Response, Emergency Staging, Communications, Uniform Management, and Evacuation (R.E.S.C.U.M.E.)

Report on Functional and Performance Requirements, and High-Level Data and Communication Needs

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16. Abstract

This Requirements Document builds upon the R.E.S.C.U.M.E. Concept of Operations document by transforming the User Needs and operational concepts captured in the ConOps and vetted in a Transportation Safety Advancement Group (TSAG) meeting on 19 September 2012 in Biloxi, MS into well-formed functional requirements. The requirements expand upon the content in the ConOps to define the required functionality, performance, interfaces, and other required system characteristics. Furthermore, performance targets for each functional requirement are identified to ensure the transformative goals detailed in the ConOps are accomplished. The structure of this Requirements Document is developed based on guidance in the Institute of Electrical and Electronics Engineers (IEEE) Standard 1233-1998 – IEEE Guide for Developing System Requirements Specifications.

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Executive Summary

The US DOT sponsored Dynamic Mobility Applications (DMA) program seeks to identify, develop, and deploy applications that leverage the full potential of connected vehicles, travelers and infrastructure to enhance current operational practices and transform future surface transportation systems management.[1] The DMA Program consists of a set of transformative mobility applications that, when bundled together, impact the transportation system to improve mobility. R.E.S.C.U.M.E. is included in the DMA bundles. The R.E.S.C.U.M.E. bundle is expected to communicate and interact with the other bundles under two different communication mechanisms. First, the R.E.S.C.U.M.E. bundle is expected to exchange information with other DMA Program bundles through an Information Broker (discussed below). Second, the R.E.S.C.U.M.E. bundle will use CV technology as a communication bridge to transfer information between bundles.

This Requirements Document builds upon the R.E.S.C.U.M.E. Concept of Operations document by transforming the User Needs and operational concepts captured in the ConOps and vetted in a Transportation Safety Advancement Group (TSAG) meeting on 19 September 2012 in Biloxi, MS into well-formed functional requirements. The requirements expand upon the content in the ConOps to define the required functionality, performance, interfaces, and other required system characteristics. Furthermore, performance targets for each functional requirement are identified to ensure the transformative goals detailed in the ConOps are accomplished. The structure of this Requirements Document is developed based on guidance in the Institute of Electrical and Electronics Engineers (IEEE) Standard 1233-1998 – IEEE Guide for Developing System Requirements Specifications.

[1] http://www.its.dot.gov/dma/index.htm

Chapter 1 Scope of System

Identification of System

This document describes the Functional and Performance Requirements, and High-Level Data and Communication Needs for the Response, Emergency Staging, Communications, Uniform Management, and Evacuation (R.E.S.C.U.M.E.) Program.

Document Overview

This Requirements Document builds upon the R.E.S.C.U.M.E. Concept of Operations document by transforming the User Needs and operational concepts captured in the ConOps and vetted in a Transportation Safety Advancement Group (TSAG) meeting on 19 September 2012 in Biloxi, MS into well-formed functional requirements.[2] The requirements expand upon the content in the ConOps to define the required functionality, performance, interfaces, and other required system characteristics. Furthermore, performance targets for each functional requirement are identified to ensure the transformative goals detailed in the ConOps are accomplished.

The structure of this Requirements Document is developed based on guidance in the Institute of Electrical and Electronics Engineers (IEEE) Standard 1233-1998 – IEEE Guide for Developing System Requirements Specifications. The resulting document describes what the R.E.S.C.U.M.E bundle of applications must accomplish to produce the required results, including corresponding performance requirements. It also identifies the necessary subsystems and defines the functional interface requirements among the subsystems. This document consists of the following sections:

- **Section 1 (Scope of System)** introduces this document to the reader and includes an overview of the Dynamic Mobility Applications (DMA) program and the R.E.S.C.U.M.E. bundle of applications.
- **Section 2 (Referenced Documents)** describes the external documentation referenced within this document.
- **Section 3 (Requirements Overview)** provides an overview of the requirements nomenclature, organization of the requirements and methods of verifying the requirements.
- **Section 4 (Requirements)** details the requirements for the R.E.S.C.U.M.E. bundle of applications. It also includes an overview of the functional architectures, modes of operation and performance requirements for each of the bundles.

[2] The **Transportation Safety Advancement Group** (TSAG) is an assembly of multi-discipline professionals sharing a common concern for transportation and public safety. TSAG serves as a forum for providing technologies for public safety input and guidance to the US Department of Transportation, ITS Joint Program Office.

- **Section 5 (Needs-to-Requirements Matrix)** provides a matrix tracing each requirement to the User Need that triggered it and vice versa.
- **Appendix A** lists the definitions of the acronyms, abbreviations and terms used throughout this document.

Dynamic Mobility Applications Program

The US DOT sponsored Dynamic Mobility Applications (DMA) program seeks to identify, develop, and deploy applications that leverage the full potential of connected vehicles, travelers and infrastructure to enhance current operational practices and transform future surface transportation systems management.[3] The DMA Program consists of a set of transformative mobility applications that, when bundled together, impact the transportation system to improve mobility. The vision of the DMA Program is to expedite development, testing, commercialization, and deployment of innovative mobility applications to maximize system productivity and enhance mobility of individuals within the system. These objectives will be accomplished through the identification, development, testing, deployment, and adoption of transformative mobility applications. R.E.S.C.U.M.E. is included in the DMA bundles.

Response, Emergency Staging, Communications, Uniform Management, and Evacuation (R.E.S.C.U.M.E.)

The R.E.S.C.U.M.E. bundle is expected to communicate and interact with the other bundles under two different communication mechanisms. First, the R.E.S.C.U.M.E. bundle is expected to exchange information with other DMA Program bundles through an Information Broker (discussed below). Second, the R.E.S.C.U.M.E. bundle will use CV technology as a communication bridge to transfer information between bundles.

The following sections discuss at a high level the nature of the four applications that make up the R.E.S.C.U.M.E. bundle: Advanced Automatic Crash Notification Relay (AACN-RELAY), Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG), Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE), and Emergency Communications for Evacuation (EVAC).

Advanced Automatic Crash Notification Relay (AACN-RELAY)

Advanced Automatic Crash Notification Relay (AACN-RELAY) refers to a capability that will allow vehicles to relay an emergency message (i.e., “AACN”) from other vehicles involved in a crash or other distress situation. An automatic crash notification feature transmits key data on the crash recorded by sensors mounted in the vehicle without the need for involvement of the driver or an occupant, in case they are incapacitated. For Connected Vehicle (CV) enabled vehicles, this will be initiated by two concurrent methods to get the

AACN-RELAY requirements are included in this document for completeness and consistency. However, USDOT does not plan to pursue development of AACN-RELAY during subsequent phases of the DMA Program.

[3] http://www.its.dot.gov/dma/index.htm

crash message to an Emergency Communications Center (ECC, part of which is a public safety answering point, or PSAP) for action by emergency responders. These methods are (1) a call placed by a cell phone embedded as part of the car's AACN system, and (2) the transmission of comparable information by a short-range wireless transmission to be relayed by other CV-enabled vehicles.

The capability to respond to vehicle emergencies resulting from single vehicle incidents will be improved, which is particularly needed in rural or remote areas where there may not be cell phone coverage or passers-by who are not aware that an off-road incident has even occurred. The ability to both dispatch appropriate resources and triage victims to an appropriate final destination based on the severity of injuries will also be enhanced. The AACN-RELAY application will provide the capability for CV-enabled vehicles to detect other vehicles' AACN alerts and relay them to yet other CV-enabled vehicles as well as roadside "hotspots." This relay of the original AACN message will result in it being received and acted on by the PSAP that has coverage for the location of the incident where the relayed AACN message was originated. The purpose of the AACN-RELAY application is to expand the population of AACN-RELAY capable vehicles and minimize the notification time to emergency responders. This reduces the time from the crash occurring to the emergency responders arriving on scene and delivering medical attention. AACN-RELAY also provides responders with key information regarding the characteristics of the incident that triggered transmission of the AACN message.

Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG)

The Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG) application will provide situational awareness to and coordination among emergency responders—upon dispatch and while en route— to establish incident scene work zones both upon initial arrival and staging of assets, and afterward if circumstances require additional dispatch and staging. It will provide valuable input to responder and dispatcher decisions and actions. There is a range of data that will be provided through mobile devices and other types of communication to help support emergency responder vehicle routing, staging, and secondary dispatch decision-making. These data will include staging plans, satellite imagery, geographic information system (GIS) map graphics, camera images, current weather data, sensor readings, and real-time modeling outputs.

Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)

Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE) is a communication approach that will improve protection of incident sites where there have been crashes, other accidents, or events impacting traffic such as stalled vehicles or vehicles pulled over for moving violations. It is important to note that construction work zones and accident incident zones are fundamentally different in nature. Specifically, a work zone is typically pre-planned and usually involves only a single agency (or at most a few agencies) while an incident zone is unplanned and frequently involves inter-agency responses.

Persons found in an incident zone could include crash victims, law enforcement, Emergency Medical Services (EMS), Fire and Rescue, HAZMAT Response Unit, Towing and Recovery assets, and roadway/infrastructure repair workers. One aspect of the INC-ZONE application is an in-vehicle messaging system that provides drivers with merging and speed guidance around an incident. Another aspect is providing in-vehicle incident scene alerts to drivers, both for the protection of the drivers as well as incident zone personnel. A third aspect is a warning system for on-scene workers

when a vehicle approaching or in the incident zone is operated outside of safe parameters for the conditions.

Emergency Communications for Evacuation (EVAC)

Emergency Communications for Evacuation (EVAC) will provide critical information such as dynamic route guidance information; current traffic and road conditions; location of available lodging; and location of fuel, food, water, cash machines and other necessities. EVAC will also identify and locate people requiring mobility assistance and will identify existing service providers and other available resources to them.

R.E.S.C.U.M.E. Stakeholders

The following User Classes have been identified as contributors to the R.E.S.C.U.M.E. Bundle's functional and performance requirements. These classes represent a broad spectrum of perspectives and interests and have both directly and/or indirectly provided materials used to develop the functional and performance requirements. User Classes are generalized into Federal, State, Local, and Other, allowing organizations to focus on areas of responsibility in incident preparedness, mitigation, response, and recovery. The "Other" User Class also includes those User Classes that cross multiple levels of governmental entities. Details regarding the individual User Groups and organizations within these classes are provided below.

Local User Groups

Table 1-1 identifies Local User Group and the application bundles relevant to their operations.

Table 1-1. Local User Groups

Stakeholder	Primary Function	Application Bundle
9-1-1 Call Centers/Dispatchers	Provide the key information link between 9-1-1 callers and emergency responders. They gather information directly and through technology such as CAD, deploy emergency response, and work with TMC operators to ensure the most efficient routes are taken.	AACN-RELAY RESP-STG
9-1-1 Network Service Providers	Route calls to PSAPs	AACN-RELAY
City and County Transportation Departments	Support emergency preparedness and response, evacuation planning and implementation, work zone planning and implementation, and incident response.	RESP-STG INC-ZONE EVAC
Emergency Vehicle Operators	On the front line of incident and emergency response and are charged with reaching an incident in the safest and most efficient manner.	RESP-STG INC-ZONE
Hospitals	Support emergency preparedness and response and provide medical care and response as well as trauma centers.	AACN-RELAY EVAC
Public Safety Answering Point	A call center responsible for answering calls to an emergency telephone number for emergency services.	AACN-RELAY
Public Works Departments	Help to ensure roadways, street, and bridge infrastructure are safe, clean, and attractive and can provide support to emergency and incident response and clearance.	RESP-STG INC-ZONE EVAC
Secondary Responders	Personnel who arrive on scene at an incident but are not critical to emergency response. This includes DOT, utilities, public works, and highway maintenance personnel.	RESP-STG INC-ZONE EVAC
Towing and Recovery Companies	Provide incident clearance support.	RESP-STG INC-ZONE EVAC
Transit Agencies	A critical element of the transportation system. Transit agencies support emergency preparedness and response and evacuation planning and response. More transit agencies are also utilizing ITS technologies and in-vehicle telematics to provide travel time information to passengers. They also monitor roadway conditions in order to meet level of service requirements.	EVAC
Metropolitan Planning Organizations (MPOs)	Proactively take the lead in coordination with other agencies when it comes to evacuation planning and supporting emergency preparedness. In addition, many MPOs are championing collaboration on incident management efforts.	EVAC

Source: Battelle

State User Groups

Table 1-2 identifies State User Group and the application bundles relevant to their operations.

Table 1-2. State User Groups

Stakeholder	Primary Function	Application Bundle
State Departments of Transportation (DOTs)	Proactively take the lead in coordination with other agencies when it comes to evacuation planning. DOTs use a variety of mobility-related performance measures in existing work zones to monitor the actual traffic impacts. State DOTs utilize "push" technologies such as VMSs to provide information to travelers in order to reduce congestion around incidents. They also share information and data across agencies to assist in response planning and management of traffic impacts. They support emergency preparedness and response, evacuation planning and implementation, work zone planning and implementation, and incident response.	RESP-STG INC-ZONE EVAC
State Emergency Management Agencies (EMAs)	The lead state agencies for coordination of comprehensive emergency preparedness, training, response, recovery, and mitigation services in order to save lives and reduce the impact of emergencies. They provide a key forum for dissemination of information to the general public on how to prepare for emergency and evacuation situations.	RESP-STG INC-ZONE EVAC
State Governments	Support emergency preparedness and response and evacuation planning. In addition, they are responsible for passage of legislation that may impact how incidents are handled – for example, Safe, Quick Clearance Laws.	RESP-STG EVAC
Turnpike/Toll Authorities	Support emergency preparedness and response, evacuation planning and implementation, work zone planning and implementation, and incident response.	RESP-STG INC-ZONE EVAC

Source: Battelle

Federal User Groups

Table 1-3 identifies Federal User Group and the application bundles relevant to their operations.

Table 1-3. Federal Users Groups

Stakeholder	Primary Function	Application Bundle
Army Corps of Engineers	Responsible for investigating, developing, and maintaining the nation's water and related environmental resources. As such they are responsible for devising disaster mitigation plans and implementing infrastructure to reduce impacts of hurricanes and storms as well as providing trained responders to emergency situations.	RESP-STG INC-ZONE EVAC
Centers for Disease Control and Prevention (CDC)	Support emergency preparedness and response and captures lessons learned and best practices.	EVAC
Department of Defense (DoD)	Supports emergency preparedness and response and evacuation planning and implementation at a National level. In particular, agencies such as the National Guard are often called upon for support during major national emergencies or events such as Hurricane Katrina.	RESP-STG INC-ZONE EVAC
Department of Homeland Security (DHS)	Supports emergency preparedness and response and evacuation planning and implementation at a National level.	RESP-STG INC-ZONE EVAC
Department of Health and Human Services (HHS) Assistant Secretary for Preparedness and Response (ASPR)	Leads Emergency Support Function (ESF) #8 – Public Health and Medical Services under the National Response Framework. Also provides the mechanism for coordinated Federal assistance to supplement State, tribal, and local resources in response to a public health and medical disaster, potential or actual incidents requiring a coordinated Federal response, and/or during a developing potential health and medical emergency.	EVAC
Federal Communications Commission	Regulates interstate and international communications and addresses public safety, homeland security, national security, emergency management and preparedness, and disaster management. In addition the FCC has established requirements and rules for 9-1-1 service and providers including Voice over Internet Protocol (VoIP), Enhanced 9-1-1 (E9-1-1), and Next Generation 9-1-1 (NG9-1-1).	AACN-RELAY
Federal Emergency Management Agency	Supports disaster mitigation, preparedness, response, recovery, and education and provides guidance to states, regions, emergency personnel, and the general public.	EVAC

Table 1-3. Federal Users Groups (Continued)

Stakeholder	Primary Function	Application Bundle
Federal Highway Administration	Through its Emergency Transportation Operations (ETO) programs provides tools, guidance, capacity building, and good practices that aid local and state DOTs and their partners in their efforts to improve transportation network efficiency and public/responder safety when a non-recurring event either interrupts or overwhelms transportation operations. Non-recurring events may range from traffic incidents to traffic Planned Special Event (PSE) to disaster ETO.	AACN-RELAY RESP-STG INC-ZONE EVAC
Federal Railroad Administration (FRA)	Circulates and enforces rail safety regulations; administers railroad assistance programs; conduct research and development in support of improved railroad safety and national rail transportation policy.	RESP-STG INC-ZONE EVAC
National Association of State EMS Officials (NASEMSO)	Is a national organization for EMS, a voice for national EMS policy with comprehensive concern and commitment for the development of effective, integrated, community-based, universal and consistent EMS systems.	RESP-STG INC-ZONE EVAC
National Highway Traffic Safety Administration	Carries out safety programs. Specifically, the agency directs the highway safety and consumer programs and works to help prevent crashes and their attendant costs, both human and financial.	AACN-RELAY RESP-STG INC-ZONE EVAC
National Traffic Incident Management Coalition	A multi-disciplinary partnership forum spanning the public safety and transportation communities to coordinate experiences, knowledge, practices and ideas and promote more efficient management of all incidents that occur on the nation's roadways.	AACN-RELAY RESP-STG INC-ZONE EVAC
Pipeline and Hazardous Materials Safety Administration (PHMSA)	A U.S. DOT Agency that develops and enforces regulations for the safe, reliable, and environmentally sound operation of pipeline transportation system and shipments of hazardous materials by land, sea, and air.	RESP-STG INC-ZONE EVAC

Source: Battelle

Other (or Multi-Level) User Groups

Table 1-4 identifies Other User Group and the application bundles relevant to their operations.

Table 1-4. Other (or Multi-Level) User Groups

Stakeholder	Primary Function	Application Bundle
Association of Public Safety Communications Officials International (APCO)	The world's largest organization dedicated to public safety communications. It serves public safety communications practitioners worldwide – and the welfare of the general public as a whole – by providing complete expertise, professional development, technical assistance, advocacy and outreach.	AACN-RELAY
Auto Manufacturers	Working on enhanced vehicle telematics and connected vehicle (capabilities to enable V2V (Vehicle-to-Vehicle) and V2I Vehicle-to-Infrastructure) communication, relaying of critical safety messages and warnings, and providing more accurate position and crash data directly to PSAPs and emergency responders.	AACN-RELAY RESP-STG INC-ZONE EVAC
Construction/Maintenance Personnel	Out in the field in work zones. These personnel have to adhere to referenced guidelines for safety precautions and required protective gear. They support emergency repairs of roadway infrastructure in order to resume safe traffic flow.	RESP-STG INC-ZONE EVAC
Emergency Management Agencies	Support emergency preparedness and response.	AACN-RELAY RESP-STG INC-ZONE EVAC
Emergency Responders	Support emergency and incident preparedness, evacuation planning and response, and are dispatched to incident scene locations. They include fire and rescue, law enforcement, EMS, HAZMAT, DOT staff, and coroner.	AACN-RELAY RESP-STG INC-ZONE EVAC
Emergency Responder Organizations and Associations	Support continued development of best practices, innovation, and advancement for new technologies, policies, and procedures that will increase safety of emergency responders and improve emergency response. Examples of organizations include International Association of Fire Chiefs (IAFC), International Association of Chiefs of Police (IACP), National Association of Emergency Medical Technicians (NAEMT), and National Emergency Medical Services Association (NEMSA).	AACN-RELAY RESP-STG INC-ZONE EVAC
Freeway Management Center Personnel	Electronically monitor traffic conditions, activate response strategies, and initiate coordination with intra-agency and interagency resources, including emergency response and incident management providers.	RESP-STG INC-ZONE EVAC

Table 1-4. Other (or Multi-Level) User Groups (Continued)

Stakeholder	Primary Function	Application Bundle
Freight Management/Trucking	Monitor travel conditions to maximize route efficiency and productivity. Delays on the roadway due to an incident, emergency, or work zone can have a significant economic impact on this industry.	AACN-RELAY RESP-STG INC-ZONE EVAC
General Public	Use traveler information through 5-1-1, website, or en-route information to modify route or mode choice in order to avoid congestion around work zones. The public can utilize 9-1-1, 5-1-1, or radio/news media to report incidents.	AACN-RELAY RESP-STG INC-ZONE EVAC
Insurance Companies	Use information collected by emergency personnel or the general public for purposes of processing claims due to emergencies or crashes. Increased engagement of the insurance companies with vehicle telematics helps them better monitor driver safety and behavior.	AACN-RELAY INC-ZONE EVAC
Internet Service Providers	Enable services such as VoIP and other information exchange through Wi-Fi with smart phones.	AACN-RELAY RESP-STG INC-ZONE EVAC
Labor Unions	Such as the Fraternal Order of Police (FOP) and the International Association of Fire Firefighters (IAFF) improve the working conditions of public safety personnel through education, legislation, information, community involvement, and employee representation.	AACN-RELAY RESP-STG INC-ZONE EVAC
National Emergency Number Association (NENA)	Focuses on 9-1-1 policy, technology, operations, and education issues. NENA promotes the implementation and awareness of 9-1-1 communication systems and works with public policy leaders, emergency services and telecommunications industry partners, and other stakeholder groups to carry out critical programs and initiatives.	AACN-RELAY
Phone Companies	Required to comply with FCC regulations and rules regarding 9-1-1 services.	AACN-RELAY
Public and Elected Officials	Involved in emergency and evacuation planning and response – particularly in disseminating information to the public or in requesting resources and support from neighboring jurisdictions.	AACN-RELAY RESP-STG INC-ZONE EVAC
Private Traveler Information Providers	Monitor and report on traffic conditions across the nation either as a free service or fee-based service and provide pre-trip and in some cases en-route information to motorists regarding roadway conditions. These services can supplement and enhance monitoring conducted by DOTs and can help to enhance response route selection and congestion mitigation strategies.	RESP-STG INC-ZONE EVAC

Table 1-4. Other (or Multi-Level) User Groups (Continued)

Stakeholder	Primary Function	Application Bundle
Public Health Officials/Agencies	Support emergency preparedness and response and evacuation planning. They provide key leadership in understanding potential health risks associated with biological/chemical/HAZMAT threats and mitigation strategies.	AACN-RELAY EVAC
Public Information Officers	provide a single point-of-contact for media and help to distribute critical information to the public.	INC-ZONE EVAC
Regional Planning Organizations/ Transportation Commissions	Establish regional emergency coordination and contingency plans.	AACN-RELAY RESP-STG INC-ZONE EVAC
Telematics Service Providers	Route emergency calls to PSAPs based on the location of the caller and have to adhere to all FCC requirements and regulations in the level of service they provide.	AACN-RELAY RESP-STG INC-ZONE EVAC
Traffic Engineering and Operations Staff	Assist with ITS resources, timing traffic signals, and providing traffic control devices such as cones, barriers, and signs to assist in directing traffic during an evacuation.	AACN-RELAY RESP-STG INC-ZONE EVAC
Volunteer Organizations	Such as the American Red Cross provide assistance to the public during by providing aid to victims of devastating natural disasters in order to prevent and relieve suffering.	RESP-STG INC-ZONE EVAC
Wireless Service Providers	Required to transmit all 9-1-1 calls to a PSAP, and through enhanced services and next generation 9-1-1 wireless service providers will be required to provide the PSAP with the telephone number of the originator of the 9-1-1 call and location of the cell site or base station transmitting the call. In addition, they will be required as part of phase two of the enhanced 9-1-1 service to provide more precise location information to PSAPs, specifically the latitude and longitude of the caller.	AACN-RELAY RESP-STG INC-ZONE EVAC
Work Zone Planners and Managers	Responsible for work zone planning, design, and determining work zone impacts as well as development of transportation management plans to mitigate impacts.	RESP-STG INC-ZONE

Source: Battelle

Chapter 2 Referenced Documents

Section 2 lists the documents referenced in the generation of this Requirements Document including title, revision, and date of the documents.

1. Response, Emergency Staging, Communications, Uniform Management, and Evacuation (R.E.S.C.U.M.E.) Concept of Operations. Prepared for the Federal Highway Administration under contract number DTFH61-06-D-0007, task number BA07-100. May 29, 2012.
2. Institute of Electrical and Electronics Engineering (IEEE) Standard 1220–2005, Application and Management of the Systems Engineering Process, 9 September 2005.
3. Institute of Electrical and Electronics Engineering (IEEE) Standard 1233–1998, IEEE Guide for Developing System Requirements Specifications, 8 December 1998.
4. Institute of Electrical and Electronics Engineering (IEEE) Standard 1362-1998, Guide for Information Technology – System Definition – Concept of Operations (ConOps) Document, 19 March 1998.
5. Research and Innovative Technology Administration (R ITA). "RITA – Intelligent Transportation Systems – Dynamic Mobility Applications." http://www.its.dot.gov/dma/index.htm (accessed December 3, 2012.)
6. Campbell, J. L., C. Carney, and B. H. Kantowitz. Report Number FHWA–RD–98–057. "Human Factors Design Guidelines for Advanced Traveler Information Systems (ATIS) and Commercial Vehicle Operations (CVO)."
7. U.S. Department of Defense. MIL-HDBK-1472G. "Department of Defense Design Criteria Standard: Human Engineering." 11 January 2012.

