responsible for message assessment and response, the Center User(s) might also wish to forward multimedia messages to others that did not receive the message. If so, refer to Message Re-distribution guidelines in section III.A.3.

b) Mobile

Note: As of the release of this document, the concept of mobile Center Users has not been formally accepted for the initial phase of the study. Therefore, Mobile Center User Devices have not yet been selected. Candidate devices include:

- Treo 700w (Microsoft Outlook Mobile / Verizon)
- PPC-6700 (Microsoft Outlook Mobile / Sprint)
- Mobile – HTC Wizard / Qtek 9100 (MS Outlook Mobile / GSM)

IV. FUTURE PLANS

Phase I of this study relies on provider resources (e.g. MMSC, Email Servers, etc.), for many message handling functions, and therefore many message handling capabilities (send, store, distribute) are limited to the provider's implementation. Based upon the results of this current phase, Phase II might involve the development and use of messaging servers (such as an MMSC) owned and operated by CapWIN in order to optimize and customize message handling.

Any modifications to the messaging system that impact the operational procedures may be reflected in an updated version of this document.

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Guidance Report

Camera Phone Proof-of-Concept Project

Quick Reference Guide

The operational procedures were summarized by UMD-CATT/CapWIN in the following *Camera Phone Proof-of-Concept Project – Quick Reference Guide.* This guide was given to the participants in the study to facilitate participation.

Camera Phone Project Quick Reference Guide

Step 1. Activate the Camera Program

1. Open the flip phone.
2. From the standby mode, press the Camera Key above the number pad.

Step 2. Take Your Photo of the Accident / Incident

1. Point the camera lens towards the items to be photographed.
2. View the image on the LCD screen.
3. Press left or right on the Navigation Key to zoom, and up or down to adjust the brightness. To use the flash, press the Flash Key on the left side of the phone, below the volume keys.

4. Press OK for TAKE.
5. Optional: Press Left Soft Key for Save or Right Soft Key for Erase.

Step 3. Send Your Photo to the System

1. Press the OK key to start the Send process.
2. On the "To 1." line press the LEFT Soft Key labeled ADD.
3. Select Contacts by pressing the OK key.
4. Choose the "CPP Distribution" contact by highlighting and pressing the OK key.
   * A check mark will appear in the box on the left of the contact selected.

5. Select Done by pressing the LEFT Soft Key button.
6. Press OK.
7. See Step 3a and/or Step 3b to add voice or text message with the photo prior to sending (Optional).
8. OR….Send the image by pressing the OK key.

Step 3a. Add Voice Message to Photo (Optional)

1. From the “Create PIX Message” screen, scroll down to the “Sounds” section.
2. Press the Left Navigation button labeled “Sounds.” This will bring up the “My Sounds” screen.

3. The first option on the list (Number 1.) is “Record New.” Press the “OK” button to select “Recorbd New.”
4. Press the “OK” button again to begin your recording, and the “OK” button again (now labeled “Stop”) to finish your recording.
5. You will then be back at the “My Sounds” screen and your recording will be listed under the date and time that you performed it. Highlight the recording and press “OK.”
6. If you are ready to send photo with voice message, click “OK” OR you can go to step 3b to also add a text message.

Step 3b. Add TXT Message to Photo (Optional)

1. From the “Create PIX Message” screen, scroll down to the “Text” field.
2. Enter the Text that you wish to show in the Subject of the broadcast message in this box.
3. For easier entry, select the Left Navigation button (Labeled “Abc” to bring up other input options. Refer to the Phone user Guide for instructions regarding text entry.
4. Send the image with the TXT message by pressing the OK key.

The camera phone will now automatically connect and send an email with the attached image to all users on the CapWIN Camera Phone Project distribution list, at the email address they provided to CapWIN. Additionally, all users will receive an email on their camera phone with the attached image file.

Step 4. OPTION – Send More Photos

You can send more images if desired. If more images are not necessary, continue with your normal agency procedures. Please note that the CapWIN Camera Phone Project is not a dispatch program, it is an image / information-sharing tool.