Chapter 3 Requirements Overview

Requirement Nomenclature

The requirements for each of the four R.E.S.C.U.M.E applications and the Information Broker are tabulated in separate sections below. The tables are constructed to include columns with the following headings: Requirement Unique Identifier, Requirement Outline Designator, Functional Requirement Description, Performance Requirement Description, High-Level Communications Need, and Verification Methods.

Each application's table is split further into sections divided by row headings to identify the specific function of each application that is being addressed.

Requirement Unique Identifier

Every requirement begins with a Requirement Unique Identifier that includes a reference to the applicable application and a number for identifying the requirement. For example, AR-1 is AACN-RELAY requirement number 1.

The references to the applications are as follows: AR = AACN-RELAY, RS = RESP-STG, IZ = INC-ZONE, EV = EVAC, and IB = Information Broker.

Requirement Outline Designator

The Requirement Outline Designator shows the hierarchy of the requirements for a specific application function. For example, requirement outline number 2. flows down to 2.1. which flows down to 2.1.1. etc.

Functional Requirement Description

The functional requirements are described in detail in this column. They describe what the application must do to meet the functional objectives.

All requirements identified with a "shall" statement are to be considered mandatory. Any requirement identified with a "should" statement is considered desirable, but is not critical for the application to meet its intended function.

Any entry that uses a "will" statement inherently assumes that an external entity will provide the identified information when needed by the application function. It is not a requirement for R.E.S.C.U.M.E.

Optionally, immediately following and on the next line from the requirement statement, some descriptive text may be listed to provide context or background for the requirement. Descriptive text is for information only, and is not intended to be used as contractual or acceptance criteria.

Performance Requirement Description

The performance requirements are described in detail in this column. They describe how well the application must perform the functional requirements.

High Level Communication Needs

The High Level Communication Needs identified in this column are intended to capture the communications methods that the relevant application could employ when transmitting or receiving data. The specific security needs, protocols, and interfaces will be compatible with existing communications systems.

Verification Methods

All functional or performance requirements that are identified with a “shall” or “should” statement must be verified using one of the four methods described in Section Chapter 0., and listed in this column.

Verification Methods

System verification is a critical process that is conducted in order to ascertain that the system of interest conforms to the requirements defined for each component of the R.E.S.C.U.M.E. application bundle. Verification methods applicable to R.E.S.C.U.M.E. are described below.

Analysis (A)

Analysis is a verification method that utilizes established technical or mathematical models or simulations, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures to provide evidence that stated requirements are met.

Demonstration (D)

Demonstration is a verification method that generally denotes the actual operation, adjustment, or re-configuration of items to provide evidence that the designed functions were accomplished under specific scenarios.

Inspection (I)

A verification method that consists of investigation, without the use of special laboratory appliances or procedures, of items to determine conformance to those specified requirements. Inspection is generally nondestructive and typically includes the use of sight, hearing, smell, touch; and/or simple physical manipulation of the system when it is safe to do so. Inspection can also be applied to the project work products. For instance, verifying that software is developed using a certain programming language would be verified by inspection.

Test (T)

Testing is a verification method that generally denotes the determination of properties by instrumentation and measurement. This method includes functional operation, and involves the application of established scientific principles and procedures.

Chapter 4 Functional and Performance Requirements

Functional and performance requirements for the four R.E.S.C.U.M.E. applications and the Information Broker were derived from the Concept of Operations. These system-level requirements do not imply a predisposition toward a particular technological solution; rather, the requirements are crafted in such a fashion as to enable multiple technological solutions.

The R.E.S.C.U.M.E. Bundle serves a variety of different functions, but all provide a mechanism for the gathering of information to support incident planning and operations. One cornerstone of the R.E.S.C.U.M.E. Bundle is the leveraging of existing systems currently being used by the responder community, including the ability for the bundle's components to connect and share information through these existing mechanisms and CV technology.

The Functional Requirements, Performance Requirements, High Level Communication Needs, and Verification Methods provided below are based on conceptual visions of the Functional Architectures for each of the R.E.S.C.U.M.E. applications. The overall functional model of the system originally presented in the ConOps is included here as Figure 4-1 for reference to illustrate how the R.E.S.C.U.M.E. bundle of applications and the Information Broker are envisioned to interact with each other and with external entities.

This information will help to provide a better understanding of the *Functional and Performance Requirements* without the need to reference other documentation.

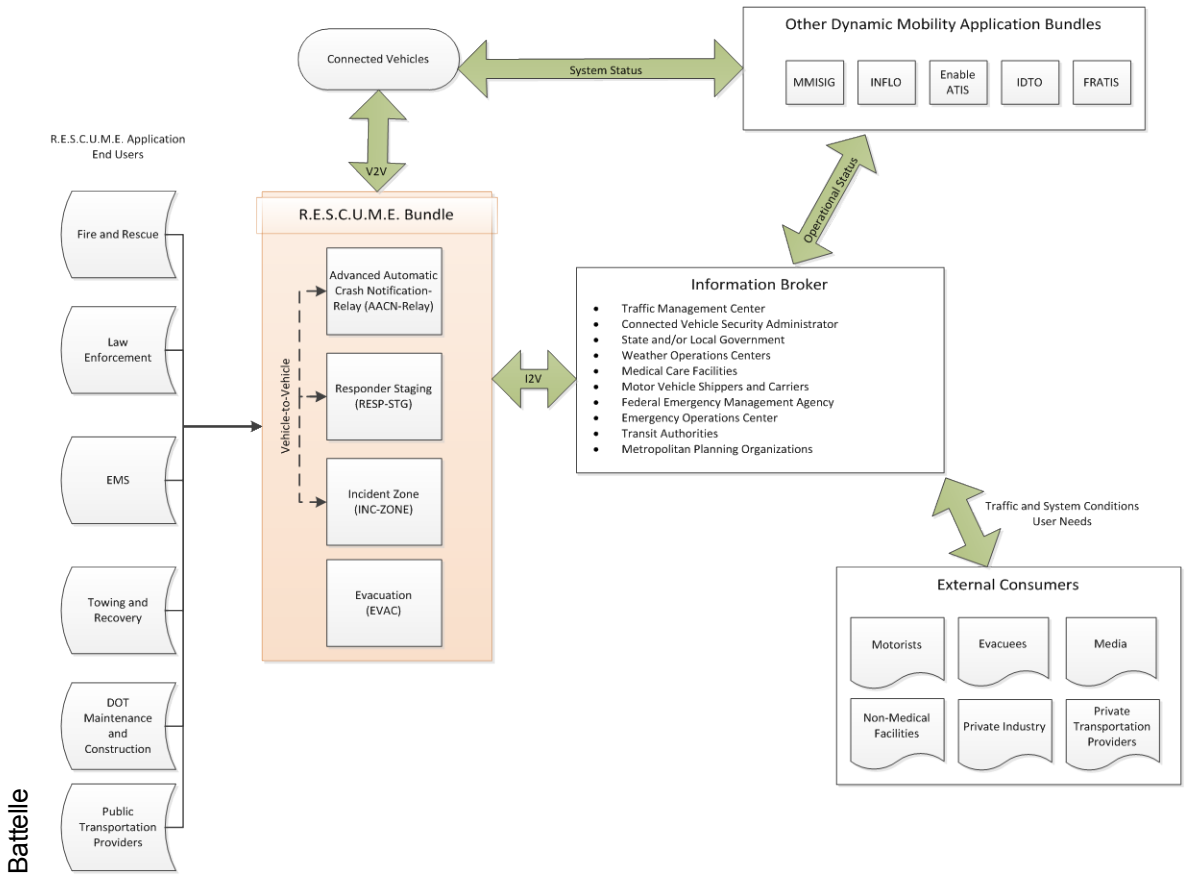

Figure 4-1. R.E.S.C.U.M.E. Functional Model

AACN

AACN Functional Architecture

AACN-RELAY requirements are included in this document for completeness and consistency. However, USDOT does not plan to pursue development of AACN-RELAY during subsequent phases of the DMA Program.

AACN-RELAY refers to a capability that will allow CV-enabled vehicles to relay an emergency message (i.e., an Advanced Automatic Crash Notification or AACN message) from other vehicles involved in an accident or other distress situation. This emergency message is automatically generated by internal systems embedded within the vehicle and includes key data on the crash recorded by sensors mounted in the vehicle without the need for involvement of the driver or an occupant, in case they are incapacitated.

The capability to respond to vehicle emergencies resulting from single vehicle accidents will be improved, which is particularly needed in rural or remote areas where there may not be cell phone coverage or passers-by who are aware that an off-road incident has even occurred. The AACN-RELAY application will provide the capability for CV-enabled vehicles to detect other vehicles' AACN alerts and relay them to yet other CV-enabled vehicles as well as roadside communications "hotspots." This relay of the original AACN message will result in its being received by the Information Broker via an infrastructure element (i.e., V2I communication) and routed to the appropriate

organization for action. The purpose of the AACN-RELAY application is to improve mobility through reducing the total incident time by reducing the time required for emergency responders to learn of the crash, arrive at the scene and deliver medical attention, and provide responders with as much key information as possible regarding the characteristics of the incident.

The AACN-RELAY approach uses CV technology, particularly DSRC. DSRC is a short to medium range (< 1 km) high-speed (up to 27 Mbps) wireless communications protocol specifically designed for automotive use at vehicle speeds up to 120 mph. In the event of a crash, the crashed vehicle's CV technology will automatically transmit AACN crash data as well as injury severity prediction information via a DSRC message. The DSRC message will be captured and relayed by other CV-enabled vehicles and to roadside "hotspots" as the initial relay vehicle or any subsequent relay vehicles pass. The relayed AACN and crash severity message will then be forwarded from the receiving roadside hotspot to public safety officials at ECCs and/or TMCs. Figure 4-2 summarizes the functional components of the AACN-RELAY application and indicates the type of information that is expected to be received and provided by the AACN-RELAY application and the entities that are receiving and providing the information. Generally, the AACN-RELAY application receives information from a vehicle involved in an incident as well as other AACN-RELAY vehicles, processes this information, and provides it to organizations within the Information Broker as well as other AACN-RELAY vehicles as described below.

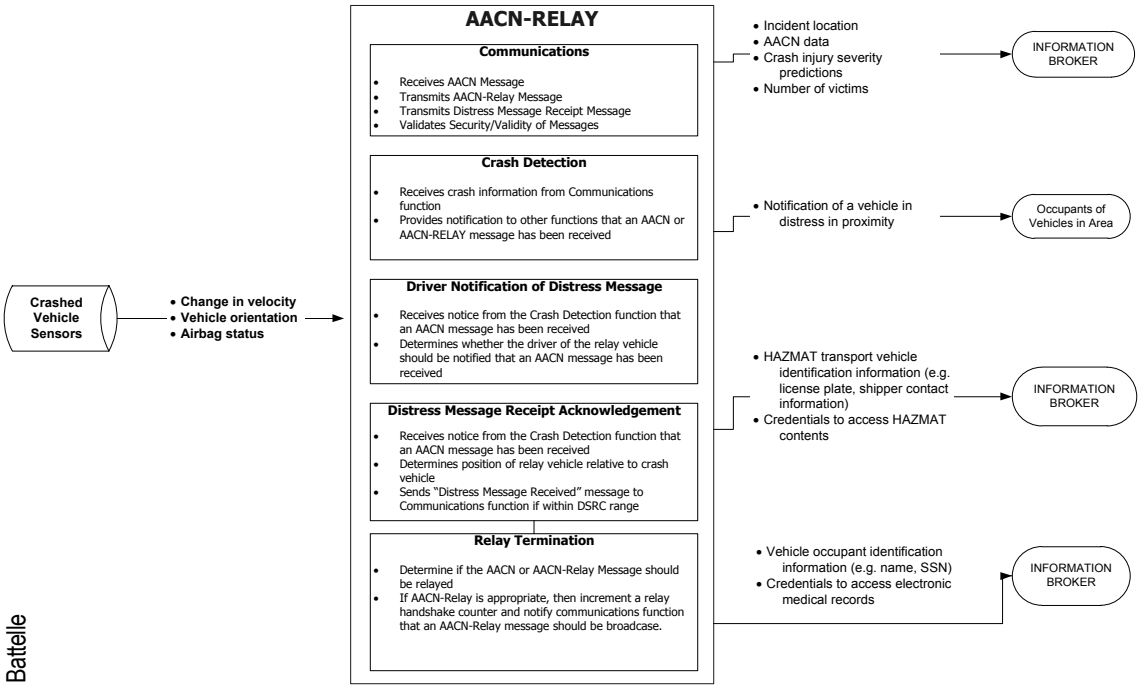

Figure 4-2. AACN-RELAY Functional Architecture

The following describes the functional components of AACN-RELAY application.

Crash Detection

The AACN-RELAY application intends to significantly leverage the technologies implemented by automotive OEM's for the AACN message initiation and generation. General Motors' OnStar and Ford's Sync programs, not to mention similar offerings from other automotive companies, are able to

determine when a vehicle has crashed by analyzing the data captured by sensors embedded in the vehicle. The programs also capture and collect relevant crash data and bundle it into a message that can be sent via a cellular message.

The AACN-RELAY Crash Detection function will be accomplished by using existing OEM systems to determine when a vehicle has been involved in a crash and to collect the relevant crash data, all packaged into an AACN message. This AACN message is received by the AACN-RELAY's Communication function where it is further analyzed, augmented, processed, and distributed.

Communications

The Communications function enables the AACN-RELAY application to receive information (i.e., input data) and then transmit the generated output data to its intended data consumer quickly and securely. This includes the processes required to exchange messages with the Information Broker component of R.E.S.C.U.M.E., RESP-STG, and in certain situations INC-ZONE and EVAC. Communication approaches and mechanisms will likely vary on a regional basis based on existing systems.

The AACN-RELAY application initiates when the Crash Detection function (described next) determines that a vehicle has crashed and sends an AACN message to the AACN-RELAY Communications function. The Communications function will add to the AACN message information that is not currently captured by the OEM AACN systems in the areas of occupancy and injury prediction data, medical records access, and HAZMAT awareness. These additional data sets will be included in the information that is eventually delivered by the AACN-RELAY application to the Information Broker (via the relay) and will further improve the situational awareness of the dispatcher and emergency responder assets.

The AACN-RELAY Communications function is expected to utilize both DSRC and a cellular communications formats, depending upon the availability of the communications mechanisms. DSRC communications would be conducted and transmitted very similarly to a basic safety message. At the same time, a secure Transmission Control Protocol/Internet Protocol (TCP/IP) cellular data message would be attempted to be sent directly to the Information Broker via the communications function. Transmittal of the AACN-RELAY message will be performed continuously until the Relay Termination function determines and indicates that further transmission should be terminated.

Driver Notification

The Driver Notification function receives a notice from the Crash Detection function that an AACN message has been received and determines whether the driver of the relay vehicle should be notified that an AACN message has been received. Notification would consist of visual and/or audible alerts indicating that an AACN message has been received. Only notifications of receipt of an original message (i.e., from the crashed vehicle and not relayed) will be made. The value of the driver notification is that the driver can independently check whether there is a crash in sight, or if it is dark or foggy, at least notify public safety authorities that he or she is getting an indication of a crashed vehicle at a certain location.

Distress Message Receipt

When the crashed vehicle sends the DSRC AACN message, its transmission is "fire and forget" and there is no embedded acknowledgement in the message (i.e., a return "ack"). However, when the Crash Detection function identifies that an AACN message has been received it will notify the Distress Message Receipt function, which will then compare the position of the relay vehicle to that of the distress vehicle (included in the AACN message). If within DSRC range, the Distress Message

Receipt function will generate a "Distress Message Received" message and send this to the Communications function for immediate DSRC broadcast to provide a feedback to the crash victim that their message has been received by another entity.

Relay Termination

The AACN relay capability helps increase the likelihood of the AACN DSRC message reaching the Information Broker's PSAP component. After the first CV-enabled vehicle passing by the crash scene receives the initial AACN message from the crashed vehicle, it is desirable that the AACN message be relayed by greater numbers of CV-enabled vehicles. This is particularly true in locations where there are relatively few passers-by and few roadside hotspots. When emergency responders arrive at the crash scene, they will turn off the crashed vehicle's AACN message transmissions.

However, it is not intended that the relayed messages proliferate past a certain point either, so there must be a protocol to terminate the relay. There are a number of different options for relay termination. The AACN-RELAY as envisioned in the ConOps and repeated in this Requirements Document would employ a variable termination criterion that is based upon distance from the original incident and the number of previous "handshakes" between relay vehicles, which would be aggregated by each AACN-RELAY equipped vehicle and included in the AACN-RELAY message sent to other vehicles. A "handshake" is defined as the exchange of the AACN message between two CV-enabled relay vehicles in which the AACN message is new to the receiving vehicle. Table 4-1 illustrates these variable termination criteria.

Table 4-1. Illustration of Variable Termination Criteria as a Function of Distance and Number of Handshakes

	Short (0-1 mile)	Medium (1-10 miles)	Far (>10 miles)
Low (0-5 handshakes)	Active	Active	Active
Medium (5-15 handshakes)	Terminate	Active	Terminate
Large (>15 handshakes)	Active	Terminate	Terminate

Source: Battelle

AACN-RELAY Modes of Operation

Five modes of operation are envisioned for the AACN-RELAY application including three modes in which the application is overloaded and/or degraded.

Normal Mode

In normal mode the AACN-RELAY application is installed and operational on vehicles with connected vehicle equipment. Full connectivity and capability to cellular data network is available to the relay vehicle.

Degraded Mode – No Cellular Coverage

In this mode of operation, the AACN-RELAY application in the relay vehicle does not have the ability to connect to the cellular network. In this mode, the AACN-RELAY application will initiate communications using DSRC methods to another AACN-RELAY equipped vehicle who will subsequently relay the message to the Information Broker through cellular or roadside equipment or to another relay vehicle via DSRC if cellular capability is unavailable. Under this mode, there is no

absolute guarantee that the relay will eventually reach the Information Broker as the relay messages may exceed the termination criteria before a successful transfer through roadside equipment (DSRC) or through cellular.

Degraded Mode – Partial Implementation

It is likely that the AACN-RELAY application will exist only in some vehicles and not in other vehicles for an extended time frame. In this condition, the AACN-RELAY would essentially "ignore" the non-equipped vehicles and proceed as under Normal mode. This may result in incidents that are not identified through an AACN message/AACN-RELAY and may reduce the benefits of the AACN-RELAY application depending upon the penetration rate of unequipped vehicles.

Overloaded Mode

In densely populated traffic situations, it may be possible that the AACN-RELAY mechanism causes a system overload as a result of the need to process a large number of relay messages. In this mode, the AACN-RELAY application should begin to restrict the number of relay messages being received and processed to maintain the capability to provide the basic services for which the in-vehicle system was originally intended. This may result in incidents that are not identified through an AACN message/AACN-RELAY and may reduce the benefits of the AACN-RELAY application depending upon the extent to which incoming messages need to be filtered. The operator of the relay vehicle should be notified that incident information is being filtered.

Complete System Failure

In complete system failure mode, the AACN-RELAY application will be unavailable and incidents cannot be identified through a relay function. Identification of incidents would revert to non-relay centric mechanisms including radio dispatch and cellular calls. Because the AACN-RELAY provides the operator of the relay vehicle with situational awareness of incidents, the operator of the relay vehicle should be notified that the system has failed.

AACN-RELAY Functional Requirements, Performance Requirements and Verification Methods

Table 4-2 provides the functional requirements, associated performance requirements, high-level communication needs and verification methods for the AACN-RELAY application.

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AACN-RELAY Communications Function						
AR-1	1.	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and the Information Broker using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#1, Step 18
AR-2	2.	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and RESP-STG using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Overarching AACN-RELAY need
AR-3	3.	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and INC-ZONE using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Overarching AACN-RELAY need
AR-4	4.	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and EVAC using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Overarching AACN-RELAY need

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-5	5.	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and CV-enabled vehicles using DSRC radio	NA	DSRC	Demonstration	OS#1, Step 6
AR-6	6.	The AACN-RELAY Communications shall receive and transmit data between AACN-RELAY and roadside hotspots using a reliable transport mechanism.	NA	Cellular, Wi-Fi	Demonstration	OS#1, Step 16
AR-7	7.	The AACN-RELAY Communications Function shall initiate and populate an augmented AACN Message after receiving notification of a vehicle crash from the AACN-RELAY Crash Detection Function.	The augmented AACN Message shall be fully populated within thirty (30) seconds after the data has been received.	In-vehicle wired network	Test	OS#1, Step 3

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-8	7.1.	The augmented AACN Message shall be populated with: • Change in velocity • Vehicle orientation • Airbag status • Latitude and Longitude coordinates of crash vehicle relative to the WGS84 datum • Crash date and time (local) • Timestamp of AACN-Message generation • Augmented AACN-Message ID	NA	In-vehicle wired network	Inspection	OS#1, Step 3
AR-9	7.1.1.	The AACN-RELAY Communications Function shall generate an AACN-Message ID that uniquely identifies the message from other augmented AACN-Messages	NA	NA	Demonstration	OS#1, Step 3
AR-10	7.1.2.	The augmented AACN-Message timestamp shall be in a format that can be correlated to local time	NA	NA	Inspection	OS#1, Step 3

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-11	7.2.	The augmented AACN-Message should be populated with the following information to assist emergency responders in assessing the severity of the crash on the vehicle occupants: • Crash vehicle principal direction of force • Crash vehicle seat-belt use • Crash vehicle occupancy • Crash vehicle call-back number • Crash vehicle rollover details • Crash vehicle injury severity predictions • Crash vehicle occupant intrusion data (e.g. how far a door protrudes into the passenger compartment) • Crash vehicle video and audio feeds	NA	In-vehicle wired network	Inspection	OS#1, Step 3
AR-12	7.3.	The augmented AACN-Message should be populated with the following information to assist emergency responders in understanding any pre-existing medical conditions of the occupants: • Credentials to access occupants medical records	NA	In-vehicle wired network, In-vehicle Wi-Fi	Inspection	OS#1, Step 20

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-13	7.4.	The augmented AACN-Message should be populated with the following information to assist emergency responders in understanding the vehicle contents or unusual precautions that should be followed when approaching the vehicle: • HAZMAT transportation vehicle identification • Vehicle license plate number • Vehicle shipping company contact phone number • Credentials to access HAZMAT contents • Vehicle identifying information (make, model, color, year)	NA	In-vehicle wired network, In-vehicle Wi-Fi	Inspection	OS#4, Step 7
AR-14	8.	The AACN-RELAY Communications Function shall attempt to transmit the augmented AACN Message using Cellular Service to the Information Broker	NA	Cellular	Demonstration	OS#1, Step 3
AR-15	8.1.	The cellular transmission shall be secure.	NA	Cellular	NA	Derived from OS#1, Step 3
AR-16	8.2.	The cellular transmission will include receipt acknowledgement functionality.	NA	Cellular	NA	Derived from OS#1, Step 3

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-17	8.3.	The AACN-RELAY Communications Function shall receive a Cellular Transmission Status Message indicating the status of the transmission of the augmented AACN-Message via cellular communications.	NA	Cellular	NA	Derived from OS#1, Step 3
AR-18	8.3.1.	The Cellular Transmission Status Message will consist of the AACN-RELAY message contents and a field that provides whether the cellular transmission was successful or unsuccessful	NA	Cellular	NA	Derived from OS#1, Step 3
AR-19	9.	The AACN-RELAY Communications Function shall transmit the augmented AACN-Message through the DSRC radio for broadcast if the Cellular Transmission Status Message field indicates unsuccessful transmission.	NA	DSRC	Demonstration	OS#1, Step 4
AR-20	9.1.	The DSRC radio will properly authenticate and package the augmented AACN-Message.	NA	DSRC	NA	Derived from OS#1, Step 4
AR-21	9.2.	The AACN-RELAY Communications Function shall transmit information compatible with the Vehicular Emergency Data Set (VEDS).	NA	DSRC	Demonstration	Derived from OS#1, Step 4

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-22	10.	The AACN-RELAY Communications Function shall immediately broadcast the "Distressed Message Received" message when directed by the AACN-RELAY Distress Message Receipt Function.	The Distressed Message Received" message shall be broadcast within a maximum of one (1) second of being commanded by the Distress Message Receipt Function	DSRC	Test	OS#1, Step 8
AACN-RELAY Crash Detection Function						
AR-23	11.	The AACN-RELAY Crash Detection Function shall use the OEM AACN systems to determine when a vehicle is involved in a crash.	NA	In-vehicle wired network, In-vehicle Wi-Fi	Test	Derived from OS#1, Step 3
AR-24	12.	The AACN-RELAY Crash Detection Function shall send the AACN-RELAY Communications Function data from the crashed vehicle's onboard Advanced Automatic Collision Notification (AACN) system when the AACN system determines the vehicle has crashed.	NA	In-vehicle wired network, Wi-Fi	Test	Derived from OS#1, Step 3