If you have any questions or problems please call the CapWIN Help Desk at 301-614-3730 or 1-877-CapWIN1

Guidance Report

Camera Phone Proof-of-Concept Project

Training Guide

UMD-CATT/CapWIN created the following *Camera Phone Proof-of-Concept Project – Training Guide*. This guide was used for training study participants.

Camera Phone Project
Training Guide

Background

The Camera Phone Project (CPP) will allow users the ability to take real-time on-scene photos of traffic accidents and other public safety incidents, using a standard photo-capable cell phone, and share them with other first responders and transportation professionals. The hopes of this Project will allow the sharing of better details of accidents and incidents, via images, resulting in better response capabilities.

Equipment

This Training Guide will demonstrate using the Verizon Wireless LG VX-5200 Camera Phone.

1. Camera Phone
2. Camera Phone Charger
3. Cellular Service w/Data

The Verizon Wireless LG VX-5200 Camera Phone is an all-digital phone that operates on the CDMA/1xRTT service. The phone has several advanced features including a built-in VGA still camera with flash.

Step 1. Charge Your Camera Phone

The phone comes with a rechargeable battery. Keep the battery charged while not in use in order to maximize use time.

1. Plug the round end of the adapter into the phone's charger jack at the bottom of the phone, and the other end into an electrical outlet.
2. The charge time varies depending upon the battery level. The maximum charge time for a fully discharged battery is 3.5 hours. The battery charge level is shown at the top of the LCD screen.

Step 2. Power ON the Phone

1. Press and hold the PWR key for a few seconds until the display screen lights up. At this point, you will now be able to send/receive phone calls, email images, and other standard camera phone features.

Step 3. Activate the Camera Program

1. Open the flip phone.
2. From the standby mode, press the Camera Key above the number pad.

Step 4. Take Your Photo of the Accident / Incident

1. Point the camera lens towards the items to be photographed.
2. View the image on the LCD screen.
3. Press left or right on the Navigation Key to zoom, and up or down to adjust the brightness. To use the flash, press the Flash Key on the left side of the phone, below the volume keys.
4. Press OK for TAKE.
5. Optional: Press Left Soft Key for Save or Right Soft Key for Erase.

Step 5. Send Your Photo to the System

1. Press the OK key to start the Send process.
2. On the "To 1." line press the LEFT Soft Key labeled ADD.
3. Select Contacts by pressing the OK key.
4. Choose the "CPP Distribution" contact by highlighting and pressing the OK key.
   * A check mark will appear in the box on the left of the contact selected.
5. Select Done by pressing the LEFT Soft Key button.
6. Press OK.
7. See Step 5a and/or Step 5b to add voice or text message with the photo prior to sending (Optional).
8. OR….Send the image by pressing the OK key.

Step 5a. Add Voice Message to Photo (Optional)

1. From the “Create PIX Message” screen, scroll down to the “Sounds” section.
2. Press the Left Navigation button labeled “Sounds.” This will bring up the “My Sounds” screen.
3. The first option on the list (Number 1.) is “Record New.” Press the “OK” button to select “Record New.”
4. Press the “OK” button again to begin your recording, and the “OK” button again (now labeled “Stop”) to finish your recording.

5. You will then be back at the "My Sounds" screen and your recording will be listed under the date and time that you performed it. Highlight the recording and press "OK."
6. If you are ready to send photo with voice message, click "OK"
   OR you can go to step 5b to also add a text message.

Step 5b. Add TXT Message to Photo (Optional)

1. From the "Create PIX Message" screen, scroll down to the "Text" field.
2. Enter the Text that you wish to show in the Subject of the broadcast message in this box.
3. For easier entry, select the Left Navigation button

   (Labeled "Abc" to bring up other input options. Refer to the Phone user Guide for instructions regarding text entry.
4. Send the image with the TXT message by pressing the OK key.

The camera phone will now automatically connect and send an email with the attached image to all users on the CapWIN Camera Phone Project distribution list, at the email address they provided to CapWIN. Additionally, all users will receive an email on their camera phone with the attached image file.

Step 6. OPTION - Send More Photos

You can send more images if desired. If more images are not necessary, continue with your normal agency procedures. Please note that the CapWIN Camera Phone Project is not a dispatch program, it is an image / information-sharing tool.

If you have any questions or problems please call the
CapWIN Help Desk at 301-614-3730 or 1-877-CapWIN1

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Guidance Report

Camera Phone Proof-of-Concept Project

Readiness Report

Readiness Report

Camera Phone Proof-of-Concept Project

Submitted to:

Federal Highway Administration (FHWA)
United States Department of Transportation

1 December 2006

TABLE OF CONTENTS

1 Introduction

This document describes the readiness of all systems and participants to initiate the Phase I demonstration period of the Camera Phone Proof-of-Concept Project (CPP).

In the initial project schedule, this document was intended to take a snapshot of the readiness of the systems and participants before the initiation of the Phase I demonstration, at the completion of Task 9 (Configure Hardware, Train Users, and Distribute Hardware). As the camera phone/system configuration, user training, and hardware distribution continued past the initial demonstration period kickoff, this document has expanded to cover both the status of systems and participants at the demonstration period start, and the status of the systems after the completion of the user training and hardware distribution.

2 Participant Status

This section details the readiness of the CPP user participants to initiate the demonstration.

The initial demonstration period kickoff meeting occurred in early August 2006. However, on the morning of the meeting, three separate tractor-trailer road incidents occurred within CPP participant study area, resulting in the absence of nearly every CPP user participant at the meeting. As a result, individual hardware distribution and user training occurred over the next few weeks at various locations as needed.

2.1 Virginia Department of Transportation

The Virginia Department of Transportation (VDOT) is the project's largest participant. Nine project camera phones were assigned for VDOT for project use. In addition, a number of VDOT users already had camera phones (personal and/or issued by VDOT) – some initial guidance was given to VDOT concerning the use of those phones for the project.

The email addresses of multiple VDOT Smart Traffic Center (STC) users were added to the CPP distribution list. These users represent the VDOT "dispatch" center in the CPP concept of operations / system description.

Also during the initial demonstration period, VDOT was in the process of purchasing phones for normal VDOT operational use, and wished to select phones that would be compatible with the CPP as well if possible. CapWIN and Mitretek provided technical guidance for this selection.

2.2 Towing Operators

Device distribution and user training for the towing operators occurred in multiple meetings at the individual operators' dispatch centers.

- Willow Spring Towing & Recovery: received two camera phones; four of their own phones were added to the CPP distribution list and provisioned for the project
- Henry's Wrecker Service: received one camera phone; two email addresses were added to the CPP distribution list – one of their administrator, and another for a distribution list internal to (and managed by) Henry's.
- Redman Fleet Services: received one camera phone; at the time of kickoff, dispatch did not have email
- Wards Towing: did not want a project camera phone; two of their own phones were added to the distribution list
- Waggy's Towing: dispatch email address added to the distribution list

2.3 Virginia State Police

In April 2006, the Virginia State Police (VSP) informed the project that they would not be participating in the demonstration. Efforts were made to re-engage the VSP, however it was decided that we should proceed with the Phase I demonstration without the VSP.

3 System Status

This section details the readiness of the CPP systems and services to initiate the demonstration. It covers the state of the systems and services both at the initial demonstration period kickoff meeting (in early August 2006), as well as the system readiness over the course of the individual hardware distribution and user training, occurring over the following few weeks.

3.1 Camera Phones

Approximately twenty Verizon LG VX-5200 camera phones were acquired for field use for the project. All were configured with an email contact for the CPP distribution list. Step-by-step instructions for taking and sending a picture were produced, distributed in both CDROM and laminated instruction sheet form.

The six phones that had been acquired earlier for evaluation and testing purposes continued to be utilized for testing and development, as well as for demonstration purposes at various project meetings.

In addition, multiple participant user phones (primarily Nextel i860's) were configured for project use.