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-25	12.1.	The AACN-RELAY Crash Detection Function shall send the AACN-RELAY Communications Function the following items from the AACN system when the AACN-RELAY Crash Detection Function determines a crash has occurred: • Change in velocity • Vehicle orientation • Airbag status (Deployed/not-deployed)	NA	In-vehicle wired network, Wi-Fi	NA	Derived from OS#1, Step 3
AACN-RELAY Driver Notification Function						
AR-26	13.	The AACN-RELAY Driver Notification Function shall receive notification from the AACN-RELAY Communications Function that an augmented AACN Message has been received directly from a crashed vehicle.	NA	Internal to application	Demonstration	OS#1, Step 8
AR-27	13.1.	The AACN-RELAY Driver Notification Function shall notify the driver of a relay vehicle when an augmented AACN-Message is received directly from a crashed vehicle.	The notification shall occur within 1 second.	Internal to application	Test	OS#1, Step 8
AR-28	13.1.1.	The notification shall consist of audible and visual alerts indicating an augmented AACN-Message has been received from a crashed vehicle.	NA	Speaker, Display	Demonstration	OS#1, Step 8

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-29	13.1.2.	The AACN-RELAY Driver Notification Function shall include an option for the User to disable or enable the visible and audible notifications.	NA	NA	Demonstration	Derived from OS#1, Step 8
AR-30	13.1.3.	The notification should identify the distance to the crashed vehicle	The reported distance shall be accurate to within 10%	NA	Test	OS#1, Step 9
AACN-RELAY Distress Message Receipt Function						
AR-31	14.	The AACN-RELAY Driver Notification Function shall receive notification from the AACN-RELAY Communications Function that an augmented AACN Message has been received directly from a crashed vehicle.	NA	Internal to application	Demonstration	Derived from OS#1, Step 6
AR-32	14.1.	The AACN-RELAY Distress Message Receipt Function shall compare the position of the relay vehicle to that of the crashed vehicle and determine if they are within the range of the DSRC radio.	NA	Internal to application	Demonstration	OS#1, Step 8
AR-33	14.1.1.	The location of the crashed vehicle will be included in the AACN Message contents.	NA	Internal to application	Inspection	Derived from OS#1, Step 8
AR-34	14.1.2.	The location of the relay vehicle will be obtained from onboard GPS.	NA	DSRC	Inspection	Derived from OS#1, Step 8
AR-35	14.2.	The AACN-RELAY Distress Message Receipt Function shall generate a “Distressed Message Received” message.	NA	Internal to application	Demonstration	OS#1, Step 10

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-36	14.2.1.	The AACN-RELAY Distress Message Receipt Function shall send the "Distressed Message Received" message to the AACN-RELAY Communications Function with instructions for it to be immediately broadcast using the DSRC radio. *Note: the intention is to deliver to the crashed vehicle an acknowledgement that its distress message was received. However, this requirement only requires that the acknowledgement message be sent, it does not require that the acknowledgement message be received by the crashed vehicle.*	The message shall be sent from the AACN-RELAY Distress Message Receipt Function to the AACN-RELAY Communications Function within one (1) second.	Internal to application	Test	OS#1, Step 11
AACN-RELAY Termination Function						
AR-37	15.	The AACN-RELAY Termination Function shall be initiated when the AACN-RELAY Communications Function conveys to the Relay Vehicle that it has received an augmented AACN Message	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-38	16.	The AACN-RELAY Termination Function shall maintain a persistent, on-board, local database of previously received augmented AACN Messages.	NA	Internal to application	Analysis	OS#1, Steps 6-15

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-39	16.1.	The database shall be cleared of all AACN Message data.	The database shall be cleared when TBD conditions are met.	Internal to application	Demonstration	OS#1, Steps 6-15
AR-40	17.	The AACN-RELAY Termination Function shall compare a received augmented AACN-Message to the Received AACN Message Storage Database and compare all available elements of the received AACN-Message to their corresponding elements in the Received AACN-Message Storage to determine the whether to classify the augmented AACN-Message as “Old” or “New”.	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-41	17.1.	The AACN-RELAY Termination Function shall classify the augmented AACN-Message as “Old” if the unique ID of the received AACN-Message is identical to its corresponding element in the Received AACN-Message Storage Database.	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-42	17.2.	The AACN-RELAY Termination Function shall classify the augmented AACN-Message as a “New” message if this message is not already contained in the vehicle’s local Received AACN-Message Storage Database.	NA	Internal to application	Demonstration	OS#1, Steps 6-15

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-43	17.2.1.	If the augmented AACN Message is “New”, then the AACN-RELAY Crash Detection Function shall perform the following operations:	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-44	17.2.1.1.	The AACN-RELAY Termination Function shall inform the AACN-RELAY Driver Notification Function that a “New” augmented AACN Message has been received.	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-45	17.2.1.2.	The AACN-RELAY Termination Function shall inform the AACN-RELAY Distress Message Function that a “New” augmented AACN Message has been received.	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-46	17.2.1.3.	The AACN-RELAY Termination Function shall set the “handshake” field for this augmented AACN Message to 1.	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-47	17.2.2.	If the augmented AACN Message is classified “Old”, then the AACN-RELAY Termination Function shall perform the following operations:	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-48	17.2.2.1.	The AACN-RELAY Crash Detection Function shall increment the “handshake” field by 1.	NA	Internal to application	Demonstration	OS#1, Steps 6-15
AR-49	17.3.	The AACN-RELAY Termination Function shall store the augmented AACN Message and the “handshake” field value.	NA	Internal to application	Demonstration	OS#1, Steps 6-15

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-50	18.	The AACN-Relay Termination Function shall extract from the processed augmented AACN-message the following information: • Latitude and Longitude coordinates of crash vehicle relative to the WGS84 datum • Crash date and time (local) • Number of message handshakes	NA	Internal to application	Demonstration	Derived from OS#1, Steps 6-15
AR-51	19.	The AACN-RELAY Termination Function shall obtain the current position of the Relay Vehicle in latitude and longitude relative to the WGS84 datum.	NA	DSRC	Demonstration	Derived from OS#1, Steps 6-15
AR-52	20.	The AACN-RELAY Termination Function shall terminate AACN Message Relay Based on the termination criterion. *See AR-53 for criterion.*	NA	Internal to application	Demonstration	Derived from OS#1, Steps 12-14

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-53	20.1.	The AACN-RELAY Termination Function shall convey the AACN Message to the AACN-RELAY Communications Function with instruction to relay the AACN message if any of the following criterion are satisfied: • The number of handshakes is between 0 and 5, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is less than 1 mile; • The number of handshakes is between 0 and 5, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is between 1 and 10 miles, inclusive; • The number of handshakes is between 0 and 5, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is greater than 10 miles; • The number of handshakes is between 6 and 15, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is between 1 and 10 miles, inclusive; • The number of handshakes is greater than 16, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is less than 1 mile. *Note: The values included are an initial suggested threshold. Further data could be collected to support future implementation decisions*	NA	Internal to application	Demonstration	Derived from OS#1, Steps 12-14

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-54	20.2.	The AACN-RELAY Termination Function shall convey the AACN Message to the AACN-RELAY Communications Function with instructions to stop relaying the AACN Message if any of the following criterion are satisfied: • The number of handshakes is between 6 and 15, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is less than 1 mile; • The number of handshakes is between 6 and 15, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is greater than 10 miles; • The number of handshakes is greater than or equal to 16, and the distance between the Relay Vehicle and the Crash Vehicle is between 1 and 10 miles, inclusive; • The number of handshakes is greater than or equal to 16, and the distance between the Relay Vehicle and the Crash Vehicle is greater than 10 miles.	NA	Internal to application	Demonstration	Derived from OS#1, Steps 12-14

Table 4-2. AACN-RELAY Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Methods	CONOPS Operational Scenario Reference
AR-55	21.	The AACN-Relay Termination Function shall write the contents of the AACN-Message to the Received AACN-Message Storage Database and include instructions on whether the relaying of the message should be terminated or should continue.	NA	Internal to application	Demonstration	Derived from OS#1, Steps 12-14
AR-56	22.	The AACN-RELAY Termination Function should include a manual means to stop transmission of the AACN Message from the crashed vehicle. • *Note: this would enable an on-scene emergency responder to stop additional AACN Messages from being sent by the crashed vehicle.*	NA	Internal to application	Demonstration	Not linked to current OS

Source: Battelle

RESP-STG

RESP-STG Functional Architecture

The staging of all emergency responders including law enforcement, fire, emergency medical services, HAZMAT, towing and recovery among others is well-established and has many protocols in place to guide all personnel involved, from those receiving the initial calls for assistance; to dispatch, arrival, and staging of the responders and establishment of the incident zone; to secondary dispatch of responders if needed; to transport of victims to medical facilities and towing and recovery operations. However, the basic motivation of the practices followed during an incident response is to ensure responder safety; achieve safe, quick clearance; and provide prompt, reliable, interoperable communications. These are laudable and quite achievable objectives, but it is noteworthy that these objectives cannot be achieved in a vacuum, and that while securing the incident scene and attending to the victims is a critical mission, the needs and safety of the traveling public and responders' en-route to the scene also need to be addressed. By combining the traditional elements and information components of incident management with transportation information sources and data, the transformative impacts on mobility will be achieved through more informed decision-making and reductions in response and clearance times.

Improving situational awareness to public safety responders while they are en-route can help establish incident scene work zones that are safe for responders, travelers and accident victims while being less disruptive to traffic. Situational awareness information can also provide valuable input to responder and dispatcher decisions and actions. The RESP-STG application will provide situational awareness to and coordination among emergency responders—upon dispatch, while en route to establish incident scene work zones, upon initial arrival and staging of assets, and afterward if circumstances require additional dispatch and staging. It will provide valuable input to responder and dispatcher decisions and actions. There is a range of data that will be provided through mobile devices and other types of communications to help support emergency responder vehicle routing, staging, and secondary dispatch decision-making. These data will include staging plans, satellite imagery, GIS map graphics, camera images, current weather data, traffic conditions, dynamic routing guidance, sensor readings, and real-time modeling outputs.

The RESP-STG application is a collection of integrated functions designed to minimize the adverse effects on mobility and safety caused by an incident affecting the roadways. This is achieved by increasing the preparedness and situational awareness of the emergency responders upon dispatch and while en route to an incident scene. Such information includes dynamic routing to the scene to avoid road closures and roads impassable due to snow, details regarding the HAZMAT content of transport vehicles, and victim injury severity predictions. Awareness of this information in advance enables critical, time-saving, and potentially life-saving decisions to be made prior to arrival on scene. These decisions in turn enable the responders to clear the incidents sooner and to enhance the incident staging to facilitate mobility.

The RESP-STG application will be deployed on existing MDTs within responder vehicles, when they are available. Figure 4-3 illustrates the RESP-STG functional architecture, showing the input data types and providers on the left, the core functional components in the middle, and the data output type and consumers on the right. These inputs are transformed by RESP-STG into the outputs sent to the data consumers to enable them to restore traffic flow to pre-incident conditions.

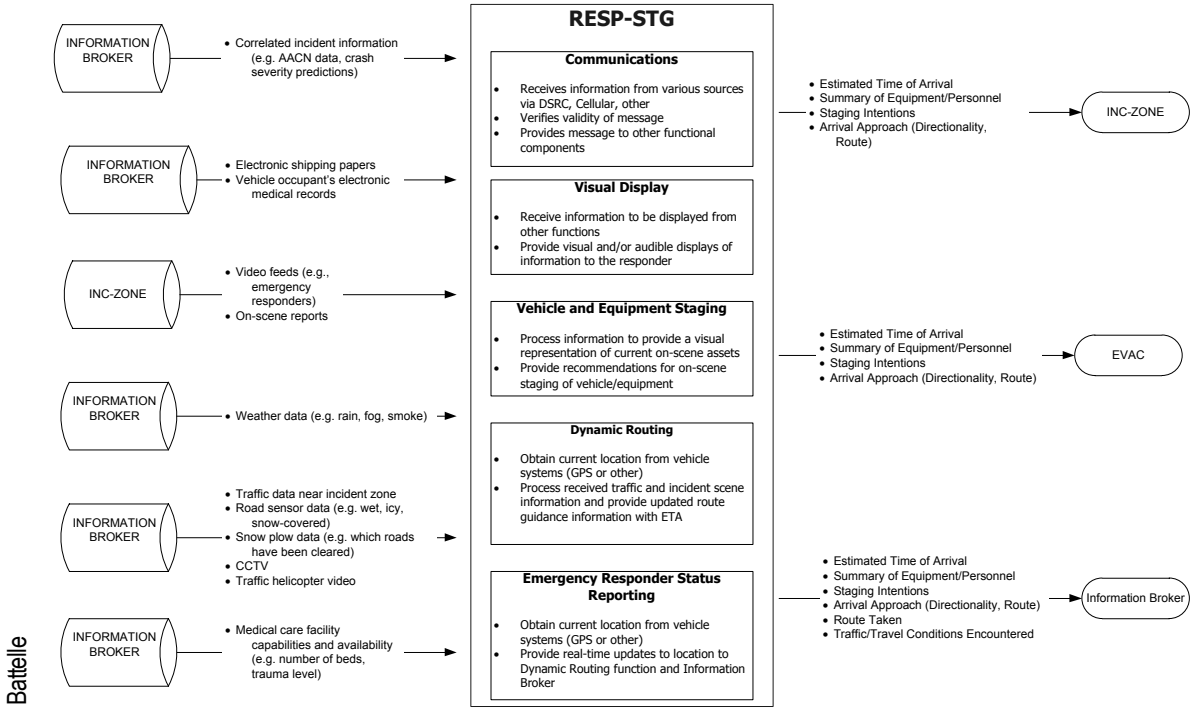

Figure 4-3. RESP-STG Functional Architecture

Communications

The Communications function enables RESP-STG to receive information from various sources over a variety of different communication methods and to transmit information to its intended data consumer quickly and securely. One important activity of the Communications function is to verify the validity of the received message. If needed (or required), the Communications function is responsible for acknowledging received messages.

Visual Display

The Visual Display function performs the straightforward function of providing a visual and/or audible display of the information that is provided to it by the other functions.

Vehicle and Equipment Staging

The Vehicle and Equipment Staging function supplies the en-route responders with additional information they can use to determine where to stage personnel and equipment prior to their arrival on-scene. This function is responsible for accessing a database of still photographs, satellite imagery, GIS overlays, video feeds, and modeling programs (e.g., predicted HAZMAT plumes) to provide a visual representation of the scene to facilitate the staging of equipment. Additional components such as the current traffic conditions and existing vehicles already on-scene are also critical components integrated into the situational awareness picture developed and provided by the Vehicle and Equipment Staging function.

This function receives information from a variety of sources, routed through the Communications function and uses that information together with on-board databases and Internet accessible sources to develop a multi-layered special representation of the incident. The arriving responder's approach and likely staging will be projected onto the incident as an additional layer.

Dynamic Routing

The goal of the Dynamic Routing function is to provide additional information that is not common to existing routing systems to enhance the ability of those systems to quickly and efficiently route the responder. The Dynamic Routing function of RESP-STG provides emergency responders with real-time navigation instructions to travel from their base to the incident scene, accounting for traffic conditions, road closures, and snowplow reports if needed. Supplemental information such as video feeds from TMC closed-circuit television (CCTV) or traffic helicopter cameras will be received, processed, and included in alternative routing algorithms to enhance the routing. For example, the function will receive, through the Communications function, information from the Information Broker that a HAZMAT plume is projected to cross their current route, and an alternative route will be provided.

Emergency Responder Status Reporting

This function continuously monitors the location of the en-route responder vehicles as well as the vehicles already on-scene (via the INC-ZONE and/or Information Broker). The function develops and maintains the current position of the responder's vehicles and provides updates for estimated time of arrival (ETA) to both the Information Broker as well as the INC-ZONE application. Other information such as traffic encountered, speed, heading, and route to destination are also captured and processed by this function. This information is forwarded to the INC-ZONE and Information Broker via the Communications function.

RESP-STG Modes of Operations

The RESP-STG application provides en-route situational awareness and routing information to responders. There are five modes of operation envisioned for this application, including four that are overloaded.

Normal Mode

In normal mode the RESP-STG application is installed and operational on all responder vehicles. Full connectivity and access to the cellular data network is available, and the Information Broker is available to the relay vehicle. Real-time information from the vehicle's telematics and positioning systems are available and can be accessed by the application.

Degraded Mode – No or Limited Connectivity to Information Broker

In this mode of operation, the RESP-STG application in the relay vehicles does not have the ability to connect to the Information Broker or has slow connectivity that cannot support the transfer of the data needed by the application. If in a data limited mode, the RESP-STG application would dynamically allow the responder to select and prioritize the information that is accessed from the Information Broker and provided to the responder via the RESP-STG application. The expected download and processing time should be provided so that the responder can make an informed decision on the elements to request.

In the case where there is no connectivity to the Information Broker, the RESP-STG will continue to operate but will indicate to the responder that data from the Information Broker is not being accessed. When in range of DSRC, particularly the broadcasting INC-ZONE application, the RESP-STG application will utilize DSRC communications to communicate with INC-ZONE to update the situational information.

Degraded Mode – Partial Implementation

RESP-STG may be installed and operational on a portion of the responder vehicles. In this mode, the RESP-STG application will rely upon the Information Broker for information regarding non-equipped vehicles, which would be entered into the system through the normal operations of one of the organizational entities comprising the Information Broker (e.g., an ECC/ PSAP could provide the dispatch location of a police vehicle). The application should provide a visual indication that the information is being provided by a non-R.E.S.C.U.M.E. Bundle source.

Overloaded Mode

In complex incidents with many responders, it may be possible that the RESP-STG application will become overloaded by the information being transferred and processed. In this mode, the RESP-STG application should begin to restrict the incoming and outgoing messages to maintain the capability to provide the basic services for which the in-vehicle system was originally intended. This may result in delayed information delivery and lags in updates to the situational reports. In this mode, the operator should be notified that information is being filtered and allowed to prioritize the information being received/sent.

Complete System Failure

In complete system failure mode, the RESP-STG application will be unavailable and operations would revert to current procedures such as using radio and deferring staging decisions until on-scene staging. The operator of the vehicle should be notified that the system has failed.

RESP-STG Functional Requirements, Performance Requirements and Verification Methods

Table 4-3 provides the functional requirements, associated performance requirements, high-level communication needs and verification method for the RESP-STG application.

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RESP-STG Communications Function						
RS-1	1.	The RESP-STG Communications function shall receive and transmit data between RESP-STG and INC-ZONE using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived – mechanism is Information Broker
RS-2	2.	The RESP-STG Communications function shall receive and transmit data between RESP-STG and EVAC using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived – mechanism is Information Broker
RS-3	3.	The RESP-STG Communications function shall receive and transmit data between RESP-STG and the Information Broker using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#2, Steps 18, 19

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RESP-STG Visual Display Function						
RS-4	4.	The RESP-STG Visual Display Function shall develop a spatial representation of the incident zone from information received from the RESP-STG functions and present information on a graphical display per guidance in ATIS/CVO (FHWA-RD-98-057), or equivalent.	NA	Internal to application	Test	Derived from OS#4, Step 9
RS-5	4.1.	The RESP-STG Visual Display Function shall permit a System Administrator to establish multiple Master displays of selected information for customizable purposes and assign these Master Display unique labels. *Note: examples could include a Master Display for a speeding violation, a minor traffic incident, and an accident involving HAZMAT vehicle.*	A minimum of three (3) Master Displays shall be established	Internal to application	Test	Derived from OS#4, Step 9
RS-6	4.2.	The RESP-STG Visual Display Function shall permit an authorized User to add or remove selected information from the display by manually turning on or off a unique layer.	NA	Internal to application	Demonstration	Derived from OS#4, Step 9

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-7	4.3.	The locations of all on-scene responder assets shall be included on the display as a configurable layer.	The locations of all on-scene responder assets shall be accurate to within 26 feet.	Internal to application	Test	Derived from OS#4, Step 9
RS-8	5.	The RESP-STG Visual Display Function should present the visual information on a platform that can be carried by a single person when on an active incident scene without the need for an external power connection.	The platform shall allow power from a portable battery source.	NA	Demonstration	Derived from OS#4, Step 9
RS-9	6.	The RESP-STG Visual Display Function shall provide an alert when any of the following conditions are met: • New information is received from any of the actively displayed information sources • A high priority message is received from any of the information sources not selected for display	NA	Internal to application	Demonstration	Derived from OS#3, Step 14
RS-10	6.1.	The alert shall include a visual indication that information has been updated or is available	NA	Internal to application	Demonstration	Derived from OS#3, Step 14

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-11	6.2.	The alert should include an audible indication that information has been updated	NA	Internal to application	Demonstration	Derived from OS#3, Step 14
RS-12	6.3.	The RESP-STG Visual Display Function shall allow the User to choose to immediately refresh the information from a selected information source.	The selected information shall be updated within five (5) seconds of being commanded.	Internal to application	Test	Derived from OS#3, Step 14
RESP-STG Vehicle and Equipment Staging Function						
RS-13	7.	The RESP-STG Vehicle and Equipment Staging Function shall consolidate information from available sources into a single viewing platform for display to the User though the Visual Display Function.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-14	7.1.	The RESP-STG Vehicle and Equipment Staging Function shall access through the Information Broker the following fixed information assets: • Geographic Information System overlays • Road maps • Topography maps • Database of still photographs • Database of satellite imagery • Video cameras	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15
RS-15	7.2.	The RESP-STG Vehicle and Equipment Staging Function shall access through the Information Broker the following variable information assets: • HAZMAT plume modeling and identification of impacted roads • Type and position of emergency responder vehicles at an incident scene • Locations of medical care facilities • Weather data	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-16	7.3.	The RESP-STG Vehicle and Equipment Staging Function shall access through the Information Broker the following traffic information assets: • Current traffic speed	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15
RS-17	7.4.	Based on the available data, the RESP-STG Vehicle and Equipment Staging Function shall suggest to an emergency responder who has not yet arrived on-scene: • What direction to approach the incident scene • Where to stage the response vehicle	The suggested driving directions and staging locations shall be updated automatically in two (2) minute intervals, maximum.	DSRC, Wi-Fi, Cellular	Test	Derived from OS#3, Step 11 and OS#6, Step 15
RS-18	7.4.1.	The RESP-STG Vehicle and Equipment Staging Function shall detect the vehicle location using GPS and update system representations.	NA	Internal to application	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-19	8.	The RESP-STG Vehicle and Equipment Staging Function shall show the locations and estimated time of arrival at the incident scene of enroute emergency responders.	The location shall be accurate to within 26 feet at the time the location was captured. The location and estimated time of arrival shall be updated automatically in two (2) minute intervals, maximum.	DSRC, Wi-Fi, Cellular	Test	Derived from OS#3, Step 11 and OS#6, Step 15
RESP-STG Dynamic Routing Function						
RS-20	9.	The RESP-STG Dynamic Routing Function shall provide real-time navigation instructions from a selected starting point to a selected destination using real-time and predictive algorithms.	NA	DSRC, Wi-Fi, Cellular	Demonstration	OS#6, Step 20
RS-21	9.1.	The navigation instructions shall route around unplanned (but previously reported) road closures.	The navigation instructions shall update the vehicle's route to avoid the road closure within five (5) minutes of a road closure being reported.	DSRC, Wi-Fi, Cellular	Test	OS#6, Step 20

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-22	9.2.	The navigation instructions shall include options to select roads that are reported to have been cleared of snow by snowplow reports.	The navigation instructions shall identify the time the road was cleared of snow.	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#6, Step 20
RS-23	9.2.1.	The navigation instructions should use real-time traffic volume data to determine travel times and account for predicted congestion of traffic near an incident scene as more vehicles approach the incident scene over time.	The estimated travel times shall be accurate to within 25%.	DSRC, Wi-Fi, Cellular	Analysis	OS#6, Step 20
RS-24	9.2.2.	The RESP-STG Dynamic Routing Function shall access video feeds from assets in and around an incident zone, including: • Transportation Manager Center closed circuit television (CCTV) • Traffic helicopters or airplanes • Emergency responder vehicles	Active video feeds shall be accessible to this function 90% of the time.	Wi-Fi, Cellular	Analysis	Derived from OS#3, Step 8

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-25	9.2.2.1.	The video feeds shall be processed to assess traffic congestion and the results shall be incorporated into the travel time estimates.	NA	DSRC, Wi-Fi, Cellular	Demonstration	OS#3, Step 10
RS-26	9.3.	The navigation instructions shall include options to avoid roads that are predicted to be impacted by hazardous fumes at the time of passage. *Note: HAZMAT plume modeling and identification of impacted roads will be performed by the Information Broker.*	The navigation instructions shall indicate that the vehicles planned route will cross a HAZMAT plume within one (1) minute of a road on the route being identified as being impacted by a HAZMAT plume.	DSRC, Wi-Fi, Cellular	Test	Not linked to specific OS
RS-27	10.	The RESP-STG Dynamic Routing Function shall receive from the Information Broker a list of medical facilities capable of treating the injuries sustained by the incident victims that are within a customizable distance from the incident scene.	A minimum of 3 medical facilities shall be listed with ten (10) seconds of the request being submitted.	Wi-Fi, Cellular	Test	OS#5, Step 29