3.2 CPP Distribution List

An email distribution list was setup to route all incoming picture messages to all dispatch centers, select camera phones, and project participants: cpp@cpp.capwin.org

At the demonstration kickoff meeting, it was found that while all messages sent by the phones via the distribution list were being received by the dispatch centers' email accounts, the Verizon camera phones were not receiving the sent picture messages (though, the Verizon development phones continued to receive messages). Due to this problem, the Verizon field use project phones were removed from the distribution list – they would no longer receive pictures sent to the list (however, they could still create and send messages to the list).

The problem was identified to be an issue with the wireless carriers' firewalls/anti-spam filters. Initial debugging steps were taken to try to diagnose and resolve this issue (header modification, DNS SenderID/SPF settings, etc.). In addition, Verizon was contacted in an attempt to resolve the issue. However, as of the end of the hardware distribution and user training period, no solution had been found to reliably send the messages through.

3.3 Current Incidents Web Page

A web page showing all pictures of incidents sent to the distribution list over the previous 24 hours was created: http://cpp.capwin.org/CPP/index.jsp

At the time of the demonstration kickoff meeting, it was online and fully functional.

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Guidance Report

Camera Phone Proof-of-Concept Project

Technical Issues Overview

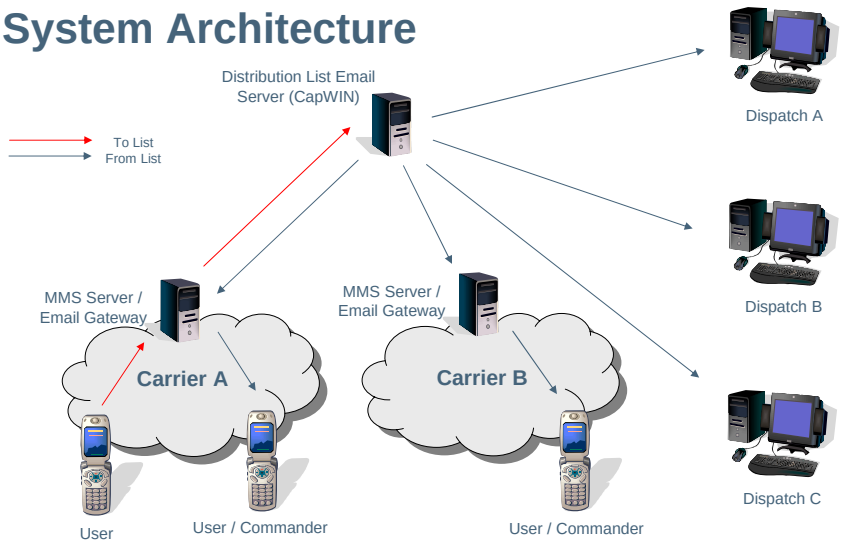
Noblis created the *USDOT Camera Phone Proof-of-Concept Project Technical Issues Overview* to detail to the users specific technical issues encountered during the evaluation. This was presented to project participants at a user debriefing held at the end of the demonstration/test period.

USDOT Camera Phone Proof-of-Concept Project Technical Issues Overview (Phase I)

March 1st 2007

noblis
For the best of reasons

System Architecture



noblis
For the best of reasons

Message Content / Annotation

- Callback Number
  - Hidden by / embedded in email address
  - Possible to make phone number selectable on some devices (e.g. Nextel i860)
- Voice (most messages)
  - Used for most messages
  - Often doubled message size
- Text (<10%)
  - Usually in addition to voice
- GPS (potential future use)
  - Carrier Tracking Services (Nextel, Verizon)
  - Embedded GPS info in image by device (HP 69xx PDA phones)

Message Size / Display

- Delivery to PC/email (no major issues)
- Delivery to Phone/MMS Device
  - Carrier incoming MMS message size limitations
  - Device incoming MMS message size limitations
  - Attachment removal by carrier/device
    - Some (but not all) audio attachments sent by the project's Verizon phones were stripped when received by Nextel i860s
  - Scrolling for viewing picture
    - For many devices, attachment displayed at end of message, requires scrolling through many pages of text before viewing