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-28	10.1.	The RESP-STG Dynamic Routing Function shall enable information about the incident victim(s) to be sent to the Information Broker for assessment of the recommended, available medical care facilities.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 29
RS-29	10.2.	The RESP-STG Dynamic Routing Function shall estimate travel times to the listed medical facilities.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 29
RS-30	10.3.	The list shall be sortable and shall include the following information regarding the medical facility: • Triage level capability • Confirmation of space available • Distance from the incident scene • Estimated travel time	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 29
RS-31	11.	The RESP-STG Dynamic Routing Function shall provide navigation instructions to the medical facility selected by the User.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 29

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RESP-STG Emergency Responder Status Reporting Function						
RS-32	12.	The RESP-STG Emergency Responder Status Reporting Function shall maintain a continuously updated inventory of all information sources available at the incident scene and shall provide access to those assets when requested via the Information Broker.	The inventory shall be updated at a frequency of one (1) minute maximum.	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Test	Not linked to a specific OS
RS-33	12.1.	The RESP-STG Emergency Responder Status Reporting Function shall transmit the following traffic- or emergency-responder-related information to the Information Broker when instructed: • Estimated Time of Arrival Summary of Equipment/Personnel • Staging Intentions • Arrival Approach (Directionality, Route) • Route Taken • Traffic/Travel Conditions Encountered	The information shall be sent within ten (10) seconds of the Emergency Responder Status Reporting Function receiving the request.	Wi-Fi, Cellular	Test	OS#4, Step 9

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-34	12.1.1.	The RESP-STG Emergency Responder Status Reporting Function shall transmit the following traffic-related information to the Information Broker when instructed: • Lane closure information in the proximity of the incident zone • Recommended traffic diversion locations	The information shall be sent within ten (10) seconds of the Emergency Responder Status Reporting Function receiving the request.	Wi-Fi, Cellular	Test	OS#4, Step 9
RS-35	12.1.1.1.	The RESP-STG Emergency Responder Status Reporting Function should transmit the following traffic-related information to the Information Broker when instructed: • Traffic helicopters or airplanes • Emergency responder vehicles	The information shall be sent within ten (10) seconds of the Emergency Responder Status Reporting Function receiving the request.	Wi-Fi, Cellular	Test	OS#4, Step 9

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communications Need	Verification Method	CONOPS Operational Scenario Reference
RS-36	12.1.2.	The RESP-STG Emergency Responder Status Reporting Function shall transmit the following emergency-response-related to the Information Broker when instructed: • Types of on-scene emergency vehicles • Locations of on-scene emergency vehicles • Emergency responder vehicles onboard dash-cams • HAZMAT plume location • Incident victim details	The information shall be sent within ten (10) seconds of the Emergency Responder Status Reporting Function receiving the request.	Wi-Fi, Cellular	Test	OS#2, Step 22
RS-37	13.	When enroute to an incident scene, the RESP-STG Emergency Responder Status Reporting Function shall report traffic-related information to the Information Broker to assess the traffic flow encountered by the emergency responder. The information will include: • Speed • Heading • Route to destination • Estimated time of arrival, reported in local time	The information shall be sent within ten (10) seconds of the Emergency Responder Status Reporting Function receiving the request.	Wi-Fi, Cellular	Demonstration	OS#4, Step 9

Table 4-3. RESP-STG Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Unique Identifier	Outline Designator	Description	Requirement Description	Communications Need	Method	Operational Scenario Reference
RS-38	14.	The RESP-STG Emergency Responder Status Reporting Function shall provide the Information Broker access to any of the available information assets when requested.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Not linked to specific OS
RS-39	14.1.	The number of information assets that can be viewed simultaneously shall be TBD, depending upon the types of feeds or information being transmitted.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Not linked to specific OS

Source: Battelle

INC-ZONE

INC-ZONE Functional Architecture

INC-ZONE is a communication approach that will improve protection of responders at incident sites where there have been crashes, other accidents, or events impacting traffic such as stalled vehicles or vehicles pulled over for moving violations. Unlike permanent route guidance and even construction zones, the dynamic nature of temporary work zones established following an incident (incident zone) can be confusing and disconcerting to drivers. For example, the number of lanes closed may change during the course of the incident and without much prior notification or notice. Enhancing the safety of such work zones requires that real-time notifications be delivered to both the driver of the vehicle operating near the incident zone, and the responders working in the zone, including law enforcement, fire and rescue, EMS, HAZMAT Response Unit, towing and recovery, emergency management, and construction workers (if brought on-scene for emergency infrastructure repairs).

Within the R.E.S.C.U.M.E. Bundle, the INC-ZONE application is the component that will serve to provide additional on-scene information to responders as well as oncoming drivers of events that are occurring in the incident zone such as a lane closure. In particular, one component of the INC-ZONE application will provide responders with real-time alerts of oncoming vehicles that have trajectories or speeds that pose a high risk to their safety. Additional information such as arriving and staging of additional responders would also be provided to assist in staging decisions and response to the incident.

A second aspect of the INC-ZONE application will involve a built-in in-vehicle messaging system that provides merging and speed guidance around an incident to on-coming vehicles. For example, vehicles approaching the incident at speeds that pose a risk to themselves as well as to the incident zone responders will be detected by on-scene portable sensors or other detection methods. They will receive a message generated by the INC-ZONE application notifying them of the dangerous speed and advising a speed reduction. An additional aspect of the INC-ZONE application would be to also notify law enforcement personal of excessive speed so that enforcement of advisories could be enacted. However, this additional aspect of the application is considered to be beyond the scope of this ConOps.

The INC-ZONE application provides real-time situational awareness to on-scene workers, responders, and the traveling public. Unlike the other applications, the INC-ZONE application may reside within equipment contained in responder's vehicles, but components of the application, particularly the data collection aspects, may also reside in additional stand-alone equipment such as a mobile traffic cone or even a fixed infrastructure asset. For the purposes of the ConOps, it is assumed that the INC-ZONE application consists of the in-vehicle components of the application, recognizing that some of the data elements utilized by the application are derived from infrastructure and road-side equipment. Figure 4-4 summaries the functional components of the INC-ZONE application. Generally, this is the application that "takes over" when the responders arrive on-scene.

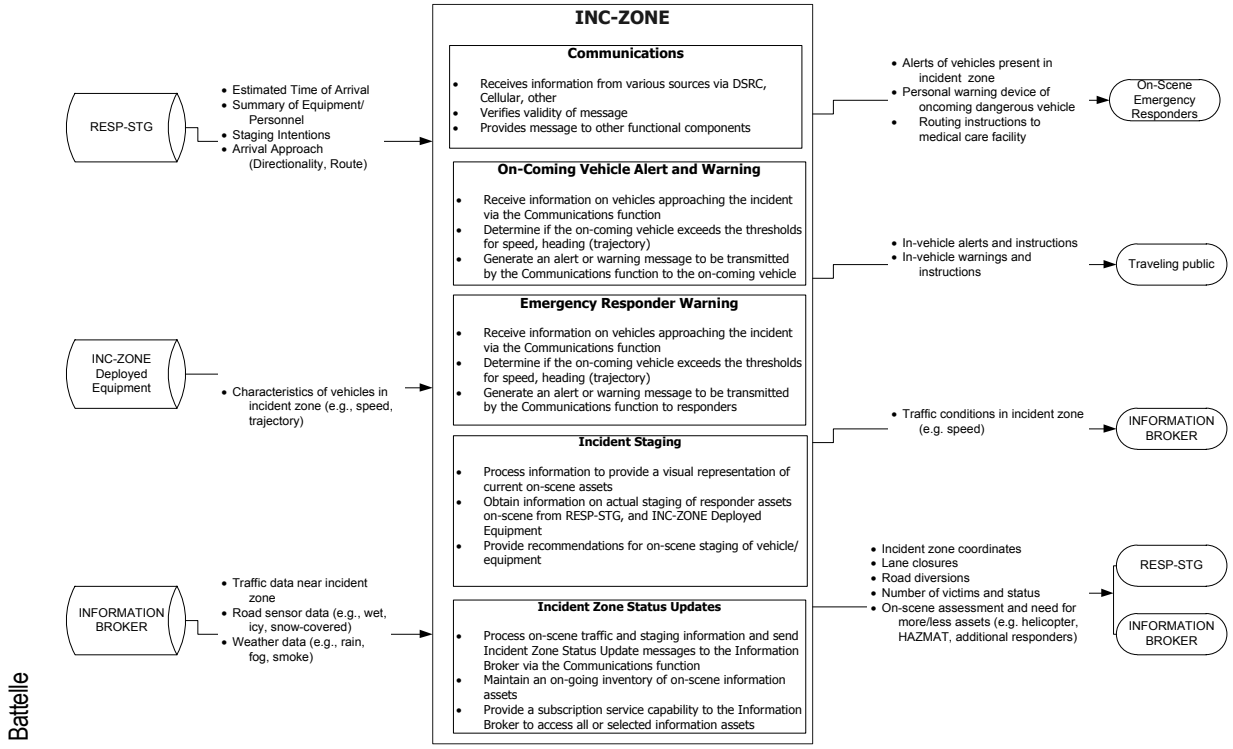

Figure 4-4. INC-ZONE Functional Architecture

Communications

The Communications function enables INC-ZONE to receive information and then transmit the generated output data to its intended data consumer quickly and securely. This includes the processes required to exchange messages with the Information Broker component of R.E.S.C.U.M.E. and with RESP-STG. Such processes include data receipt, data transmission and termination, error detection, and authentication.

On-coming Vehicle Alert and Warning

The INC-ZONE In-vehicle Alert and Warning function uses high-priority DSRC messages to alert drivers that they have entered an incident zone and direct them to change course if they are operating their vehicles unsafely for the incident zones conditions. Recognition of an unsafe vehicle would be accomplished by using specially-designed computer algorithms to analyze vehicle speed and trajectory information as well as other information sources to determine whether an alert and/or warning needs to be presented to the vehicle operator. More specifically, the On-coming Vehicle Alert and Warning function receives information from the Communications portion of the application that identifies the current road conditions. This information includes recommended speed and lane guidance that are sent to the Communications function by the INC-ZONE application. Processing this information against the vehicle's current telematics (e.g., speed, heading, distance from scene, etc.) and vehicle characteristics (e.g., weight, height, stopping distance, etc.), the On-coming Vehicle Alert and Warning function determines whether a message needs to be generated, the priority of the message, and whether it should be visually or audibly presented to the vehicle operator (or both).

Emergency Responder Warning

The INC-ZONE Emergency Responder Warning function uses high-priority DSRC messages to alert incident responders that a vehicle has entered an incident zone and represents a potential threat to the incident responders due to excessive speed and heading (trajectory). The Emergency Responder Warning function receives location and predictive path information from on-coming vehicles broadcasting the Enhanced Basic Safety Message. Location and heading information are received from CV-enabled vehicles that are broadcasting only position information. The INC-ZONE Emergency Responder Warning function also receives, via the Communications function, information from other sources such as mobile sensing platforms that also provide a mechanism for identifying vehicles that are high threats, but that are not equipped with CV technology (i.e., existing or portable radar detectors embedded in VMS, etc.).

The Emergency Responder Warning function first determines the type of information that is received and the source of the information. A series of algorithms then are invoked to determine predicted path and projected speed, together with other information such as current traffic and weather conditions to generate a hazard score. Instances that exceed a pre-determined threshold for the hazard score trigger the generation of an alert or warning message that is sent to the Communications function for immediate broadcast to all emergency responders on-scene. The threshold for triggering a warning should be a configurable setting that could be dynamically changed as traffic, weather, and other related extraneous factors change.

Incident Staging

The INC-ZONE Incident Staging function is essentially the same as that described for RESP-STG with the exception that it is focused upon on-scene assets and includes oncoming vehicles and their predicted hazard scores. This function receives information from a variety of sources, routed through the Communications function and uses that information together with on-board databases and Internet accessible sources to develop a multi-layered special representation of the incident.

Incident Zone Status Updates

The INC-ZONE Incident Zone Status Updates function provides a real-time information feed on the current conditions at the incident scene to arriving responders (RESP-STG) and to the Information Broker. This information includes traffic data (e.g., speed), lane closure details, and diversion locations. However, second-by-second updates of all information are not envisioned as this may result in communications bandwidth limitations. Rather, this component of the application will communicate automatically with the Information Broker to identify information streams that are not accessible through other means (e.g., CCTVs mounted to telephone poles) and provide this information. In short, this function will maintain an ongoing inventory of all information assets that are available to it on-scene and will allow the Information Broker to subscribe to one or more of these elements. This enables the Information Broker to have the ability for distributed processing and communications and avoids information choke points due to the same information being provided by multiple sources. For example, the Information Broker may subscribe to the in-vehicle dash camera feed from one of the on-scene patrol vehicles to observe road closures or blockages while at the same time subscribing to second-by-second traffic speeds from a second responder's INC-ZONE application. This enables the traveling public who has yet to enter the incident zone to avoid it entirely or to be aware of the likely congestion and reduced speeds ahead.

INC-ZONE Modes of Operation

The modes for the INC-ZONE application are similar to those of the RESP-STG application except that notification of degraded, overloaded, and system failure modes should also be made to the on-scene responders.

- **Normal Mode.** In normal mode the INC-ZONE application is installed on motorist vehicles, responder vehicles and a portable unit worn by the responder. Full connectivity to DSRC communications is available and the Information Broker is capable of receiving data from RESP-STG.
- **Degraded Mode – No or Limited Connectivity to Information Broker.** In this mode of operation, the INC-ZONE application in the responder vehicle does not have the ability to connect to the Information Broker or has slow connectivity that cannot support the transfer of the data needed by the application. In the case where there is no connectivity to the Information Broker, the alert functions of INC-ZONE will continue to operate but will indicate to the responder that data from the Information Broker is not being accessed.
- **Degraded Mode – Partial Implementation.** The INC-ZONE may be installed and operational on a portion of responder vehicles. In addition, it may also only be partially involved on a portion of the traveling public vehicles.
- **Overloaded Mode.** In crashes that occur on congested roadways responders receiving alerts could be overloaded with the number of alerts that are being broadcast. This could potentially result in responders ignoring alerts.
- **Complete System Failure.** In complete system failure mode, the RESP-STG application will be unavailable and operations. Responders and the traveling public should be notified that the system has failed.

INC-ZONE Functional Requirements, Performance Requirements and Verification Methods

Table 4-4 provides the functional requirements, associated performance requirements, high-level communication needs and verification methods for the INC-ZONE application.

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
INC-ZONE Communications Function						
IZ-1	1.	The INC-ZONE Communications functional shall receive and transmit data between INC-ZONE and RESP-STG using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#3, Step 14
IZ-2	2.	The INC-ZONE Communications functional shall receive and transmit data between INC-ZONE and the Information Broker using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#6, Step 17
IZ-3	3.	The INC-ZONE Communications functional shall receive and transmit data between INC-ZONE and the On-Scene Emergency Responders using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#3, Step 5
IZ-4	4.	The INC-ZONE Communications functional shall receive and transmit data between INC-ZONE and the Traveling Public using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#3, Step 12

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-5	5.	The INC-ZONE Communications function shall receive and transmit data between INC-ZONE and the INC-ZONE deployed equipment using a reliable transport mechanism.	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#3, Step 3
INC-ZONE On-coming Vehicle Alert and Warning Function						
IZ-6	6.	The INC-ZONE On-coming Vehicle Alert and Warning Function shall detect when a vehicle is TBD seconds, minimum, from entering an incident zone.	NA	DSRC	Demonstration	OS#3, Step 3
IZ-7	6.1.	The detection equipment shall operate when deployed in outdoor environmental conditions.	NA	DSRC	Demonstration	OS#3, Step 3
IZ-8	6.2.	The INC-ZONE On-coming Vehicle Alert and Warning Function will receive position information from all Connected Vehicle-enabled vehicles approaching the incident zone that are broadcasting only position information.	NA	DSRC	Demonstration	Derived from OS#3, Step 3
IZ-9	6.3.	The INC-ZONE On-coming Vehicle Alert and Warning Function will receive location and predictive path information from on-coming vehicle broadcasting Enhanced Basic Safety Messages.	NA	DSRC	Demonstration	Derived from OS#3, Step 3

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-10	7.	The INC-ZONE On-coming Vehicle Alert and Warning Function shall alert the vehicle operator that he is entering an incident zone by sending a high-priority DSRC message from the detection equipment to the Approaching Vehicle.	The message shall be received by the Approaching vehicle within one (1) second of the detection equipment detecting the Approaching Vehicle has entered the incident zone.	DSRC	Test	Not linked to specific OS
IZ-11	7.1.	The DSRC message from the INC-ZONE On-coming Vehicle Alert and Warning Function shall contain: • Notification that vehicle is entering an incident zone • Recommended incident zone speed limit • Lane closure information	NA	DSRC	Demonstration	Not linked to specific OS
IZ-12	7.2.	The in-vehicle alert shall include both audible and visual messages to communicate the DSRC message contents to the vehicle operator per guidance provided in ATIS/CVO (FHWA-RD-98-057), or equivalent.	NA	Internal to application	Demonstration	Not linked to specific OS

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-13	8.	If the INC-ZONE On-coming Vehicle Alert and Warning Function determines the vehicle is being operated in an unsafe manner, then it shall warn the vehicle operator and instruct him to take action.	NA	DSRC	Demonstration	Not linked to specific OS
IZ-14	8.1.	The INC-ZONE On-coming Vehicle Alert and Warning Function shall determine whether or not a vehicle is approaching the incident zone in a safe manner. *("Safe Manner" shall be defined as one in which the vehicle is predicted, through the use of mathematical models, to remain in the control of the operator)*	NA	DSRC	Demonstration	Not linked to specific OS
IZ-15	8.1.1.	The INC-ZONE On-coming Vehicle Alert and Warning Function shall extract the Enhanced Basic Safety Message from the vehicle's onboard equipment for inclusion in the mathematical models.	NA	DSRC	Inspection	Not linked to specific OS
IZ-16	8.1.2.	The INC-ZONE On-coming Vehicle Alert and Warning Function should extract from the vehicle's onboard equipment, the vehicle's characteristics necessary to mathematically predict the distance required for the operator to stop the vehicle.	NA	DSRC, Cellular	Demonstration	Not linked to specific OS

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-17	8.1.2.1.	The INC-ZONE On-coming Vehicle Alert and Warning Function should obtain local road condition information from the Information Broker necessary to define the road friction characteristics to more accurately mathematically predict the distance required for the operator to stop the vehicle.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Not linked to specific OS
IZ-18	8.2.	The warning shall include audible and visual messages per guidance provided in ATIS/CVO (FHWA-RD-98-057), or equivalent.	NA	Internal to application	Demonstration	Not linked to specific OS
IZ-19	8.3.	The warning shall include instructions that the vehicle operator can follow to return vehicle operation to a safe manner. Such instructions shall include the following actions as appropriate to the conditions: • Reduce speed • Merge	NA	DSRC	Demonstration	Not linked to specific OS
IZ-20	8.4.	If the vehicle operator does not take action to operate the vehicle in a safe manner, then a second DSRC high priority message shall be sent to the vehicle operator with instructions to immediately take corrective action.	The second warning and instructions shall be received by the vehicle operator within one (5) second of the vehicle having entered the incident zone.	DSRC	Test	Not linked to specific OS

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-21	8.4.1.	The warning shall include audible and visual messages, per guidance provided in ATIS/CVO (FHWA-RD-98-057), or equivalent.	NA	Internal to application	Demonstration	Not linked to specific OS
IZ-22	8.4.1.1.	The warning shall include instructions that the vehicle operator can follow to return vehicle operation to a safe manner. Such instructions shall include the following actions as appropriate to the conditions: • Reduce speed • Merge	NA	DSRC	Demonstration	Not linked to specific OS
IZ-23	8.4.2.	The warning should include a tactile indicator to capture the vehicle operator's attention.	NA	DSRC	Demonstration	Not linked to specific OS
INC-ZONE Emergency Responder Warning Function						
IZ-24	9.	The INC-ZONE Emergency Responder Warning Function shall receive notification from the INC-ZONE On-coming Vehicle Alert and Warning Function that a vehicle being operated in an unsafe manner is approaching the incident zone.	NA	DSRC	Demonstration	OS#3, Step 5
IZ-25	9.1.	The INC-ZONE Emergency Responder Warning Function shall transmit an alert of a potentially dangerous situation caused by the unsafely operated vehicle to all persons within the incident zone.	NA	DSRC, Cellular	Demonstration	OS#3, Step 5

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-26	9.1.1.	The threshold for determining when the alert is to be transmitted should be configurable.	NA	NA	Demonstration	Derived from OS#3, Step 5
IZ-27	9.1.2.	The INC-ZONE Emergency Responder Warning Function shall transmit a high priority message to a device that can be worn by an emergency responder. *Note: for the purposes of this document, a device that can be worn by a person is termed a "Personal Alerting Safety System, or PASS.*	The message shall be received by the PASS in less than one (1) second after the INC-ZONE Emergency Responder Warning Function receives notification from the INC-ZONE On-coming Vehicle Alert and Warning Function that a vehicle being operated in an unsafe manner is approaching the incident zone.	DSRC	Test	OS#3, Step 5
IZ-28	9.1.2.1.	The PASS shall generate a notification that will capture the attention of the emergency responder.	NA	DSRC, Wi-Fi, Cellular	Demonstration	OS#3, Step 5

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-29	9.1.2.1.1.	The notification shall be configurable such that the emergency responder can select to be alerted by any or multiple of the following methods: • Visible alerts • Audible alerts • Tactile alerts	The emergency responder's reaction time to receiving the alert shall be less than one (1) second.	Internal to application	Test	Derived from OS#3, Step 5
IZ-30	9.2.	The INC-ZONE Emergency Responder Warning Function should transmit an alert of a potentially dangerous situation caused by the unsafely operated vehicle to all persons within the incident zone who are not equipped with a Personal Alerting Safety System.	NA	DSRC	Demonstration	Not linked to OS
IZ-31	9.2.1.	The alert should be communicated in a manner that could secure the attention of all persons within the incident zone, including emergency responders and the general public. *Note: some examples provided here for illustration purposes only include sirens, variable message signs, and strobe lights.*	NA	DSRC	Demonstration	Not linked to OS

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
INC-ZONE Incident Staging Function						
IZ-32	10.	The INC-ZONE Incident Staging Function shall utilize the RESP-STG Visual Display Function, which shall develop a spatial representation of the incident zone from information received from the RESP-STG functions and present information on a graphical display.	NA	DSRC, Cellular, Wi-Fi	Demonstration	
IZ-33	10.1.	The INC-ZONE Incident Staging Function shall utilize the RESP-STG Visual Display Function to permit a System Administrator to establish multiple Master displays of selected information for customizable purposes and assign these Master Display unique labels. It shall permit an authorized User to add or remove selected information from the display by manually turning on or off a unique layer. *Note: examples could include a Master Display for a speeding violation, a minor traffic incident, and an accident involving HAZMAT vehicle.*	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#3, Step 3

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-34	10.2.	The INC-ZONE Incident Staging Function shall utilize the RESP-STG Visual Display Function to permit an authorized User to add or remove selected information from the display by manually turning on or off a unique layer.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#3, Step 3
IZ-35	10.3.	The locations of all on-scene responder assets shall be included on the display as a configurable layer.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#3, Step 3
IZ-36	11.	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to consolidate information from available sources into a single viewing platform for display to the User though the Visual Display Function.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15
IZ-37	11.1.	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to access through the Information Broker the following fixed information assets: • Geographic Information System overlays • Road maps • Topography maps • Database of still photographs • Database of satellite imagery • Video cameras	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-38	11.2.	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to access through the Information Broker the following variable information assets: • HAZMAT plume modeling and identification of impacted roads • Type and position of emergency responder vehicles at an incident scene • Locations of medical care facilities	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15
IZ-39	11.3.	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to access through the Information Broker the following traffic information assets: • Current traffic speed	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#3, Step 11 and OS#6, Step 15
IZ-40	11.4.	The INC-ZONE Incident Staging Function shall invoke, based on the available data, the RESP-STG Vehicle and Equipment Staging Function to suggest to an emergency responder who has not yet arrived on-scene: • What direction to approach the incident scene • Where to stage the response vehicle	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#2, Step 22

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-41	11.4.1.	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to allow the emergency responder to override the suggested approach and staging location.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#2, Step 22
IZ-42	12.	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to show the locations and estimated time of arrival at the incident scene of enroute emergency responders.	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#2, Step 23
INC-ZONE Incident Zone Status Updates Function						
IZ-43	13.	The INC-ZONE Incident Zone Status Updates Function shall invoke the RESP-STG Emergency Responder Status Reporting Function, which shall maintain a continuously updated inventory of all information sources available at the incident scene and shall provide access to those assets when requested via the Information Broker.	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#3, Step 14

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-46	13.1.	The INC-ZONE Incident Zone Status Updates Function shall invoke the RESP-STG Emergency Responder Status Reporting Function to transmit the following emergency response related information to the Information Broker when instructed: • Types of on-scene emergency vehicles • Locations of on-scene emergency vehicles • Emergency responder vehicles onboard dash-cams • HAZMAT plume location • Incident victim details	NA	DSRC, Cellular, Wi-Fi	Demonstration	Derived from OS#3, Step 14
IZ-44	13.2.	When enroute to an incident scene, the INC-ZONE Incident Zone Status Updates Function shall invoke the RESP-STG Emergency Responder Status Reporting Function, which shall report traffic-related information to the Information Broker to assess the traffic flow encountered by the emergency responder. The information will include: • Speed • Heading • Route to destination • Estimated time of arrival	NA	DSRC, Cellular, Wi-Fi	Demonstration	OS#3, Step 14

Table 4-4. INC-ZONE Functional Requirements, Performance Requirements, Communication Needs and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
IZ-45	13.3.	The INC-ZONE Incident Zone Status Updates Function shall invoke the RESP-STG Emergency Responder Status Reporting Function, which shall provide the Information Broker access to any of the available information assets when requested.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Not linked to specific OS
IZ-46	13.3.1.	The number of information assets that can be viewed simultaneously shall be TBD, depending upon the types of feeds or information being transmitted.	NA	DSRC, Cellular, Wi-Fi	Demonstration	Not linked to specific OS

Source: Battelle

EVAC

EVAC Functional Architecture

Evacuation of a city, county, or even part of a city is a challenging endeavor. Evacuation may involve a large region with days of advance notice, such as with an approaching hurricane; or it may be rapid and local, for example in response to a leak or potential explosion of a HAZMAT such as a Toxic Inhalation Hazard (TIH) like chlorine gas. Evacuation involves coordination of many agencies and functions including emergency management, public safety responders, public and private transportation providers, and DOTs. Evacuations not only involve the people who have the means and capabilities to evacuate themselves but also the functional needs population. The planning and execution of an evacuation must consider all categories of functional needs. The purpose of the EVAC application is to facilitate coordination for evacuees in both categories and those who support them.