Message Blocking

- Carriers block incoming messages that are considered possible email spam. Possible triggers for filter include:
  - Sender's email address
  - Sender's outgoing mail server name/address
    - Real-time Blackhole Lists, Sender Policy Framework (SPF)
  - Number of messages sent
    - Single connection
    - Past few minutes/hours
  - Message content (Images, URLs in text)
- Example: Verizon blocked incoming MMS messages when more than one or two Verizon phones were on the distribution list

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Guidance Report

Camera Phone Proof-of-Concept Project

Evaluation Update

SAIC created the *Camera Phone Proof of Concept Project Evaluation Update* to describe to the users the evaluation strategy, evaluation status, summary of usage, and preliminary findings. This was presented to project participants at a user debriefing held at the end of the demonstration/test period.

Camera Phone Proof of Concept Project

IPAS II – Task # 61020
Evaluation Update Briefing
March 1, 2007

Evaluation Strategy

The focus of the evaluation is to assess the impact of the camera phone with respect to the following key areas:

- **User Satisfaction:**
  - Assess end-user perceptions on feasibility of camera phones to improve incident clearance times.
  - Assess end-user perceptions regarding overall benefits of camera phone
- **Operational Procedures:**
  - Determine how the phones were used to improve incident management & response activities
  - Determine how the phones were integrated into existing operational/incident response activities
  - Assess the impact of weather, time of day, and other factors on image quality

Evaluation Strategy (cont')

- **Technology Functionality:**
  - Assess end-user perceptions on the effectiveness of the technology (image quality, equipment reliability, speed of service, etc.)
- **Safety Improvement:**
  - Assess end-user perceptions of how camera phones improve levels of safety during traffic incident remediation (including reductions in roadway exposure, secondary accidents, etc.)
- **Institutional & Technical Issues:**
  - Identify/Report any issues, technical or institutional, that were encountered during project (Ex. Storing of images)

Evaluation Status: Phase I

- SAIC developed interview guides that were designed to address key evaluation areas
- SAIC is in the process of conducting stakeholder interviews to capture participant feedback
- As of 2/8/2007, 4 interviews have been conducted with project participants
- Goal is to complete additional interviews by 03/01/2007
- As of 2/18/2007, 100 pictures have been taken by project participants (VDOT, Tow Companies, etc.)
- Submit draft Lessons Learned and Benefit write-ups by 03/22/2007
- Submit final Lessons Learned and Benefit write-ups by 05/1/2007

* At date of presentation development, two additional interviews were scheduled

Summary of Usage

- There were 100 pictures taken between August 2006 and February 2007. Of the 100 pictures sent, 56 included audio recordings detailing the accident scene.
  - 14 of the 100 pictures were taken between the times 12:00am and 6:00am
  - 45 of the 100 pictures were taken between the times 6:00am and 12:00pm
  - 23 of the 100 pictures were taken between the times 12:00pm and 6:00pm
  - 18 of the 100 pictures were taken between the times 6:00pm and 12:00am
- VDOT sent 76 of the 100 pictures
- Henry's Wrecker Service sent 12 of the 100 pictures
- Willow Spring Towing and Recovery sent 6 of the 100 pictures
- CapWIN sent 4 of the 100 pictures
- An unknown Agency sent 2 of the 100 pictures

Preliminary Findings

- Benefits
  - Camera phone functionality
    - Send photo and voice message
    - Transmission includes number of sender
  - Archived photos may be used by VDOT for training
  - Towing companies and operational changes
    - Help identify what equipment is needed to handle a particular incident
    - Help plan incident management remediation activities prior to arriving on scene
- Lessons Learned
  - Camera phone technology (features, capabilities, model type) may need to be enhanced in order to improve night-time usage and image quality
  - Lack of interoperability between different service providers often impacts the ability of users to send/receive data

Sample Images

- Image taken on 08/11/06 at 10:50am by VDOT
- Audio Clip:

- Image taken on 8/26/06 at 9:22am by VDOT

Sample Images (cont')

- Image taken on 10/05/06 at 11:53am by Willow Springs

- Image taken on 10/13/2006 at 5:12am by VDOT
- Audio Clip:

Sample Images (cont')

- Image taken on 10/20/06 at 2:02pm by Henry's Wrecker Service
- Audio Clip:

- Image taken on 2/4/2007 9:48 pm by VDOT

Sample Images (cont')

- Image taken on 08/11/06 at 3:24am by VDOT

- Image taken on 01/29/07 at 2:59pm by VDOT

Next Steps TimeLine (Phase I)

- 3/8/2007: Draft and send evaluation notes and findings to stakeholders
- 3/15/2007: Comments and updates returned to evaluation team
- 3/22/2007: Draft of benefits and lessons learned submitted to Noblis for review
- 3/29/2007: Benefits and lessons learned received and submitted to JPO
- 4/15/2007: Receive comments from JPO
- 5/1/2007: Submit final documents
- TBD: Phase II

Guidance Report

Camera Phone Proof-of-Concept Project

Lessons Learned Report

The operational improvement provided by the new system and the anecdotal experiences of the participants was documented by SAIC in the *Camera Phone Proof-of-Concept Project – Lessons-Learned Report*, which has been posted in the USDOT ITS Lessons Learned database (www.benefitcost.its.dot.gov).This report identifies insights with regard to using such a system for incident and emergency management practices.

This document is available from the following URL:

http://www.itslessons.its.dot.gov/its/benecost.nsf/Lesson?OpenForm&C78B5A4B101B00D5852572BA005783A4%5eHome

When considering the use of camera phones in managing incidents, be aware of the challenges associated with technology interoperability among agencies and first responder priorities.

Washington, D.C., metro area's experience with using camera phones

April 2007
District of Columbia, Maryland, Virginia, USA

To evaluate the feasibility of utilizing camera phones in managing traffic incidents, a proof-of-concept project was undertaken in a joint partnership between the Federal Highway Administration (FHWA) and the University of Maryland's Center for Advanced Transportation Technology. Other parties involved included the Virginia Department of Transportation (VDOT) and selected commercial towing companies.

The goal of this project is to improve incident management and response activities in the event of a traffic incident or other emergency situation that affects traffic operations. More specifically, the primary objective is to demonstrate the feasibility of using commercial off-the-shelf (COTS) wireless telephones equipped with cameras to capture and deliver traffic incident imagery that is useful to follow-on responders, such as tow companies, HAZMAT remediation services, health departments, or highway repair teams.

This pilot project was implemented in coordination with the Capital Wireless Information Net (CapWIN) staff, VDOT, and several local commercial towing and recovery services. Each camera phone employs wireless picture phone technology that enables participating agencies to capture and transmit digital photos. Emergency responders from agencies, such as the VDOT, and private towing firms used camera phones to take detailed pictures of traffic incident scenes and then transmitted those images directly to their appropriate dispatch center and follow-on responders.

During the test phase of the proof-of-concept project, a total of 19 camera phones were used by four towing companies and the Virginia Department of Transportation (VDOT) from August through October 2006 to transmit 100 photographs of incidents to responders (i.e., towing companies). The project was conducted in the Washington, D.C. metropolitan area, including Northern Virginia and Maryland.

Lesson Learned

Throughout the camera phone pilot phase, first responders captured images of incidents and forwarded them to towing companies so that the appropriate size/type of recovery vehicle could be dispatched. The Camera Phone project provides the following insights with regard to its utility in the incident and emergency management practices:

- **Encourage interoperability of systems used by the involved agencies.** There is a lack of interoperability between different service providers. Using or designing interoperable systems may assist in responsiveness and have potential benefits in transmitting images or audio recording clips even to different departments (i.e. fire, rescue). In many cases, agencies have already invested in equipment. Making the existing equipment interoperable would capitalize on that investment and make it more likely to be used for emergency response, and more likely that the required information can be shared across jurisdictions in a very timely fashion.
- **Understand that capturing and sending an image may not be the immediate concern for first responders.** Upon arrival at the incident, the first responders are typically engaged with other pressing activities. There may not be time to take the picture for use as an aid in sending tow vehicles, but those that are taken can be used later for responder training and incident management. As first responders arrive on the scene, they have duties which may be too far away from the actual incident to provide images which are meaningful to the towing companies. Also, capturing the images with this type of equipment may place the responder at risk him or herself.
- **Be aware that users will need to be trained to take pictures without exposing themselves to additional risk by unnecessary exposure at roadside.** Upon arrival on the scene and after the first responder has taken care of primary duties, the responder may be inclined to move closer to the actual incident to take pictures. The very action of taking the pictures may expose the responders to bodily harm if his/her attention is diverted from oncoming traffic.
- **Be aware that night time camera phone use or inclement weather conditions may adversely affect the image quality.** Using camera phones at night and during inclement weather is not always effective as the image was sometime blurry or too dark to be of benefit. Since the receiving agency may not have been able to view the image clearly, it made it difficult to determine the appropriate towing vehicle to send in response.
- **Encourage sending audio recording clips with all transmitted images to provide greater detail to appropriate responders.** Whether or not the camera phones were used during the daytime, night time, or during inclement weather conditions, using audio clips in addition to the transmitted images provided greater detail to the appropriate responders and service providers. The audio clips assisted the responding companies to send the proper towing equipment even if the images were not as useful.

- **Understand the diverse needs and experiences of users when several agencies are involved as stakeholders.**
    - Towing companies are able to gain benefit from the pictures for major incidents and especially if they are able to receive the pictures early enough after the incident occurs.
    - If there is a zone-type system where towing companies dispatch immediately upon receiving information about an incident, the picture may not be as beneficial regarding the type of equipment required for a particular incident. The picture, with accompanying audio clip, would give an impression about the order of magnitude of the incident, to help determine the appropriately sized towing vehicle to dispatch.
    - The camera phone images helped the towing vehicle operators plan a response strategy prior to leaving for the incident scene. For example, if the incident image revealed that two lanes were blocked on eastbound traffic lanes, a towing dispatcher may determine that it is more beneficial for the towing vehicle operator to approach the incident from the westbound lanes.
    - There must be an agency-wide attitude of acceptance of standard operating procedures and policies, which are to developed as deemed essential, to guide the use of the phones for all participants.
    - Throughout the entire proof-of-concept project, all incident images were captured and archived. Project participants stated that the archived images can be used to help enhance their future incident response/awareness training activities. For example, the VDOT safety service patrolmen may use the archived images to identify equipment needs for certain types of activities or help them develop response strategies based on the severity of the incident. The images may also be used for incident training.
    - As a result of using the phones, there is great interest in finding technically a way to pull the images in as well as having them pushed through the phone. The images could be available on an FTP (File Transfer Protocol) site, or dash-mounted or vehicle-mounted cameras could provide a continuous feed for users to observe, capture, and provide response.
    - The proof-of-concept showed that the images captured by the first responders were useful to the companies that were sending out towing vehicles. The transmitted images allowed them to view the specific extent of the damage, and to respond accordingly. The images of infrastructure damage also allowed the infrastructure asset managers to assess the damage and plan for future maintenance. The value obtained by the camera phone can be repeated and expanded when interoperability challenges are solved.

The camera phone proof-of-concept project also served as a means to promote the FHWA's broader Intelligent Transportation Systems (ITS) goals of improving safety and mobility in road travel. Used to their fullest potential, camera phones in service for incident management can assist with relaying information which may have an impact on

the type of equipment, route of approach, and subsequent responder training.

Potential success areas also exist in ITS customer satisfaction in that the actual users of the equipment find it easy to navigate and easy to transmit images and audio clips. The individuals receiving the information found it very expedient to receive the images and offered potential enhancement ideas for future iterations such as the ability to take pictures at night and improved audio messaging capability.

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Camera Phone Proof-of-Concept Project

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