During an incident, the EMA would have the ability to push information such as evacuation orders by evacuation zone to registered users of the system (either those that have pre-registered, or real-time registration during the event) through the EVAC application. The TMC working with the EOC will use the EVAC application to coordinate the listing of available transportation resources to assist with functional needs evacuation. The EVAC application will dispatch and route the transportation resources to the appropriate location, while providing communications updates to those functional needs individuals in need of assistance.

For non-functional needs evacuees, the EVAC application will provide evacuation route guidance that accounts for road conditions, traffic conditions, and final destination. If the evacuee intends to go to a shelter or hotel, the EVAC application will provide a shelter matching function to help the evacuee determine where he or she should go based upon shelter availability and capability (e.g., does the shelter accept pets?). Should the evacuee need a resource such as food or fuel along the evacuation route, the EVAC application can provide recommended stops and will incorporate user input feedback to provide information (though not necessarily validated information) on the availability of the needed resource.

Additionally, the EVAC application will include an Evacuee Return Support Function to provide evacuees with information regarding when they can return to their area of the jurisdiction and provide recommended routes taking into consideration road conditions (i.e., roadway infrastructure and traffic lights). All of these functions will support an overall reduction in the amount of time it takes to evacuate a jurisdiction, promote the use of all available evacuation routes to help minimize traffic congestion, and mitigate secondary incidents such as a car running out of fuel along an evacuation route, or too many people showing up at a shelter that is full and staying on the roads longer thereby adding to the congestion.

The EVAC application will contain multiple functions to support the efficient evacuation of functional needs and non-functional needs evacuees within a jurisdiction as well as provide real-time communications of evacuation instructions and routing guidance that accounts for current road and traffic conditions. These functions are accomplished through the integration and use of existing technologies to include communications functions (i.e., mass warning and notification systems), functional needs pre-registration databases, GIS, GPS, CAD, AVL, traffic information, and weather data. For the End Users of the application, the majority of the application functions will be accessed through a website and/or a Smartphone application or family of applications. Therefore, usage of these functions will be predicated on having a Smartphone, having connectivity (through Wi-Fi or

service provider), and having the awareness through jurisdiction outreach to know that this application is available and how it can be of value to the evacuee. Figure 4-5 summaries the functional components of the EVAC application.

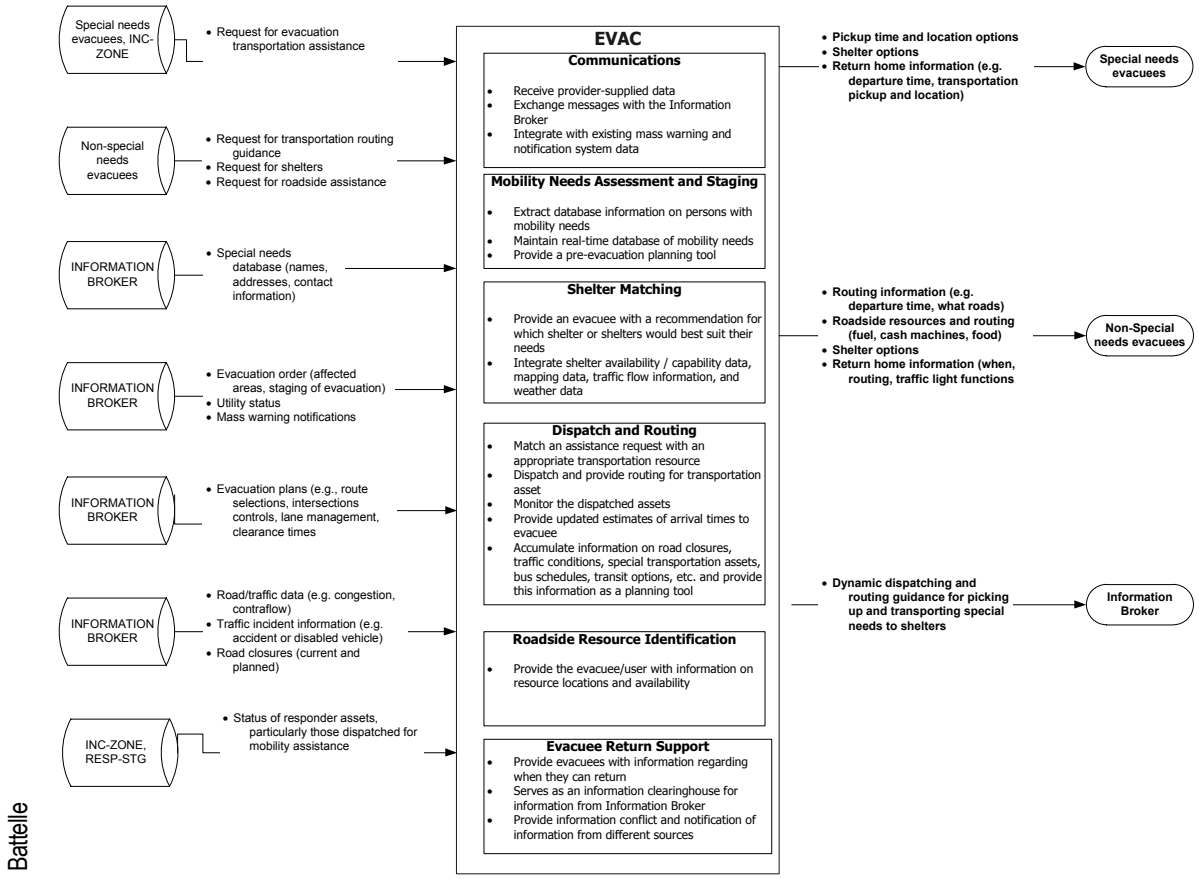

Figure 4-5. EVAC Functional Architecture

Communications

The Communications function enables EVAC to receive provider-supplied data (i.e., input data) and then transmit the generated output data to its intended data consumer quickly and securely. This includes the processes required to exchange messages with the Information Broker component of R.E.S.C.U.M.E., the EOC, TMC, functional needs evacuees and non-functional needs evacuees. Such processes include data receipt, data transmission and termination, data de-confliction to mitigate repeat requests, error detection, and authentication/data validation. The EVAC communications function should be able to integrate with existing mass warning and notification system data (either registered users and/or reverse 9-1-1-type information) to maximize the number of users the EVAC system can reach within a jurisdiction.

Most of the information flowing to and from the EVAC application will flow from the Information Broker and the entities that communicate with the Information Broker. The EVAC application itself will exist within one or more of the existing information systems of those entities that are included in the Information Broker.

Mobility Needs Assessment and Staging

The Mobility Needs Assessment and Staging function of the EVAC application serves to provide information that can be used to determine the segments of the population that require assistance to achieve enhanced mobility. This will include both persons with functional needs as well as persons without functional needs, but for whom there is an urgent mobility need as a result of the evacuation or subsequent incidents.

This component of the application would be responsible for extracting information from several different databases including those databases that provide information regarding persons with functional needs, regardless of whether they have pre-registered or are identified during the evacuation (either by a responder or through self-identification). Pre-evacuation information would be obtained from existing and/or legacy databases while on-going identification of persons with special mobility needs would be gathered and provided through the INC-ZONE application as well as from internal Information Broker entities such as a PSAP, law enforcement, State and Local government entity, etc.

The Mobility Needs Assessment and Staging function will provide a pre-evacuation planning tool that can be used to identify those segments of the population that require assistance and geographic locations and assets that could provide that assistance. However, once the evacuation is underway, it is likely that many of the assets identified during pre-evacuation planning will be diverted to other critical needs and will be unavailable at certain points in time during the evacuation. The Mobility Needs Assessment and Staging function is responsible for monitoring the identified segments of the population to maintain a situational awareness of mobility needs, which are then passed to the Dispatch and Routing Function for planning and deployment of assets.

Shelter Matching

The Shelter Matching function will provide an evacuee with a recommendation for a certain shelter or shelters that would best suit their needs, such as a standard shelter, a functional needs shelter, or a shelter that accepts pets. The Shelter Matching function may also suggest hotels/motels as potential sheltering options. As envisioned, the evacuee would access a website via a computer or smart phone application. Once the evacuee is connected, he or she would be prompted to enter information such as name, current location, number of people in his “group.” The Shelter Matching function would then prompt the evacuee to answer some critical questions such as “are you evacuating with a pet?”, “does someone in your group require medical support?”, and “what is your mode of transportation?” Based upon this information, as well as the prevailing travel conditions and predicted shelter loads, the evacuee is matched with a shelter and the system provides the evacuee with route and traffic information.

This function will require integration with shelter availability/capability data, mapping data, traffic flow information, and weather data such as that included in the American Red Cross National Shelter System (NSS). This function will promote effective movement to a matched shelter instead of potentially driving to a shelter only to find out it is not appropriate for the evacuee’s circumstances then having to continue driving to another shelter, adding to road congestion. Additionally, once an evacuee is matched with a shelter, the information can be added to the information managed by the Information Broker to allow for real time tracking of shelter availability.

Dispatch and Routing

One purpose of the Dispatch and Routing function is to match assistance/transportation requests with the appropriate resource, dispatch the appropriate resource, and provide the resource with the most effective route to their destination given current road/traffic conditions.

Through the Mobility Needs Assessment and Staging function, the Dispatch and Routing function is provided with requests for assistance and the type of assistance/resource needed to assist the functional needs individual (or group). This function will then match an assistance request with an appropriate transportation resource using information provided to the Information Broker from the RESP-STG, INC-ZONE, and other entities in the Information Broker. Once an asset is identified, a dispatch recommendation would be submitted via the Communications function to the Information Broker for processing and routing to the appropriate asset. The Dispatch and Routing function would monitor the dispatch through updates provided by the RESP-STG and INC-ZONE applications processed by the Information Broker. This function will provide estimated times of arrival and feedback to the person(s) requiring assistance through the Information Broker.

In evacuation situations, some persons will require assistance to accomplish the evacuation and request assistance in the form of a transportation asset. However, from a system congestion and asset management perspective, it may be more beneficial to either direct the individual to the asset (rather than the asset to the individual) or provide the individual with alternatives and options for self-evacuation that may not have been previously identified or known to the individual. The Dispatch and Routing function also serves the purpose of accumulating information such as road closures, traffic conditions, special transportation assets, bus schedules, and transit options and provide this information as a planning tool and resource to evacuees through the Information Broker.

Roadside Resource Identification

This function will provide the evacuee/user with information on resource locations and availability (as reported by other users – not necessarily validated information) including fuel, automated teller machines (ATMs), food, and hotels/motels along their evacuation route. The evacuee can access this information through a Smartphone application or through another device that has an Internet connection. The application will receive inputs, via the Information Broker, from mapping/GPS resources that have listings of resource locations. Other users of the application can make comments through social networking tools to alert other drivers of resource availability. For example, another user could arrive at a gas station and report that the station is out of fuel. The user who is in need of a roadside resource can select their need and will then be provided with route guidance (based upon map data and traffic/road condition data). Providing an evacuee with this type of information can help mitigate a secondary event such as running out of fuel along an evacuation route. This secondary event can disrupt traffic flow and would require dispatching of a resource to assist the evacuee.

Evacuee Return Support

Recovering from an evacuation and returning the evacuees to a jurisdiction can be just as complex as the initial evacuation depending on the extent of the damage. This function will provide evacuees with information regarding when they can return to their area of the jurisdiction and provide recommended routes taking into consideration road conditions (i.e., roadway infrastructure and traffic lights). This portion of the application serves as an information clearinghouse for information provided to the public by the various entities feeding the Information Broker. One important aspect of this function will be to process the information from the various entities intelligently to ensure that the messages are consistent and that the information provided by one entity does not conflict with the information provided by another entity. Should conflicting information be identified, this function has the

responsibility for notifying the Information Broker regarding the conflict and providing the details that caused the application to identify the information as being conflicting. The Information Broker will have the ability to deconflict the messages prior to publication.

EVAC Modes of Operation

The EVAC application differs from the other applications in that the expected mode of operation for this application is that of partial and limited connectivity depending upon the nature and stage of the evacuation. As such, the following modes of operation differ from those previously described for the other application.

Full Connectivity to Information Broker Entities

In this mode, the EVAC application can freely communicate with all entities connected to the Information Broker using a variety of communication methods, but primarily through an Internet-based network.

Partial Connectivity to Information Broker Entities

In this mode, the EVAC application cannot access information or provide information to all entities connected to the Information Broker. In this case, the Information Broker should continue to operate the processing functions but should notify the remaining entities that communications to some entities has been lost. Specific data elements that are not available should be identified. Historical and outdated information should not continue to be provided.

Full Communication Loss to Information Broker Entities

This mode essentially represents total system failure for the EVAC application as there will be no information to process or route. In this case, the EVAC application should provide a base notification that it has encountered a system failure (if possible).

Distributed Processing

The EVAC application may be divided among several Information Broker entities to maintain processing capability and to have redundant systems. There is nothing inherent in the EVAC application concept that would prohibit implementation of the EVAC application in this fashion. However, when in a distributed processing mode, the EVAC application should include a mechanism for ensuring internal consistency and integrity of the database.

EVAC Functional Requirements, Performance Requirements and Verification Methods

Table 4-5 provides the functional requirements, associated performance requirements, high-level communication need and verification methods for the EVAC application.

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EVAC Communications Function						
EV-1	1.	The Communications Function shall have the ability to receive provider-supplied data via a secure Internet connection (or other electronic equivalent communications connection).	NA	Wi-Fi, Cellular	Demonstration	Overarching EVAC Need
EV-2	1.1.	The provider-supplied data will be transmitted and received in a standardized format.	NA	Wi-Fi, Cellular	Demonstration	Overarching EVAC Need
EV-3	2.	The Communications Function shall have the capability to enable and exchange secure data transmittal of information.	NA	DSRC, Wi-Fi, Cellular	Demonstration	Overarching EVAC Need
EV-4	3.	The Communications Function shall have the ability to transmit data from within the EVAC bundle to other Information Broker electronic systems.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline,	Demonstration	Overarching EVAC Need

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-5	3.1.	The Communications Function shall utilize a security protocol that is at least as secure as AES encrypted data.	The security protocols shall be as secure as AES encrypted data or better.	Internal to application	Analysis	Overarching EVAC Need
EV-6	3.2.	The Communications Function shall include the capability to receive and transmit all data related to the EVAC Application.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline,	Demonstration	Overarching EVAC Need
EV-7	4.	The Communications Function shall have the ability to provide a data receipt or acknowledgement should this be requested by an information provider.	NA	DSRC, Wi-Fi, Cellular, Landline,	Demonstration	Overarching EVAC Need
EV-8	5.	The Communications Function shall include the ability to manage the distribution of messages by providing data de-confliction to mitigate repeat requests, error detection, and authentication/data validation.	NA	Internal to application	Demonstration	Overarching EVAC Need
EV-9	6.	The EVAC Communications Function should be able to integrate with existing mass warning and notification systems.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline, Internal to application	Demonstration	Overarching EVAC Need

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-10	7.	The EVAC Communications Function shall have the ability to communicate and facilitate communication between any of the R.E.S.C.U.M.E. Bundle applications.	NA	DSRC, Wi-Fi, Cellular, Landline	Demonstration	Overarching EVAC Need
EVAC Mobility Needs Assessment and Staging Function						
EV-11	8.	The Mobility Needs Assessment and Staging function shall have the ability to monitor identified segments of the population to maintain a situational awareness of mobility needs pre-, during, and post-evacuation.	NA	Wi-Fi, Cellular, Radio and TV Broadcast, Landline	Demonstration	OS#5, Step 6
EV-12	9.	The Mobility Needs Assessment and Staging function shall identify persons with mobility needs that are not being met and transmit this information to the Dispatch and Routing for Special Needs function for planning and deployment of assets.	NA	Wi-Fi, Cellular, Landline,	Demonstration	OS#5, Step 6

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-13	9.1.	The Mobility Needs Assessment and Staging function shall have the ability to establish thresholds or triggers based upon various user specified criteria that are used to identify gaps between persons with mobility needs that are not being met and transportation assets.	NA	Internal to application	Demonstration	OS#5, Steps 6-11
EV-14	9.1.1.	The Mobility Needs Assessment and Staging function shall include the following elements that can be used to initiate a message to the Dispatch and Routing Function: • Geographic location of the person with functional needs, • Geographic location of transportation assets; • Time until evacuation ceases (pre-event) relative to time to reach the person with an available transportation asset; • Availability and capacity of transportation assets; • Mobility and transport requirements of the person with mobility needs; • Special shelter needs, availability, and capacity for the person with mobility needs.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline,	Demonstration	OS#5, Steps 6-11

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-15	9.2.	Information for the Mobility Needs Assessment and Staging function will be available in the form of one or more existing databases that contain information on persons with mobility needs.	NA	NA	Demonstration	OS#5, Step 6
EV-16	9.2.1.	The information from these databases will be available in a standard format.	NA	NA	Inspection	OS#5, Step 6
EV-17	9.2.2.	The databases can be accessed in real-time by the Mobility Needs Assessment and Staging function.	The databases can be accessed in real time.	Wi-Fi, Cellular, Landline, Internal to application	Test	OS#5, Step 6
EV-18	9.3.	The Mobility Needs Assessment and Staging function shall have the ability to obtain pre-evacuation information from existing and/or legacy databases.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 6
EV-19	9.4.	The Mobility Needs Assessment and Staging function should provide database updates to existing/legacy mobility databases with newly identified persons with mobility needs.	NA	Wi-Fi, Cellular, Landline,	Demonstration	OS#5, Step 6 and 15

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-20	10.	The Mobility Needs Assessment and Staging function shall have the ability to receive and maintain a real-time database of persons with mobility needs that are not pre-registered, but who are identified during an evacuation.	NA	Wi-Fi, Cellular, Landline,	Demonstration	OS#5, Step 15
EV-21	11.	The Mobility Needs Assessment and Staging function shall be able to retrieve information on mobility assets from existing data sources prior to and during an evacuation.	The information shall be received within thirty (30) seconds of the request being submitted.	Wi-Fi, Cellular, Landline,	Test	
EV-22	12.	The Mobility Needs Assessment and Staging function shall use information from existing/legacy mobility databases along with existing databases on mobility related assets to provide a pre-evacuation report that links persons with mobility needs to mobility assets.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 6-11

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-23	12.1.	The linking of persons with mobility needs to mobility assets shall be based upon a number of factors including: personal choice of the person with mobility needs, availability of the transportation asset, cost, and efficiency in transportation asset utilization.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 6-11
EV-24	13.	During an evacuation, the Mobility Needs Assessment and Staging function shall maintain an ongoing database of cross-linked persons with mobility needs and transportation assets.	NA	Wi-Fi, Cellular, Landline	Test	OS#5, Step 6-11
EV-25	13.1.	Information on the intersection of persons with mobility needs and transportation assets shall be made available to all EVAC applications in real-time.	The database shall be updated every thirty (30) seconds to show who requires pickup.	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 6-11
EVAC Shelter Matching Function						
EV-26	14.	The Shelter Matching Function shall include a master database of all shelters in the evacuation and surrounding areas.	NA	Internal to application	Demonstration	OS#5, Step 32

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-27	14.1.	The Shelter Matching function shall maintain real-time updates of the shelter database based upon information received from shelter providers (via the Communications Function).	The databases shall receive updates in real-time.	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 32
EV-28	14.2.	The Shelter Matching function shall be able to interface with the American Red Cross National Shelter System database.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 32
EV-29	14.3.	Information in the shelter database shall include: • Shelter name and address, • Status of the Shelter [open, closed, full], • Capacity remaining, • Description of the services provided by the facility, • Limitations on service [pets accepted, mobility/accessibility concerns].	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 32
EV-30	15.	The Shelter Matching Function shall provide recommendations to the traveling public on shelters via multiple communication methods.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 32

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-31	15.1.	A member of the traveling public shall have the ability to access the Shelter Matching Function via the Internet and smart phone applications.	Smart phone applications shall be available for the two most commonly used mobile operating systems.	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 32
EV-32	15.2.	A member of the traveling public should have the ability to access the Shelter Matching Function through a telephone connection point.	NA	Landline	Demonstration	Derived from OS#5, Step 32
EV-33	16.	The Shelter Matching Function shall provide a mechanism for the traveling public to provide information that can be used for shelter matching.	NA	Wi-Fi, Cellular, Landline	Demonstration	Derived from OS#5, Step 32
EV-34	16.1.	A member of the traveling public shall have the ability to provide information that can be used to assess shelter suitability through the Internet and smart phone applications.	Smart phone applications shall be available for the two most commonly used mobile operating systems.	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 32
EV-35	16.2.	A member of the traveling public should have the ability to provide information that can be used to assess shelter suitability through a telephone connection point.	NA	Landline	Demonstration	Derived from OS#5, Step 32

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-36	16.3.	The Shelter Matching Function shall use, at a minimum, the following information to determine appropriate shelter matches with a traveler request: • Shelter availability, • Shelter capacity, • Requestor's current location, • Travel distance to shelter, • Modes of transportation available to reach shelter, • Need for medical support, • Number of people in the requestor's group, • Travel time to the shelter from the requestor's current location.	NA	Internal to application	Demonstration	Derived from OS#5, Step 32
EV-37	17.	The Shelter Matching Function shall provide at least one recommendation for a shelter for each request.	The function shall provide at least one shelter recommendation.	Wi-Fi, Cellular	Test	Derived from OS#5, Step 32
EV-38	18.	The Shelter Matching Function should provide multiple recommendations for shelters including estimated travel times and routes to the requestor.	The function should provide more than one shelter recommendation.	Wi-Fi, Cellular	Test	Derived from OS#5, Step 32

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EVAC Dispatch and Routing						
EV-39	19.	The Dispatch and Routing Function will have access to a database(s) of information that contains information on the availability and capacity of transportation assets.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 11
EV-40	20.	The database(s) of information on capacity and availability of transportation assets will be updated in real-time	The database(s) shall receive updates in real-time.	Wi-Fi, Cellular, Landline	Test	Derived from OS#5, Step 11
EV-41	21.	The Dispatch and Routing Function will receive from the Mobility Needs Assessment and Staging Function requests for transportation assistance.	NA	Internal to application	Demonstration	Derived from OS#5, Step 11
EV-42	21.1.	Each request for assistance shall include a description of the type of resource that is requested, a timeframe for the request to be honored within, and identification of the mobility needs.	NA	Wi-Fi, Cellular, Landline	Demonstration	Derived from OS#5, Step 11
EV-43	22.	The Dispatch and Routing Function shall include an algorithm(s) that can identify the transportation resource assets that capable of servicing each transportation request.	NA	Wi-Fi, Cellular, Landline	Demonstration	Derived from OS#5, Step 11

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-44	22.1.	The Dispatch and Routing Function shall include a decision algorithm that can prioritize, rank, and ultimately determine which transportation asset should be mobilized to each request.	The function shall identify at least one (1) transportation asset for each request.	Wi-Fi, Cellular, Landline	Test	Derived from OS#5, Step 11
EV-45	22.2.	The Dispatch and Routing Function should employ algorithms that optimize the utilization of transportation assets.	NA	Wi-Fi, Cellular, Landline	Demonstration	Derived from OS#5, Step 11
EV-46	23.	The Dispatch and Routing Function shall identify a recommended route for the identified transportation asset.	NA	DSRC, Wi-Fi, Cellular, Landline,	Demonstration	Derived from OS#5, Step 14
EV-47	23.1.	The recommended route shall be developed to account for the current state of the transportation system through identification of: • Traffic conditions, • Road closures, and • The persons who requested transportation assistance and are awaiting pick up.	The recommended route shall minimize the distance that the transportation asset must travel.	Internal to application	Demonstration	Derived from OS#5, Step 14

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-48	24.	The Dispatch and Routing Function shall prepare a dispatch message with the following elements: • Time of the request, • Time of dispatch, • Recommended route, • Expected arrival time at pickup location, • Number of passengers that requested assistance at the pickup location.	The estimated time of arrival shall be accurate to within 25% based on the exiting conditions at the time the estimate was developed.	DSRC, Wi-Fi, Cellular, Landline	Test	Derived from OS#5, Step 14
EV-49	25.	The Dispatch and Routing Function shall receive updates on the dispatched transportation assets through the Communications Functions that provide: • Current location • Distance to the pickup location.	NA	DSRC, Wi-Fi, Cellular, Landline	Demonstration	Derived from OS#5, Step 14
EV-50	25.1.	The Dispatch and Routing Function shall use the updated information to calculate an updated estimate time of arrival to the pickup location.	NA	Internal to application	Demonstration	Derived from OS#5, Step 14

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-51	25.1.1.	The updated time of arrival will be packaged as a communications message that includes: • Estimated time of arrival, • Type of transportation asset (e.g., bus, van, etc.).	When the estimated time of arrival changes more than 25% from the previously communicated estimate, the new estimate shall be communicated to the requesting party within 5 minutes of the determination of the change.	DSRC, Wi-Fi, Cellular, Landline	Test	Derived from OS#5, Step 14
EV-52	25.1.1.1.	The communications message shall be submitted to the Communications Function for transmission to the requesting party.	NA	Wi-Fi, Cellular, Landline	Demonstration	Derived from OS#5, Step 14
EV-53	26.	The Dispatch and Routing Function will be able to access real-time information on road closures, traffic conditions, special transportation assets, bus schedules, and transit options.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline	Demonstration	Derived from OS#5, Step 14

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EVAC Roadside Resource Identification						
EV-54	27.	The Roadside Resource Identification Function will be able to access real-time information on road closures, traffic conditions, motel/hotel capacity, special transportation assets, bus schedules, and transit options.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline, Internal to application	Demonstration	OS#5, Steps 33-34
EV-55	28.	The Roadside Resource Identification Function will be able to access information on gasoline availability and locations, location and status of automated teller machines, food, and hotels/motels along all evacuation routes.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline	Demonstration	OS#5, Steps 33-34
EV-56	29.	The Roadside Resource Identification Function shall be accessible to the traveling public through an Internet connection.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 33-34
EV-57	30.	The Roadside Resource Identification Function shall be accessible to the traveling public through a mobile device such as a smartphone.	Smart phone applications shall be available for the two most commonly used mobile operating systems.	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 33-34

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-58	31.	The Roadside Resource Identification Function shall be able to receive traveler provided updates that change the status of a resource.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 33-34
EV-59	31.1.	The Roadside Resource Identification Function should utilize algorithms to confirm and validate the traveler supplied information prior to reporting the updated information to other travelers.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 33-34
EV-60	32.	The Roadside Resource Identification Function shall update the status of roadside resources using updates provided from the Information Broker entities.	NA	Wi-Fi, Cellular, Landline,	Demonstration	OS#5, Steps 33-34
EV-61	33.	The Roadside Resource Identification Function shall update the status of roadside resources using updates provided by travelers.	The status update shall be posted to the Roadside Resource Identification Function within two (2) minutes of being validated.	Wi-Fi, Cellular, Landline	Test	OS#5, Steps 33-34
EV-62	34.	The Roadside Resource Identification Function shall provide updates to the Information Broker indicating and describing the change in status of a roadside resource.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 33-34

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-63	35.	The Roadside Resource Identification Function shall obtain route information from the Dispatch and Routing Function from a Traveler's location to a roadside resource when the Traveler requests assistance in finding Roadside Resources.	The Roadside Resource Identification Function shall estimate the time of arrival to within 25% of the actual time when the Traveler submits the initial request.	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 33-34
EV-64	35.1.	The Traveler shall have the ability to specify the type of resource to which routing directions are desired.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 33-34
EV-65	35.1.1.	The list of resource types shall include at least the following: Gas Station; Hotel, Transit, ATM, Bank, Grocery Store, Restaurant.	NA	Wi-Fi, Cellular, Landline,	Demonstration	Derived from OS#5, Steps 33-34
EVAC Evacuee Return Support						
EV-66	36.	The Evacuee Return Support Function shall be accessible from the Internet and a mobile device.	The Evacuee Return Support Function shall be compatible with the two most common mobile operating systems.	Wi-Fi, Cellular	Test	OS#5, Steps 41-43

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-67	37.	The Evacuee Return Support Function shall display information on current alerts, policies, emergency levels, etc. that indicate whether an evacuee can return to their residence.	The information on the availability and closure of transportation roadways, and systems shall be updated in real time.	Wi-Fi, Cellular, Landline	Test	OS#5, Steps 41-43
EV-68	38.	The Evacuee Return Support Function shall include the ability to have an evacuee type or select a specific geographic location such as a household address and provide information for that address.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 41-43
EV-69	39.	The Evacuee Return Support Function shall utilize the Dispatch and Routing function to calculate a route for the evacuee from their current location to the geographic location of interest.	The route shall be provided to the evacuee within (15) seconds of the request submission	Internal to application	Test	OS#5, Steps 41-43
EV-70	39.1.	The routes should be determined through using real-time information on the availability and closure of transportation roadways, and systems.	NA	DSRC, Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 41-43

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-71	39.2.	The Evacuee Return Support Function shall indicate those routes that are unavailable for evacuation return to the user.	NA	Internal to application	Demonstration	OS#5, Steps 41-43
EV-72	39.3.	If no available routes can be identified, the Evacuee Return Support Function shall indicate to the user that there are no safe routes that are available for their return.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Steps 41-43
EV-73	40.	The Evacuee Return Support Function will receive information on evacuation from a number of different sources.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline	NA	Derived from OS#5, Steps 41-43
EV-74	40.1.	The Evacuee Return Support Function shall identify when it receives conflicting information from different sources on the availability of transportation assets, systems, infrastructure components, and policy/orders.	NA	DSRC, Wi-Fi, Cellular, Radio and TV Broadcast, Landline	Demonstration	Derived from OS#5, Steps 41-43
EV-75	40.1.1.	If conflicting information is identified, the Evacuee Return Support Function shall submit a conflict notification message to the Communications Function to be sent to the information sources.	NA	Internal to application	Demonstration	Derived from OS#5, Steps 41-43

Table 4-5. EVAC Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High-Level Communication Need	Verification Method	CONOPS Operational Scenario Reference
EV-76	40.1.1.1.	The conflict notification message shall identify the information provided as well as the conflicting information provided by the other source.	NA	Internal to application	Demonstration	Derived from OS#5, Steps 41-43
EV-77	40.1.1.2.	The conflict notification message shall identify the sources of the information in conflict.	NA	Internal to application	Demonstration	Derived from OS#5, Steps 41-43
EV-78	40.1.2.	If conflicting information is identified, the Evacuee Return Support Function shall display the information received last.	NA	DSRC, Wi-Fi, Cellular, Landline	Demonstration	Derived from OS#5, Steps 41-43

Source: Battelle

Information Broker

Information Broker Functional Architecture

As discussed in Chapter 3, there are a number of well-established systems currently being utilized by the responder community. Additionally, there are complementary systems being utilized by other stakeholders, such as TMCs or public service dispatch centers that also relate to emergency response. It is critical to understand that the fundamental concept of the R.E.S.C.U.M.E. Bundle is that it will "live" within these existing systems rather than serve as a replacement to those existing systems. That is, the R.E.S.C.U.M.E. Bundle is conceived of as providing "value-added services" to those existing systems to assist responders in performance of their functions, while at the same time improving the overall mobility of those responders as well as the general traveling public during an incident. Representation of the existing systems and the flow of information among these systems are not detailed in this ConOps, beyond those discussions included in Chapter 3, as they can vary significantly from jurisdiction to jurisdiction. Rather, it is assumed that these various systems exist and that the necessary linkages between them also exist and will be used for information exchange. Figure 4-6, therefore, simply lists some of the many organizations that are expected to have existing systems that communicate with other organizations during an incident.

At the heart of R.E.S.C.U.M.E. is an Information Broker entity whose role is to collect, process, and disseminate data among the applications. As envisioned in the R.E.S.C.U.M.E. Bundle, the Information Broker would require and incorporate the functionalities currently provided by entities such as ECCs/PSAPs, TMCs, and EOCs. More than just simply receiving or sending information, this organization or collection of organizations serves as an Information Broker. This includes processing of the received information and determining the entities that need to be informed and providing other decisions on routing of information and data based upon the breadth of the information available throughout the incident. This is not meant to imply that the Information Broker would replace the Incident Commander or subsume the decision-making responsibilities of other organizations. Rather, the Information Broker would have the responsibility for both providing information and facilitating the routing and transfer of information among both internal and external entities. A key aspect of the Information Broker is to rapidly sift through the multitudes of input data; interpret, de-conflict, and correlate the data; and through implementation of algorithms and procedures make decisions on the relevance of data to a particular incident and application and communicate this information to the appropriate entity. Figure 4-6 summarizes the flow of information and the functional architecture of the Information Broker.

As illustrated in Figure 4-6, the information broker receives information from the R.E.S.C.U.M.E. Bundle Applications as well as information from other organizational entities. Once the information is received, it is processed and then distributed to the applications as well as other organizational entities. In short, the primary role of the Information Broker as envisioned is to serve as an information processor and router. The functional elements of the processing are described below for each of the R.E.S.C.U.M.E. Bundle Applications.

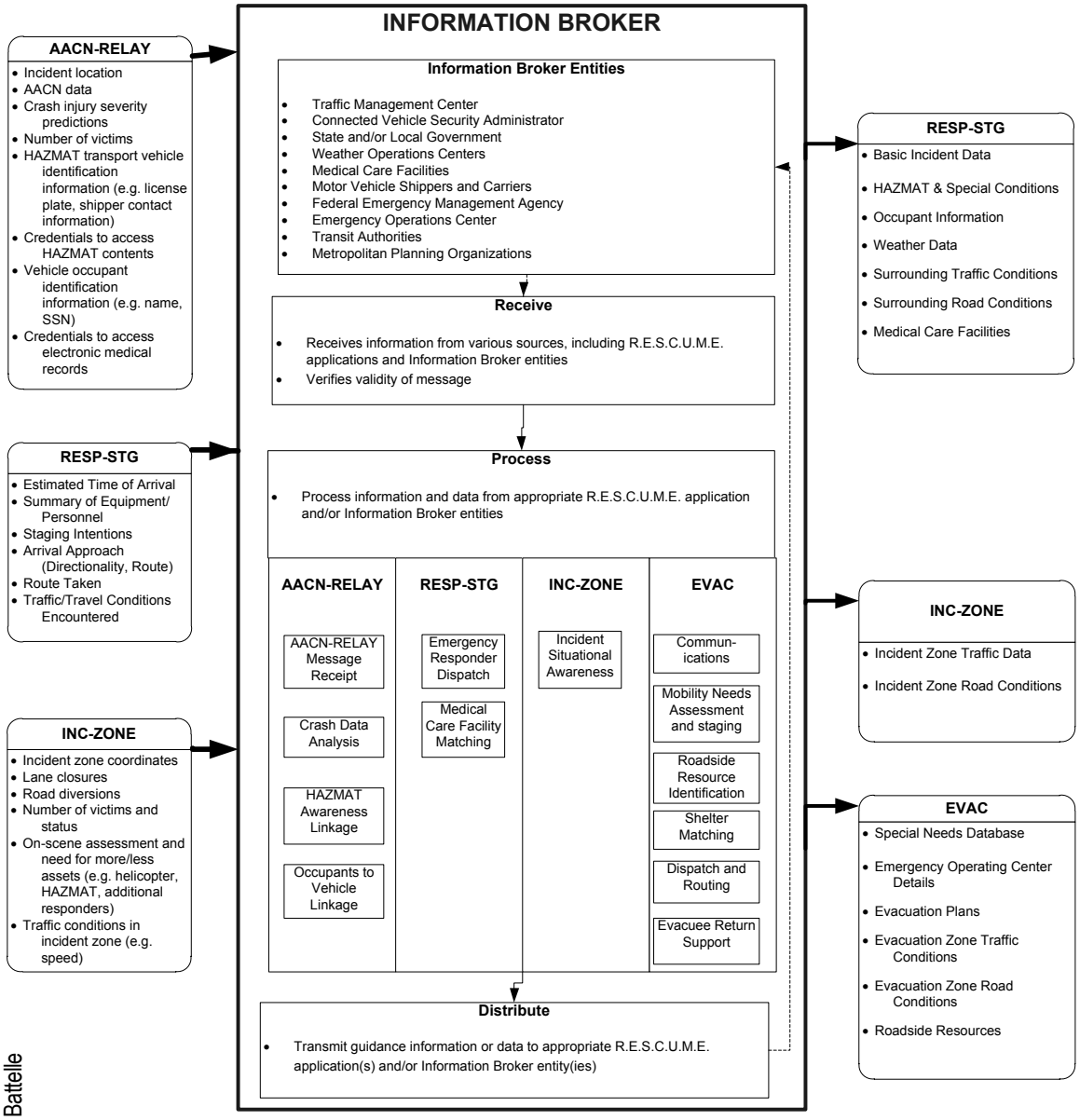

Figure 4-6. Information Broker Functional Architecture

Information Broker – Advanced Automatic Crash Notification Relay

The Information Broker has four processing functions related to the AACN-RELAY application. Collectively, these functions receive information from the AACN-RELAY application and are the processing entities. The four processing functions are:

AACN-RELAY Message Receipt

This function receives, processes, interprets, correlates, and de-conflicts information on the reported crash. The function looks for embedded information indicating there is medical documentation or HAZMAT electronic shipping papers/emergency response forms stored that are associated with a

vehicle occupant or the vehicle, respectively. This function then notifies the other functions accordingly and transfers the appropriate portions of the message to those other functions.

Crash Data Analysis

This function will process the captured crash data and will apply algorithms on the AACN data such as vehicle velocity change, PDOF, seat belt usage, crash with multiple impacts, and vehicle type to determine whether the crash data are consistent with a high risk of injury. The result will be packaged and distributed to the INC-ZONE and RESP-STG applications as well as other organizational entities.

HAZMAT Awareness Linkage

This function will process the information received from the AACN-RELAY application including an electronic version of the required HAZMAT shipping papers/emergency response forms or indications that a HAZMAT electronic shipping paper is on file with an organizational entity. This function then issues a request for the electronic shipping papers to that entity and upon receipt it is packaged and distributed to the INC-ZONE and RESP-STG applications. If the vehicle is a truck carrying HAZMAT cargo, the stored data will include information needed to access and retrieve electronic versions of the cargo's required HAZMAT shipping papers and emergency response information correlated to the vehicle and the trip.

Occupants to Vehicle Linkage

The Information Broker is assumed to include, in one of its organizational entities, information on the likely vehicle occupants and their medical conditions (Note: such information does not currently exist in a format that can be accessed, and a future database would likely require voluntary participation). Part of the AACN-RELAY message is expected to include information on the victims that the Information Broker function will use to match against this database and retrieve medical history on the victims that would enhance the emergency response. This information will be compiled and distributed to the INC-ZONE and RESP-STG applications.

Information Broker – Incident Scene Pre-Arrival Staging Guidance for Emergency Responders

The Information Broker has two processing functions related to the RESP-STG application:

Emergency Responder Dispatch

The Emergency Responder Dispatch function identifies the resources required to respond to a reported incident and then issues a request to dispatch those emergency responders to the appropriate organizational entity. The function analyzes the correlated incident information to determine the type(s) and number(s) of responders that should be dispatched. This incident information includes AACN crash data, crash injury severity predictions, and vehicle type, among others. For example, knowing the vehicle type is a tractor-trailer or a compact car enables the dispatcher to contact the appropriate towing and recovery agency before any emergency responders arrive, likely reducing clearance time.

Medical Care Facility Matching

The medical care facility matching function processes information from the RESP-STG and INC-ZONE applications to provide pre-alerts to medical care facilities (e.g., Level I trauma center) to advise them that incident victims will be arriving. This function interfaces with the Information Broker's medical care facility entity to access a medical care facility's bed availability and ability to stabilize and treat the injuries projected by the crash severity predictions originating from AACN-RELAY. The matching also considers the victims' medical records. This information on the medical care facility that

has the best ability to receive the incident victims is then distributed to the RESP-STG and INC-ZONE applications.

Information Broker – Incident Scene Work Zone Alerts for Drivers and Workers

The Information Broker has only one processing function related to INC-ZONE; Incident Situational Awareness. This processing function is responsible for processing the information received by the Information Broker from a variety of sources, filtering the information, and compiling and distributing real-time updates on the activities and conditions at and surrounding the incident zone to the INC-ZONE application and the RESP-STG application.

Information Broker – Emergency Communications for Evacuation

The Information Broker has six functions related to the EVAC application. As discussed above, most, if not all, of the components of this application will reside within the systems operated and maintained by the organizational entities that comprise the Information Broker. The functionality and activities that are conducted through these six functions are discussed above within the description of the R.E.S.C.U.M.E. Bundle Applications description.

Information Broker Functional Requirements, Performance Requirements and Verification Methods

Table 4-6 provides the functional requirements, associated performance requirements, high-level communication needs and verification methods for the Information Broker.

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
Information Broker Interfaces – Internal to R.E.S.C.U.M.E.						
IB-1	1.	The Information Broker shall provide a communications mechanism to enable secure and reliable transport of information between the Information Broker and the R.E.S.C.U.M.E applications, specifically, AACN-RELAY, RESP-STG, INC-ZONE, and EVAC.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Overarching need derived from all OS
Information Broker Interfaces – External to R.E.S.C.U.M.E.						
IB-2	2.	The Information Broker shall provide a communications mechanism to enable secure and reliable transport of information between the Information Broker and the non-R.E.S.C.U.M.E applications.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Overarching need derived from all OS

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-3	2.1.	The non-R.E.S.C.U.M.E applications shall include: • Traffic Management Centers • Connected Vehicle Security Administrators • State and/or Local Governments • Weather Operations Centers • Medical Care Facilities • Motor Vehicle Shippers and Carriers • Federal Emergency Management Agency • Emergency Operations Center • Transit Authorities • Metropolitan Planning Organizations	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Overarching need derived from all OS
IB-4	2.2.	The Information Broker shall be expandable to enable additional non-R.E.S.C.U.M.E. applications to contribute and receive information.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Analysis	Overarching need derived from all OS
Information Broker Functional Requirements – Receive Function						
IB-5	3.	The Information Broker Receive Function shall receive information from R.E.S.C.U.M.E. applications and Information Broker entities.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Overarching need derived from all OS
IB-6	4.	The Information Broker Receive Function shall verify the validity of the message to ensure the message originated from an approved source.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Overarching need derived from all OS

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
Information Broker Functional Requirements – Process Function						
IB-7	5.	The Information Broker Process Function shall process received information by invoking appropriate R.E.S.C.U.M.E. application functions that reside within the Information Broker domain.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Overarching need derived from all OS
IB-8	6.	The Information Broker Process Function shall establish a mechanism to uniquely identify each unique incident to enable subsequent processes to associate data to the correct incident.	NA	Internal to application	Analysis	Overarching need derived from all OS
Information Broker Functional Requirements – AACN-RELAY Message Receipt Function						
IB-9	7.	The AACN-RELAY Message Receipt Function shall receive the AACN message that was initiated by a crashed vehicle and sent via the AACN-RELAY Communications function.	NA	DSRC, Wi-Fi, Cellular	Demonstration	OS#2, Step 4
IB-10	7.1.	The AACN-RELAY Message Receipt Function shall analyze all AACN messages received over the previous 72 (TBD) hours to determine if the AACN message is unique.	NA	Internal to application	Analysis	Derived from OS#2, Step 13
IB-11	7.1.1.	If the AACN message has already been received, the AACN-RELAY Message Receipt Function shall delete the message.	NA	Internal to application	Demonstration	Derived from OS#2, Step 13

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-12	7.1.2.	If the AACN message is unique, the AACN-RELAY Message Receipt Function shall process the message contents and transfer the information to the appropriate functions.	NA	Internal to application, DSRC, Wi-Fi, Cellular	Demonstration	OS#2, Step 18
IB-13	7.1.2.1.	The AACN-RELAY Message Receipt Function shall identify the location of the incident and the responsible jurisdiction for dispatching responders to the incident.	NA	Internal to application, DSRC, Wi-Fi, Cellular,	Demonstration	OS#2, Step 18
IB-14	7.1.2.2.	The AACN-RELAY Message Receipt Function shall parse information classified as a “Crash Data” and associate it with a specific incident.	NA	Internal to application	Demonstration	OS#1, Step 19
IB-15	7.1.2.2.1.	The AACN-RELAY Message Receipt Function shall transfer information classified as “Crash Data” to the AACN-RELAY Crash Data Analysis Function for analysis.	NA	Internal to application	Demonstration	OS#1, Step 19
IB-16	7.1.2.3.	The AACN-RELAY Message Receipt Function shall parse information classified as “Medical” and associate it with a specific incident.	NA	Internal to application	Demonstration	OS#1, Step 20
IB-17	7.1.2.3.1.	The AACN-RELAY Message Receipt Function shall transfer information classified as “Medical” to the AACN-RELAY Occupants to Vehicle Linkage Function for analysis.	NA	Internal to application	Demonstration	OS#1, Step 20

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-18	7.1.2.4.	The AACN-RELAY Message Receipt Function shall parse information classified as a "HAZMAT" and associate it with a specific incident.	NA	Internal to application	Demonstration	OS#4, Steps 7-8
IB-19	7.1.2.4.1.	The AACN-RELAY Message Receipt Function shall transfer information classified as "HAZMAT" to the AACN-RELAY HAZMAT Awareness Linkage Function for analysis.	NA	Internal to application	Demonstration	OS#4, Steps 7-8
Information Broker Functional Requirements – AACN-RELAY Crash Data Analysis Function						
IB-20	8.	The AACN-RELAY Crash Data Analysis function shall receive information classified as "Crash Data" from the AACN-RELAY Message Receipt function.	NA	Internal to application	Demonstration	OS#1, Step 19
IB-21	9.	The AACN-RELAY Crash Data Analysis function shall apply algorithms to the available data to develop an injury severity prediction score.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	OS#1, Step 19
IB-22	9.1.	The AACN-RELAY Crash Data Analysis function shall correlate the injury severity score with the probable injuries predicted to have been sustained by the vehicle occupants.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	OS#1, Step 19
IB-23	9.2.	The AACN-RELAY Crash Data Analysis function shall compile and send the information to the Information Broker Distribute function.	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#1, Step 19

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-24	9.2.1.	The information shall be sent to the following functions: • RESP-STG Emergency Responder Dispatch Function in the Information Broker	The required information shall be sent to the identified function within two (2) minutes of the AACN-RELAY Crash Data Analysis Function receiving information classified as "Crash Data".	DSRC, Wi-Fi, Cellular	Test	OS#1, Step 19
IB-25	9.2.2.	The information should be sent to Medical Care Facilities within a configurable distance from the incident scene.	The required information shall be sent to the identified function within two (2) minutes of the AACN-RELAY Crash Data Analysis Function receiving information classified as "Crash Data".	Wi-Fi, Cellular	Test	Derived from OS#1, Step 19

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
Information Broker Functional Requirements – AACN-RELAY HAZMAT Awareness Linkage						
IB-26	10.	The AACN-RELAY HAZMAT Awareness Linkage function shall receive information classified as "HAZMAT" from the AACN-RELAY Message Receipt function.	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#4, Steps 7-8
IB-27	10.1.	The information classified as "HAZMAT" shall include a HAZMAT Identification Passcode and identification of the Information Broker entity responsible for maintaining the required shipping papers on file (identified herein as the Information Broker HAZMAT Entity).	NA	Internal to application	Demonstration	Derived from OS#4, Steps 7-8
IB-28	10.2.	The AACN-RELAY HAZMAT Awareness Linkage function shall send the HAZMAT Identification Passcode to the Information Broker HAZMAT Entity.	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#4, Steps 7-8
IB-29	10.3.	The AACN-RELAY HAZMAT Awareness Linkage function shall receive back from the Information Broker HAZMAT Entity the following information: • Identification of the hazardous material present in the crashed vehicle • Advisory information to ensure the safety of emergency responders as they approach and provide care at the incident scene.	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#4, Steps 7-8

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-30	11.	The AACN-RELAY HAZMAT Awareness Linkage function shall compile and send the information to the Information Broker Distribute function.	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#4, Steps 7-8
IB-31	11.1.	The information shall be sent to the following function OSs: • RESP-STG Emergency Responder Dispatch in the Information Broker	The required information shall be sent to the identified function within two (2) minutes of the AACN-RELAY HAZMAT Awareness Linkage Function receiving information classified as “HAZMAT”.	DSRC, Wi-Fi, Cellular	Test	Derived from OS#4, Steps 7-8

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
Information Broker Functional Requirements – AACN-RELAY Occupants to Vehicle Linkage						
IB-32	12.	The AACN-RELAY Occupants to Vehicle Linkage function shall receive information classified as "Medical" from the AACN-RELAY Message Receipt function that includes credentials for accessing medical information about the vehicle occupants. *Note: these credentials are referred to as an Occupant Identification Passcode in this document.*	NA	DSRC, Wi-Fi, Cellular	Demonstration	OS#1, Step 20
IB-33	12.1.	The AACN-RELAY Occupants to Vehicle Linkage function shall send the Occupant Identification Passcode to the TBD Information Broker entity.	NA	DSRC, Wi-Fi, Cellular	Demonstration	OS#1, Step 20
IB-34	13.	The AACN-RELAY Occupants to Vehicle Linkage function shall receive back from the TBD Information Broker entity the following information: • Identification of the vehicle occupants • Identification of signification medical conditions of each occupant that would influence critical care decisions made by emergency responders	The information shall be protected per HIPPA requirements.	DSRC, Wi-Fi, Cellular	Demonstration, Analysis	Derived from OS#1, Step 19

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-35	14.	The AACN-RELAY Occupants to Vehicle Linkage function shall compile and send the information to the Information Broker Distribute function.	The required information shall be sent to the identified function within two (2) minutes of the AACN-RELAY Occupants to Vehicle Linkage Function receiving information classified as "Medical".	DSRC, Wi-Fi, Cellular	Test	Derived from OS#1, Step 19
Information Broker Functional Requirements – Process Function: RESP-STG						
Information Broker Functional Requirements – RESP-STG Emergency Responder Dispatch Function						
IB-36	15.	The Emergency Responder Dispatch function shall identify the necessary resources required to respond to a reported incident.	NA	DSRC, Wi-Fi, Cellular	Demonstration	OS#5, Step 24
IB-37	15.1.	Data from the following information sources shall be available to determine the types of emergency responders necessary: • AACN-RELAY Crash Data Analysis Function • AACN message	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#4, Steps 7-8

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-38	15.2.	The Emergency Responder Dispatch function shall access the AACN-RELAY HAZMAT Awareness Linkage Function in the Information Broker to determine if hazardous materials are expected to be present at the incident scene.	NA	DSRC, Wi-Fi, Cellular	Demonstration	OS#4, Steps 7-8
IB-39	15.2.1.	If hazardous materials are expected to be present, the Emergency Responder Dispatch function shall access the AACN-RELAY HAZMAT Awareness Linkage Function to identify the specific materials and related safety measures that are needed.	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#4, Steps 7-8
IB-40	16.	The Emergency Responder Dispatch function shall issue a request to dispatch the necessary emergency responders to the appropriate Information Broker's Dispatch entities.	NA	Wi-Fi, Cellular, Landline	Demonstration	OS#5, Step 22
IB-41	16.1.	Dispatch decisions should be made with the objective to minimize the clearance time of an incident from the roadway.	NA	NA	Demonstration	Derived from OS#5, Step 24

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
Information Broker Functional Requirements – RESP-STG Medical Care Facility Matching Function						
IB-42	17.	The Medical Care Facility Matching function shall process available data and develop a list of medical care facilities meeting the following criteria: • Equipped with the necessary technology and expertise to treat a victim • Available space • Within a selectable distance from an incident scene	NA	NA	Demonstration	OS#5, Step 29
IB-43	17.1.	Available data shall include data from the following resources: • Crash-severity and injury predictions via the AACN-RELAY Crash Data Analysis Function in the Information Broker • Victim details and location confirmation from on-scene emergency responders via the RESP-STG Emergency Responder Status Update Function • Medical facility capability (e.g. trauma level), space availability, and location from the Information Broker's Medical Care Facility entity.	NA	NA	Demonstration	OS#1, Step 19, OS#1, Step 20

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-44	17.1.1.	The Information Broker's Medical Care Facility entity shall interact with participating medical care facilities to maintain access to current space availability conditions.	The current space availability at a medical care facility shall be accurate to within 10% at the time a status update is requested by the Information Broker's Medical Care Facility entity	NA	Analysis	Derived from OS#5, Step 29
IB-45	18.	The Medical Care Facility Matching function shall enable the User to select a medical care facility as the desired destination.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 29
IB-46	18.1.	The Medical Care Facility Matching function shall invoke the RESP-STG Dynamic Routing Function to predict the travel time to the destination and communicate that estimate to the User.	NA	DSRC, Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 29
IB-47	18.1.1.	If the travel time is not acceptable to the User, then the Medical Care Facility Matching function shall allow the User to select a different destination.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 29

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-47	18.2.	The Medical Care Facility Matching function shall provide the selected medical care facility with advanced notice that incident victims are enroute.	The notice shall be sent to the medical care facility at least 10 minutes prior to arrival at the medical care facility, unless the travel time from the incident scene to the medical care facility is 10 minutes or less.	Wi-Fi, Cellular, Landline	Test	Derived from OS#5, Step 29
IB-48	18.2.1.	The Medical Care Facility Matching function shall provide the destination medical care facility with victim identification information to enable the medical care facility to access the victim's medical records prior to arrival.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#5, Step 29
IB-49	18.2.1.1.	The mechanism shall be HIPPA compliant.	The information shall be protected per HIPPA requirements.	Wi-Fi, Cellular	Demonstration, Analysis	Derived from OS#5, Step 29

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
Information Broker Functional Requirements – Process Function: INC-ZONE						
Information Broker Functional Requirements – INC-ZONE Incident Situational Awareness Function						
IB-50	19.	The INC-ZONE Incident Situational Awareness Function shall process information available from the Information Broker entities into a format that can be communicated to the INC-ZONE application and RESP-STG application when requested by those applications.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#4, Step 9
IB-51	20.	The INC-ZONE Incident Situational Awareness Function shall filter and compile the requested information based on User-configurable parameters to enable more than one perspective of the incident scene.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#4, Step 9
IB-52	20.1.	A User–configurable setting shall include selecting the distance of the information source from the incident scene.	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#4, Step 9
IB-53	21.	The INC-ZONE Incident Situational Awareness Function shall transmit the processed information to the INC-ZONE application and RESP-STG application when requested by those applications	NA	Wi-Fi, Cellular	Demonstration	Derived from OS#4, Step 9

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
IB-54	22.	The INC-ZONE Incident Situational Awareness Function shall transmit high priority alerts to the INC-ZONE application and RESP-STG application when the Information Broker entities request such an alert be sent.	The high priority alert shall be sent within five (5) seconds of a request being received.	Wi-Fi, Cellular	Demonstration	Derived from OS#4, Step 9
Information Broker Functional Requirements – Process Function: EVAC						
IB-55	23.	The specific requirements are covered within the EVAC Application	NA	NA	NA	See EVAC
Information Broker Functional Requirements – EVAC Mobility Needs Assessment and Staging Function						
IB-56	24.	The specific requirements are covered within the EVAC Application	NA	NA	NA	See EVAC
Information Broker Functional Requirements – EVAC Roadside Resource Identification Function						
IB-57	24.1.1.	The specific requirements are covered within the EVAC Application	NA	NA	NA	See EVAC
Information Broker Functional Requirements – EVAC Shelter Matching Function						
IB-58	25.	The specific requirements are covered within the EVAC Application	NA	NA	NA	See EVAC
Information Broker Functional Requirements – EVAC Dispatch and Routing Function						
IB-59	26.	The specific requirements are covered within the EVAC Application	NA	NA	NA	See EVAC
Information Broker Functional Requirements – EVAC Evacuee Return Support Function						
IB-60	27.	The specific requirements are covered within the EVAC Application	NA	NA	NA	See EVAC

Table 4-6. Information Broker Functional Requirements, Performance Requirements and Verification Methods (Continued)

Requirement Unique Identifier	Requirement Outline Designator	Functional Requirement Description	Performance Requirement Description	High Level Communication Needs	Verification Method	CONOPS Operational Scenario Reference
Information Broker Functional Requirements – Distribute Function						
IB-61	28.	The Information Broker Distribute function shall compile all information that has been associated with a specific incident or incident scene by other functions within the Information Broker.	NA	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Demonstration	Overarching need derived from all OS
IB-62	28.1.	The Information Broker Distribute function shall apply algorithms to determine the appropriate recipients of the compiled information.	NA	NA	Demonstration	Overarching need derived from all OS
IB-63	28.2.	The Information Broker Distribute function shall disseminate the compiled information to the recipients who are determined to require the information.	Any information protected per HIPPA shall be disseminated only to the approved recipients.	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Analysis	Overarching need derived from all OS
IB-64	28.3.	The Information Broker Distribute function shall host the compiled information and permit access for R.E.S.C.U.M.E applications and Information Broker entities that request the information and have the required credentials.	Any information protected per HIPPA shall be disseminated only to the approved recipients.	DSRC, Wi-Fi, Cellular, Radio and Television Broadcasts	Analysis	Overarching need derived from all OS

Source: Battelle

Chapter 5 Traceability Matrices

This section provides a mapping of user needs to requirements that have been developed to define the individual R.E.S.C.U.M.E. applications.

AACN-RELAY

AACN-RELAY requirements are included in this document for completeness and consistency. However, USDOT does not plan to pursue development of AACN-RELAY during subsequent phases of the DMA Program.

AACN-RELAY Stakeholder Needs

User needs that were considered in the development of requirements for AACN-RELAY are provided in Table 5-1.

Table 5-1. AACN User Needs

User Need ID	AACN-RELAY User Need
AA-1	Improve the detection of crashes in rural areas.
AA-2	Improve crash-reporting capabilities in rural areas.
AA-3	Provide location of crash vehicles in rural areas.
AA-4	Enhance emergency responders analytical and decisions making capabilities by capturing additional data from crash vehicles such as vehicle occupancy, change in forward crash speed, crash victim seat belt usage and airbag status.
AA-5	Provide crash victim data such as medical records in a secure environment.
AA-6	Ensure that exchange and use of medical data complies with HIPPAA requirements.
AA-7	Provide emergency responders with access to TSP data such as vehicle location, direction of impact and airbag status in order to facilitate an appropriate response.
AA-8	Enable easy access to electronic shipping papers for commercial vehicles in order to initiate an appropriate emergency response.

Source: Battelle

AACN-RELAY Traceability Matrix

Table 5-2 relates identified user needs to specific AACN-RELAY requirements.

Table 5-2. AACN Traceability Matrix

Requirement ID	AACN-RELAY Functional Requirement Description	User Need ID
AR-1	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and the Information Broker using a reliable transport mechanism.	AA-1, AA-2
AR-2	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and RESP-STG using a reliable transport mechanism.	AA-1, AA-2
AR-3	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and INC-ZONE using a reliable transport mechanism.	AA-1, AA-2
AR-4	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and EVAC using a reliable transport mechanism.	AA-1, AA-2
AR-5	The AACN-RELAY Communications function shall receive and transmit data between AACN-RELAY and CV-enabled vehicles using DSRC radio	AA-1, AA-2
AR-6	The AACN-RELAY Communications shall receive and transmit data between AACN-RELAY and roadside hotspots using a reliable transport mechanism.	AA-1, AA-2
AR-7	The AACN-RELAY Communications Function shall initiate and populate an augmented AACN Message after receiving notification of a vehicle crash from the AACN-RELAY Crash Detection Function.	AA-1, AA-2
AR-8	The augmented AACN Message shall be populated with: • Change in velocity • Vehicle orientation • Airbag status • Latitude and Longitude coordinates of crash vehicle relative to the WGS84 datum • Crash date and time (local) • Timestamp of AACN-Message generation • Augmented AACN-Message ID	AA-3, AA-4
AR-9	The AACN-RELAY Communications Function shall generate an AACN-Message ID that uniquely identifies the message from other augmented AACN-Messages	AA-1, AA-2
AR-10	The augmented AACN-Message timestamp shall be in a format that can be correlated to UTC (Coordinated Universal Time) time	AA-1, AA-2

Table 5-2. AACN Traceability Matrix (Continued)

Requirement ID	AACN-RELAY Functional Requirement Description	User Need ID
AR-11	The augmented AACN-Message should be populated with the following information to assist emergency responders in assessing the severity of the crash on the vehicle occupants: • Crash vehicle principal direction of force • Crash vehicle seat-belt use • Crash vehicle occupancy • Crash vehicle call-back number • Crash vehicle rollover details • Crash vehicle injury severity predictions • Crash vehicle occupant intrusion data (e.g. how far a door is protrudes into the passenger compartment) • Crash vehicle video and audio feeds	AA-3, AA-4
AR-12	The augmented AACN-Message should be populated with the following information to assist emergency responders in understanding any pre-existing medical conditions of the occupants: • Credentials to access occupants medical records	AA-5
AR-13	The augmented AACN-Message should be populated with the following information to assist emergency responders in understanding the vehicle contents or unusual precautions that should be followed when approaching the vehicle: • HAZMAT transportation vehicle identification • Vehicle license plate number • Vehicle shipping company contact phone number • Credentials to access HAZMAT contents • Vehicle identifying information (make, model, color, year)	AA-7, AA-8
AR-14	The AACN-RELAY Communications Function shall attempt to transmit the augmented AACN Message using Cellular Service to the Information Broker	AA-1, AA-2
AR-15	The cellular transmission will be secure.	AA-1, AA-2
AR-16	The cellular transmission will include receipt acknowledgement functionality.	AA-1, AA-2
AR-17	The AACN-RELAY Communications Function will receive a Cellular Transmission Status Message indicating the status of the transmission of the augmented AACN-Message via cellular communications.	AA-1, AA-2
AR-18	The Cellular Transmission Status Message will consist of the AACN-RELAY message contents and a field that provides the following status of the cellular transmission: • Successful • Unsuccessful	AA-1, AA-2
AR-19	The AACN-RELAY Communications Function shall transmit the augmented AACN-Message through the DSRC radio for broadcast if the Cellular Transmission Status Message field indicates “Unsuccessful” transmission.	AA-1, AA-2
AR-20	The DSRC radio will properly authenticate and package the augmented AACN-Message.	AA-1, AA-2

Table 5-2. AACN Traceability Matrix (Continued)

Requirement ID	AACN-RELAY Functional Requirement Description	User Need ID
AR-21	The AACN-RELAY Communications Function shall transmit information compatible with the Vehicular Emergency Data Set (VEDS).	AA-1, AA-2
AR-22	The AACN-RELAY Communications Function shall immediately broadcast the "Distressed Message Received" message when directed by the AACN-RELAY Distress Message Receipt Function.	AA-1, AA-2
AR-23	The AACN-RELAY Crash Detection Function will use the OEM AACN systems to determine when a vehicle is involved in a crash.	AA-1, AA-2
AR-24	The AACN-RELAY Crash Detection Function will send the AACN-RELAY Communications Function data from the crashed vehicle's onboard Advanced Automatic Collision Notification (AACN) system when the AACN system determines the vehicle has crashed.	AA-1, AA-2
AR-25	The AACN-RELAY Crash Detection Function will send the AACN-RELAY Communications Function the following items from the AACN system when the AACN-RELAY Crash Detection Function determines a crash has occurred: • Change in velocity • Vehicle orientation • Airbag status (Deployed/not-deployed)	AA-4
AR-26	The AACN-RELAY Driver Notification Function shall receive notification from the AACN-RELAY Communications Function that an augmented AACN Message has been received directly from a crashed vehicle.	AA-1, AA-2
AR-27	The AACN-RELAY Driver Notification Function shall notify the driver of a relay vehicle when an augmented AACN-Message is received directly from a crashed vehicle.	AA-1, AA-2
AR-28	The notification shall consist of audible and visual alerts indicating an augmented AACN-Message has been received from a crashed vehicle.	AA-1, AA-2
AR-29	The AACN-RELAY Driver Notification Function shall include an option for the User to disable or enable the visible and audible notifications.	AA-1, AA-2
AR-30	The notification should identify the distance to the crashed vehicle	AA-1, AA-2, AA-4
AR-31	The AACN-RELAY Driver Notification Function shall receive notification from the AACN-RELAY Communications Function that an augmented AACN Message has been received directly from a crashed vehicle.	AA-1, AA-2
AR-32	The AACN-RELAY Distress Message Receipt Function shall compare the position of the relay vehicle to that of the crashed vehicle and determine if they are within the range of the DSRC radio.	AA-1, AA-2
AR-33	The location of the crashed vehicle will be included in the AACN Message contents.	AA-1, AA-2
AR-34	The location of the relay vehicle will be obtained from onboard GPS.	AA-1, AA-2
AR-35	The AACN-RELAY Distress Message Receipt Function shall generate a "Distressed Message Received" message.	AA-1, AA-2

Table 5-2. AACN Traceability Matrix (Continued)

Requirement ID	AACN-RELAY Functional Requirement Description	User Need ID
AR-36	The AACN-RELAY Distress Message Receipt Function shall send the "Distressed Message Received" message to the AACN-RELAY Communications Function with instructions for it to be immediately broadcast using the DSRC radio. *Note: the intention is to deliver to the crashed vehicle an acknowledgement that its distress message was received. However, this requirement only requires that the acknowledgement message be sent, it does not require that the acknowledgement message be received by the crashed vehicle.*	AA-1, AA-2
AR-37	The AACN-RELAY Termination Function shall be initiated when the AACN-RELAY Communications Function conveys to the Relay Vehicle that it has received an augmented AACN Message	AA-1, AA-2
AR-38	The AACN-RELAY Termination Function shall maintain a persistent, on-board, local database of previously received augmented AACN Messages.	AA-1, AA-2
AR-39	The database shall be cleared of all AACN Message data.	AA-1, AA-2
AR-40	The AACN-RELAY Termination Function shall compare a received augmented AACN-Message to the Received AACN Message Storage Database and compare all available elements of the received AACN-Message to their corresponding elements in the Received AACN-Message Storage to determine the whether to classify the augmented AACN-Message as "Old" or "New".	AA-1, AA-2
AR-41	The AACN-RELAY Termination Function shall classify the augmented AACN-Message as "Old" if the unique ID of the received AACN-Message is identical to its corresponding element in the Received AACN-Message Storage Database.	AA-1, AA-2
AR-42	The AACN-RELAY Termination Function shall classify the augmented AACN-Message as a "New" message if this message is not already contained in the vehicle's local Received AACN-Message Storage Database.	AA-1, AA-2
AR-43	If the augmented AACN Message is "New", then the AACN-RELAY Crash Detection Function shall perform the following operations:	AA-1, AA-2
AR-44	The AACN-RELAY Termination Function shall inform the AACN-RELAY Driver Notification Function that a "New" augmented AACN Message has been received.	AA-1, AA-2
AR-45	The AACN-RELAY Termination Function shall inform the AACN-RELAY Distress Message Function that a "New" augmented AACN Message has been received.	AA-1, AA-2
AR-46	The AACN-RELAY Termination Function shall set the "handshake" field for this augmented AACN Message to 1.	AA-1, AA-2
AR-47	If the augmented AACN Message is classified "Old", then the AACN-RELAY Termination Function shall perform the following operations:	AA-1, AA-2
AR-48	The AACN-RELAY Crash Detection Function shall increment the "handshake" field by 1.	AA-1, AA-2
AR-49	The AACN-RELAY Termination Function shall store the augmented AACN Message and the "handshake" field value.	AA-1, AA-2

Table 5-2. AACN Traceability Matrix (Continued)

Requirement ID	AACN-RELAY Functional Requirement Description	User Need ID
AR-50	The AACN-Relay Termination Function shall extract from the processed augmented AACN-message the following information: • Latitude and Longitude coordinates of crash vehicle relative to the WGS84 datum • Crash date and time (local) • Number of message handshakes	AA-3
AR-51	The AACN-RELAY Termination Function shall obtain the current position of the Relay Vehicle in latitude and longitude relative to the WGS84 datum.	AA-1, AA-2
AR-52	The AACN-RELAY Termination Function shall terminate AACN Message Relay Based on the termination criterion. *See AR-53 for criterion.*	AA-1, AA-2
AR-53	The AACN-RELAY Termination Function shall convey the AACN Message to the AACN-RELAY Communications Function with instruction to relay the AACN message if any of the following criterion are satisfied: • The number of handshakes is between 0 and 5, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is less than 1 mile; • The number of handshakes is between 0 and 5, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is between 1 and 10 miles, inclusive; • The number of handshakes is between 0 and 5, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is greater than 10 miles; • The number of handshakes is between 6 and 15, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is between 1 and 10 miles, inclusive; • The number of handshakes is greater than 16, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is less than 1 mile. *Note: The values included are an initial suggested threshold. Further data could be collected to support future implementation decisions*	AA-1, AA-2
AR-54	The AACN-RELAY Termination Function shall convey the AACN Message to the AACN-RELAY Communications Function with instructions to stop relaying the AACN Message if any of the following criterion are satisfied: • The number of handshakes is between 6 and 15, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is less than 1 mile; • The number of handshakes is between 6 and 15, inclusive and the distance between the Relay Vehicle and the Crash Vehicle is greater than 10 miles; • The number of handshakes is greater than or equal to 16, and the distance between the Relay Vehicle and the Crash Vehicle is between 1 and 10 miles, inclusive; • The number of handshakes is greater than or equal to 16, and the distance between the Relay Vehicle and the Crash Vehicle is greater than 10 miles.	AA-1, AA-2

Table 5-2. AACN Traceability Matrix (Continued)

Requirement ID	AACN-RELAY Functional Requirement Description	User Need ID
AR-55	The AACN-Relay Termination Function shall write the contents of the AACN-Message to the Received AACN-Message Storage Database and include instructions on whether the relaying of the message should be terminated or should continue.	AA-1, AA-2
AR-56	The AACN-RELAY Termination Function should include a manual means to stop transmission of the AACN Message from the crashed vehicle. *Note: this would enable an on-scene emergency responder to stop additional AACN Messages from being sent by the crashed vehicle.*	AA-1, AA-2

Source: Battelle

RESP-STG

RESP-STG Stakeholder Needs

User needs that were considered in the development of requirements for RESP-STG are provided in Table 5-3.

Table 5-3. RESP-STG User Needs

User Need ID	RESP-STG User Need
RE-1	Enhance emergency responder's analytical and decision-making capabilities to foster safe and expedient responses to crashes.
RE-2	Improve emergency responders situational awareness while they are en-route by providing additional data in-vehicle including satellite imagery; GIS map graphics, camera images, current weather data, traffic conditions, dynamic routing guidance, sensor readings, and real-time modeling outputs.
RE-3	Facilitate more expedient clearance of incidents.
RE-4	Enhance coordination among emergency responders across multiple jurisdictions and disciplines.
RE-5	Generate route guidance instructions to facilitate more expedient arrival and departure of response vehicles from the crash site.
RE-6	Generate staging plans that enhance the safety of crash victims, emergency responders and the traveling public, and that minimize traffic impacts and enhance mobility.
RE-7	Provide the ability to determine what resources have been dispatched, their location and anticipated arrival time.
RE-8	Enhance responder and civilian safety by providing and distributing additional information during HAZMAT incidents.

Source: Battelle

RESP-STG Traceability Matrix

Table 5-4 relates identified user needs to specific RESP-STG requirements.

Table 5-4. RESP-STG Traceability Matrix

Requirement ID	RESP-STG Functional Requirement Description	User Need ID
RS-1	The RESP-STG Communications function shall receive and transmit data between RESP-STG and INC-ZONE using a reliable transport mechanism.	RE-1, RE-4
RS-2	The RESP-STG Communications function shall receive and transmit data between RESP-STG and EVAC using a reliable transport mechanism.	RE-1, RE-4
RS-3	The RESP-STG Communications function shall receive and transmit data between RESP-STG and the Information Broker using a reliable transport mechanism.	RE-1, RE-4
RS-4	The RESP-STG Visual Display Function shall develop a spatial representation of the incident zone from information received from the RESP-STG functions and present information on a graphical display per guidance in ATIS/CVO (FHWA-RD-98-057), or equivalent.	RE-1, RE-7
RS-5	The RESP-STG Visual Display Function shall permit a System Administrator to establish multiple Master displays of selected information for customizable purposes and assign these Master Display unique labels. *Note: examples could include a Master Display for a speeding violation, a minor traffic incident, and an accident involving HAZMAT vehicle.*	RE-1, RE-7
RS-6	The RESP-STG Visual Display Function shall permit an authorized User to add or remove selected information from the display by manually turning on or off a unique layer.	RE-1, RE-7
RS-7	The locations of all on-scene responder assets shall be included on the display as a configurable layer.	RE-1, RE-5, RE-7
RS-8	The RESP-STG Visual Display Function should present the visual information on a platform that can be carried by a single person when on an active incident scene without the need for an external power connection.	RE-1
RS-9	The RESP-STG Visual Display Function shall provide an alert when any of the following conditions are met: • New information is received from any of the actively displayed information sources • A high priority message is received from any of the information sources not selected for display	RE-1
RS-10	The alert shall include a visual indication that information has been updated or is available	RE-1
RS-11	The alert should include an audible indication that information has been updated	RE-1

Table 5-4. RESP-STG Traceability Matrix (Continued)

Requirement ID	RESP-STG Functional Requirement Description	User Need ID
RS-12	The RESP-STG Visual Display Function shall allow the User to choose to immediately refresh the information from a selected information source.	RE-1
RS-13	The RESP-STG Vehicle and Equipment Staging Function shall consolidate information from available sources into a single viewing platform for display to the User though the Visual Display Function.	RE-1, RE-2
RS-14	The RESP-STG Vehicle and Equipment Staging Function shall access through the Information Broker the following fixed information assets: • Geographic Information System overlays • Road maps • Topography maps • Database of still photographs • Database of satellite imagery • Video cameras	RE-1, RE-2
RS-15	The RESP-STG Vehicle and Equipment Staging Function shall access through the Information Broker the following variable information assets: • HAZMAT plume modeling and identification of impacted roads • Type and position of emergency responder vehicles at an incident scene • Locations of medical care facilities • Weather data	RE-8
RS-16	The RESP-STG Vehicle and Equipment Staging Function shall access through the Information Broker the following traffic information assets: • Current traffic speed	RE-2
RS-17	Based on the available data, the RESP-STG Vehicle and Equipment Staging Function shall suggest to an emergency responder who has not yet arrived on-scene: • What direction to approach the incident scene • Where to stage the response vehicle	RE-6
RS-18	The RESP-STG Vehicle and Equipment Staging Function shall detect the vehicle location using GPS and update system representations.	RE-6, RE-8
RS-19	The RESP-STG Vehicle and Equipment Staging Function shall show the locations and estimated time of arrival at the incident scene of enroute emergency responders.	RE-8
RS-20	The RESP-STG Dynamic Routing Function shall provide real-time navigation instructions from a selected starting point to a selected destination using real-time and predictive algorithms.	RE-3, RE-5
RS-21	The navigation instructions shall route around unplanned (but previously reported) road closures.	RE-3, RE-5
RS-22	The navigation instructions shall include options to select roads that are reported to have been cleared of snow by snowplow reports.	RE-3, RE-5

Table 5-4. RESP-STG Traceability Matrix (Continued)

Requirement ID	RESP-STG Functional Requirement Description	User Need ID
RS-23	The navigation instructions should use real-time traffic volume data to determine travel times and account for predicted congestion of traffic near an incident scene as more vehicles approach the incident scene over time.	
RS-24	The RESP-STG Dynamic Routing Function shall access video feeds from assets in and around an incident zone, including: • Transportation Manager Center closed circuit television (CCTV) • Traffic helicopters or airplanes • Emergency responder vehicles	RE-3, RE-5
RS-25	The video feeds shall be processed to assess traffic congestion and the results shall be incorporated into the travel time estimates.	RE-2, RE-3, RE-5
RS-26	The navigation instructions shall include options to avoid roads that are predicted to be impacted by hazardous fumes at the time of passage. *Note: HAZMAT plume modeling and identification of impacted roads will be performed by the Information Broker.*	RE-2
RS-27	The RESP-STG Dynamic Routing Function shall receive from the Information Broker a list of medical facilities capable of treating the injuries sustained by the incident victims that are within a customizable distance from the incident scene.	RE-5
RS-28	The RESP-STG Dynamic Routing Function shall enable information about the incident victim(s) to be sent to the Information Broker for assessment of the recommended, available medical care facilities.	RE-5
RS-29	The RESP-STG Dynamic Routing Function shall estimate travel times to the listed medical facilities.	RE-5
RS-30	The list shall be sortable and shall include the following information regarding the medical facility: • Triage level capability • Confirmation of space available • Distance from the incident scene • Estimated travel time	RE-5
RS-31	The RESP-STG Dynamic Routing Function shall provide navigation instructions to the medical facility selected by the User.	RE-5
RS-32	The RESP-STG Emergency Responder Status Reporting Function shall maintain a continuously updated inventory of all information sources available at the incident scene and shall provide access to those assets when requested via the Information Broker.	RE-5

Table 5-4. RESP-STG Traceability Matrix (Continued)

Requirement ID	RESP-STG Functional Requirement Description	User Need ID
RS-33	The RESP-STG Emergency Responder Status Reporting Function shall transmit the following traffic- or emergency-responder-related information to the Information Broker when instructed: • Estimated Time of Arrival Summary of Equipment/Personnel • Staging Intentions • Arrival Approach (Directionality, Route) • Route Taken • Traffic/Travel Conditions Encountered	RE-5
RS-34	The RESP-STG Emergency Responder Status Reporting Function shall transmit the following traffic-related information to the Information Broker when instructed: • Lane closure information in the proximity of the incident zone • Recommended traffic diversion locations	RE-1, RE-2
RS-35	The RESP-STG Emergency Responder Status Reporting Function should transmit the following traffic-related information to the Information Broker when instructed: • Traffic helicopters or airplanes • Emergency responder vehicles	RE-1, RE-2
RS-36	The RESP-STG Emergency Responder Status Reporting Function shall transmit the following emergency-response-related to the Information Broker when instructed: • Types of on-scene emergency vehicles • Locations of on-scene emergency vehicles • Emergency responder vehicles onboard dash-cams • HAZMAT plume location • Incident victim details	RE-1, RE-2
RS-37	When enroute to an incident scene, the RESP-STG Emergency Responder Status Reporting Function shall report traffic-related information to the Information Broker to assess the traffic flow encountered by the emergency responder. The information will include: • Speed • Heading • Route to destination • Estimated time of arrival, reported in local time	RE-1, RE-6, RE-7
RS-38	The RESP-STG Emergency Responder Status Reporting Function shall provide the Information Broker access to any of the available information assets when requested.	RE-1, RE-6, RE-7
RS-39	The number of information assets that can be viewed simultaneously shall be TBD, depending upon the types of feeds or information being transmitted.	RE-1, RE-6, RE-7

Source: Battelle

INC-ZONE

INC-ZONE Stakeholder Needs

User needs that were considered in the development of requirements for INC-ZONE are provided in Table 5-5.

Table 5-5. INC-ZONE User Needs

User Need ID	INC-ZONE User Need
IN-1	Enhance crash scene or work zone safety by alerting responders about encroaching vehicles.
IN-2	Enhance crash scene safety by warning motorists via in-vehicle device that they impeding on a crash scene or other work zone operation.
IN-3	Enhance crash scene safety by providing motorists with margining and speed guidance via in-vehicle devices.
IN-4	Facilitate the exchange of information to other users such as TMC operators to enhance crash scene or work zone safety.
IN-5	Facilitate the exchange of information to other users such as TMC operators to enhance mobility in proximity to crash scenes and work zones.
IN-6	Provide and receive additional information that is a critical input into developing staging plans.
IN-7	Provide and receive data that is a critical input into route guidance functions.

Source: Battelle

INC-ZONE Traceability Matrix

Table 5-6 relates identified user needs to specific INC-ZONE requirements.

Table 5-6. INC-ZONE Traceability Matrix

Requirement ID	INC-ZONE Functional Requirement Description	User Need ID
IZ-1	The INC-ZONE Communications functional shall receive and transmit data between INC-ZONE and RESP-STG using a reliable transport mechanism.	IN-4, IN-5, IN-6
IZ-2	The INC-ZONE Communications functional shall receive and transmit data between INC-ZONE and the Information Broker using a reliable transport mechanism.	IN-4, IN-5, IN-6
IZ-3	The INC-ZONE Communications functional shall receive and transmit data between INC-ZONE and the On-Scene Emergency Responders using a reliable transport mechanism.	IN-4, IN-5, IN-6
IZ-4	The INC-ZONE Communications functional shall receive and transmit data between INC-ZONE and the Traveling Public using a reliable transport mechanism.	IN-3, IN-3
IZ-5	The INC-ZONE Communications function shall receive and transmit data between INC-ZONE and the INC-ZONE deployed equipment using a reliable transport mechanism.	IN-2, IN-3
IZ-6	The INC-ZONE On-coming Vehicle Alert and Warning Function shall detect when a vehicle is TBD seconds, minimum, from entering an incident zone.	IN-1, IN-2
IZ-7	The detection equipment shall operate when deployed in outdoor environmental conditions.	IN-1, IN-2, IN-3, IN-4 IN-5, IN-6
IZ-8	The INC-ZONE On-coming Vehicle Alert and Warning Function will receive position information from all Connected Vehicle-enabled vehicles approaching the incident zone that are broadcasting only position information.	IN-1, IN-2, IN-3
IZ-9	The INC-ZONE On-coming Vehicle Alert and Warning Function will receive location and predictive path information from on-coming vehicle broadcasting Enhanced Basic Safety Messages.	IN-1, IN-2, IN-3,
IZ-10	The INC-ZONE On-coming Vehicle Alert and Warning Function shall alert the vehicle operator that he is entering an incident zone by sending a high-priority DSRC message from the detection equipment to the Approaching Vehicle.	IN-2
IZ-11	The DSRC message from the INC-ZONE On-coming Vehicle Alert and Warning Function shall contain: • Notification that vehicle is entering an incident zone • Recommended incident zone speed limit • Lane closure information	IN-2

Table 5-6. INC-ZONE Traceability Matrix (Continued)

Requirement ID	INC-ZONE Functional Requirement Description	User Need ID
IZ-12	The in-vehicle alert shall include both audible and visual messages to communicate the DSRC message contents to the vehicle operator per guidance provided in ATIS/CVO (FHWA-RD-98-057), or equivalent.	IN-2
IZ-13	If the INC-ZONE On-coming Vehicle Alert and Warning Function determines the vehicle is being operated in an unsafe manner, then it shall warn the vehicle operator and instruct him to take action.	IN-2
IZ-14	The INC-ZONE On-coming Vehicle Alert and Warning Function shall determine whether or not a vehicle is approaching the incident zone in a safe manner. *("Safe Manner" shall be defined as one in which the vehicle is predicted, through the use of mathematical models, to remain in the control of the operator)*	IN-2
IZ-15	The INC-ZONE On-coming Vehicle Alert and Warning Function shall extract the Enhanced Basic Safety Message from the vehicle's onboard equipment for inclusion in the mathematical models.	IN-2, IN-3
IZ-16	The INC-ZONE On-coming Vehicle Alert and Warning Function should extract from the vehicle's onboard equipment, the vehicle's characteristics necessary to mathematically predict the distance required for the operator to stop the vehicle.	IN-2, IN-3
IZ-17	The INC-ZONE On-coming Vehicle Alert and Warning Function should obtain local road condition information from the Information Broker necessary to define the road friction characteristics to more accurately mathematically predict the distance required for the operator to stop the vehicle.	IN-2, IN-3, IN-4, IN-5
IZ-18	The warning shall include audible and visual messages per guidance provided in ATIS/CVO (FHWA-RD-98-057), or equivalent.	IN-2, IN-3
IZ-19	The warning shall include instructions that the vehicle operator can follow to return vehicle operation to a safe manner. Such instructions shall include the following actions as appropriate to the conditions: • Reduce speed • Merge	IN-2, IN-3
IZ-20	If the vehicle operator does not take action to operate the vehicle in a safe manner, then a second DSRC high priority message shall be sent to the vehicle operator with instructions to immediately take corrective action.	IN-2, IN-3
IZ-21	The warning shall include audible and visual messages, per guidance provided in ATIS/CVO (FHWA-RD-98-057), or equivalent.	IN-2, IN-3
IZ-22	The warning shall include instructions that the vehicle operator can follow to return vehicle operation to a safe manner. Such instructions shall include the following actions as appropriate to the conditions: • Reduce speed • Merge	IN-2, IN-3

Table 5-6. INC-ZONE Traceability Matrix (Continued)

Requirement ID	INC-ZONE Functional Requirement Description	User Need ID
IZ-23	The warning should include a tactile indicator to capture the vehicle operator's attention.	IN-2
IZ-24	The INC-ZONE Emergency Responder Warning Function shall receive notification from the INC-ZONE On-coming Vehicle Alert and Warning Function that a vehicle being operated in an unsafe manner is approaching the incident zone.	IN-1
IZ-25	The INC-ZONE Emergency Responder Warning Function shall transmit an alert of a potentially dangerous situation caused by the unsafely operated vehicle to all persons within the incident zone.	IN-1
IZ-26	The threshold for determining when the alert is to be transmitted should be configurable.	IN-1
IZ-27	The INC-ZONE Emergency Responder Warning Function shall transmit a high priority message to a device that can be worn by an emergency responder. *Note: for the purposes of this document, a device that can be worn by a person is termed a "Personal Alerting Safety System, or PASS.*	IN-1
IZ-28	The PASS shall generate a notification that will capture the attention of the emergency responder.	IN-1
IZ-29	The notification shall be configurable such that the emergency responder can select to be alerted by any or multiple of the following methods: • Visible alerts • Audible alerts • Tactile alerts	IN-1
IZ-30	The INC-ZONE Emergency Responder Warning Function should transmit an alert of a potentially dangerous situation caused by the unsafely operated vehicle to all persons within the incident zone who are not equipped with a Personal Alerting Safety System.	IN-1
IZ-31	The alert should be communicated in a manner that could secure the attention of all persons within the incident zone, including emergency responders and the general public. Note: some examples provided here for illustration purposes only include sirens, variable message signs, and strobe lights.	IN-1
IZ-32	The INC-ZONE Incident Staging Function shall utilize the RESP-STG Visual Display Function, which shall develop a spatial representation of the incident zone from information received from the RESP-STG functions and present information on a graphical display.	IN-6

Table 5-6. INC-ZONE Traceability Matrix (Continued)

Requirement ID	INC-ZONE Functional Requirement Description	User Need ID
IZ-33	The INC-ZONE Incident Staging Function shall utilize the RESP-STG Visual Display Function to permit a System Administrator to establish multiple Master displays of selected information for customizable purposes and assign these Master Display unique labels. It shall permit an authorized User to add or remove selected information from the display by manually turning on or off a unique layer. *Note: examples could include a Master Display for a speeding violation, a minor traffic incident, and an accident involving HAZMAT vehicle.*	IN-6
IZ-34	The INC-ZONE Incident Staging Function shall utilize the RESP-STG Visual Display Function to permit an authorized User to add or remove selected information from the display by manually turning on or off a unique layer.	IN-6
IZ-35	The locations of all on-scene responder assets shall be included on the display as a configurable layer.	IN-6
IZ-36	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to consolidate information from available sources into a single viewing platform for display to the User though the Visual Display Function.	IN-6
IZ-37	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to access through the Information Broker the following fixed information assets: • Geographic Information System overlays • Road maps • Topography maps • Database of still photographs • Database of satellite imagery • Video cameras	IN-6
IZ-38	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to access through the Information Broker the following variable information assets: • HAZMAT plume modeling and identification of impacted roads • Type and position of emergency responder vehicles at an incident scene • Locations of medical care facilities	IN-6
IZ-39	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to access through the Information Broker the following traffic information assets: • Current traffic speed	IN-5, IN-6
IZ-40	The INC-ZONE Incident Staging Function shall invoke, based on the available data, the RESP-STG Vehicle and Equipment Staging Function to suggest to an emergency responder who has not yet arrived on-scene: • What direction to approach the incident scene • Where to stage the response vehicle	IN-1, IN-6

Table 5-6. INC-ZONE Traceability Matrix (Continued)

ID		User Need ID
IZ-41	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to allow the emergency responder to override the suggested approach and staging location.	IN-1, IN-6
IZ-42	The INC-ZONE Incident Staging Function shall invoke the RESP-STG Vehicle and Equipment Staging Function to show the locations and estimated time of arrival at the incident scene of enroute emergency responders.	IN-1, IN-6
IZ-43	The INC-ZONE Incident Zone Status Updates Function shall invoke the RESP-STG Emergency Responder Status Reporting Function, which shall maintain a continuously updated inventory of all information sources available at the incident scene and shall provide access to those assets when requested via the Information Broker.	IN-1, IN-6
IZ-44	The INC-ZONE Incident Zone Status Updates Function shall invoke the RESP-STG Emergency Responder Status Reporting Function to transmit the following emergency response related information to the Information Broker when instructed: • Types of on-scene emergency vehicles • Locations of on-scene emergency vehicles • Emergency responder vehicles onboard dash-cams • HAZMAT plume location • Incident victim details	IN-1, IN-6
IZ-45	When enroute to an incident scene, the INC-ZONE Incident Zone Status Updates Function shall invoke the RESP-STG Emergency Responder Status Reporting Function, which shall report traffic-related information to the Information Broker to assess the traffic flow encountered by the emergency responder. The information will include: • Speed • Heading • Route to destination • Estimated time of arrival	IN-6
IZ-46	The INC-ZONE Incident Zone Status Updates Function shall invoke the RESP-STG Emergency Responder Status Reporting Function, which shall provide the Information Broker access to any of the available information assets when requested.	IN-1, IN-6
IZ-47	The number of information assets that can be viewed simultaneously shall be TBD, depending upon the types of feeds or information being transmitted.	IN-6

Source: Battelle

EVAC

EVAC Stakeholder Needs

User needs that were considered in the development of requirements for EVAC are provided in Table 5-7.

Table 5-7. EVAC User Needs

User Need ID	EVAC User Need
EM-1	Improve access to evacuation related information and guidance.
EM-2	Enhance coordination between emergency management, public safety responders, public and private transportation service providers and DOTs
EM-3	Enhance coordination with private sector service providers such as those providing fuel, food and lodging.
EM-4	Improve the dissemination of consumer services information to evacuees.
EM-5	Foster evacuation route guidance through the dissemination of road conditions, traffic conditions, and final destinations.
EM-6	Improve coordination of transportation services for those requiring assistance with mobility.
EM-7	Improve the efficiency of dispatching and routing of public and private transportation service provider's resources.
EM-8	Improve matching of transportation services to requests for service.
EM-9	Enhance communication capabilities with those requiring assistance during evacuations.
EM-10	Provide evacuees with timely and accurate information related to re-entering evacuated areas.
EM-11	Improve utilization of vehicle fleets to enhance efficiency of evacuations.
EM-12	Reduce the number of people that are unable to evacuate.

Source: Battelle

EVAC Traceability Matrix

Table 5-8 relates identified user needs to specific EVAC requirements.

Table 5-8. EVAC Traceability Matrix

Requirement ID	EVAC Functional Requirement Description	User Need ID
EV-1	The Communications Function shall have the ability to receive provider-supplied data via a secure Internet connection (or other electronic equivalent communications connection).	EM-1 EM-2, EM-3, EM-4
EV-2	The provider-supplied data will be transmitted and received in a standardized format.	EM-1 EM-2, EM-3, EM-4
EV-3	The Communications Function shall have the capability to enable and exchange secure data transmittal of information.	EM-1 EM-2, EM-3, EM-4
EV-4	The Communications Function shall have the ability to transmit data from within the EVAC bundle to other Information Broker electronic systems.	EM-1 EM-2, EM-3, EM-4
EV-5	The Communications Function shall utilize a security protocol that is at least as secure as AES encrypted data.	EM-1 EM-2, EM-3, EM-4
EV-6	The Communications Function shall include the capability to receive and transmit all data related to the EVAC Application.	EM-1 EM-2, EM-3, EM-4
EV-7	The Communications Function shall have the ability to provide a data receipt or acknowledgement should this be requested by an information provider.	EM-1 EM-2, EM-3, EM-4
EV-8	The Communications Function shall include the ability to manage the distribution of messages by providing data de-confliction to mitigate repeat requests, error detection, and authentication/data validation.	EM-1 EM-2, EM-3, EM-4
EV-9	The EVAC Communications Function should be able to integrate with existing mass warning and notification systems.	EM-1 EM-2, EM-3, EM-4
EV-10	The EVAC Communications Function shall have the ability to communicate and facilitate communication between any of the R.E.S.C.U.M.E. Bundle applications.	EM-1 EM-2, EM-3, EM-4
EV-11	The Mobility Needs Assessment and Staging function shall have the ability to monitor identified segments of the population to maintain a situational awareness of mobility needs pre-, during, and post-evacuation.	EM-1
EV-12	The Mobility Needs Assessment and Staging function shall identify persons with mobility needs that are not being met and transmit this information to the Dispatch and Routing for Special Needs function for planning and deployment of assets.	EM-6, EM-9, EM-12

Table 5-8. EVAC Traceability Matrix (Continued)

Requirement ID	EVAC Functional Requirement Description	User Need ID
EV-13	The Mobility Needs Assessment and Staging function shall have the ability to establish thresholds or triggers based upon various user specified criteria that are used to identify gaps between persons with mobility needs that are not being met and transportation assets.	EM-6, EM-9, EM-12
EV-14	The Mobility Needs Assessment and Staging function shall include the following elements that can be used to initiate a message to the Dispatch and Routing Function: • Geographic location of the person with functional needs, • Geographic location of transportation assets; • Time until evacuation ceases (pre-event) relative to time to reach the person with an available transportation asset; • Availability and capacity of transportation assets; • Mobility and transport requirements of the person with mobility needs; • Special shelter needs, availability, and capacity for the person with mobility needs.	EM-6, EM-9, EM-12
EV-15	Information for the Mobility Needs Assessment and Staging function will be available in the form of one or more existing databases that contain information on persons with mobility needs.	EM-6, EM-9, EM-12
EV-16	The information from these databases will be available in a standard format.	EM-6, EM-9, EM-12
EV-17	The databases can be accessed in real-time by the Mobility Needs Assessment and Staging function.	EM-6, EM-9, EM-12
EV-18	The Mobility Needs Assessment and Staging function shall have the ability to obtain pre-evacuation information from existing and/or legacy databases.	EM-6, EM-9, EM-12
EV-19	The Mobility Needs Assessment and Staging function should provide database updates to existing/legacy mobility databases with newly identified persons with mobility needs.	EM-1, EM-6, EM-8, EM-9, EM-12
EV-20	The Mobility Needs Assessment and Staging function shall have the ability to receive and maintain a real-time database of persons with mobility needs that are not pre-registered, but who are identified during an evacuation.	EM-1, EM-6, EM-8, EM-9, EM-12
EV-21	The Mobility Needs Assessment and Staging function shall be able to retrieve information on mobility assets from existing data sources prior to and during an evacuation.	EM-1, EM-6, EM-8, EM-9, EM-11, EM-12
EV-22	The Mobility Needs Assessment and Staging function shall use information from existing/legacy mobility databases along with existing databases on mobility related assets to provide a pre-evacuation report that links persons with mobility needs to mobility assets.	EM-1, EM-6, EM-8, EM-9, EM-12

Table 5-8. EVAC Traceability Matrix (Continued)

Requirement ID	EVAC Functional Requirement Description	User Need ID
EV-23	The linking of persons with mobility needs to mobility assets shall be based upon a number of factors including: personal choice of the person with mobility needs, availability of the transportation asset, cost, and efficiency in transportation asset utilization.	EM-1, EM-6, EM-8, EM-9, EM-11, EM-12
EV-24	During an evacuation, the Mobility Needs Assessment and Staging function shall maintain an ongoing database of cross-linked persons with mobility needs and transportation assets.	EM-1, EM-6, EM-8, EM-9, EM-11, EM-12
EV-25	Information on the intersection of persons with mobility needs and transportation assets shall be made available to all EVAC applications in real-time.	EM-1, EM-6, EM-8, EM-9, EM-12
EV-26	The Shelter Matching Function shall include a master database of all shelters in the evacuation and surrounding areas.	EM-1
EV-27	The Shelter Matching function shall maintain real-time updates of the shelter database based upon information received from shelter providers (via the Communications Function).	EM-1
EV-28	The Shelter Matching function shall be able to interface with the American Red Cross National Shelter System database.	EM-1
EV-29	Information in the shelter database shall include: • Shelter name and address, • Status of the Shelter [open, closed, full], • Capacity remaining, • Description of the services provided by the facility, • Limitations on service [pets accepted, mobility/accessibility concerns].	EM-1
EV-30	The Shelter Matching Function shall provide recommendations to the traveling public on shelters via multiple communication methods.	EM-1
EV-31	A member of the traveling public shall have the ability to access the Shelter Matching Function via the Internet and smart phone applications.	EM-1
EV-32	A member of the traveling public should have the ability to access the Shelter Matching Function through a telephone connection point.	EM-1
EV-33	The Shelter Matching Function shall provide a mechanism for the traveling public to provide information that can be used for shelter matching.	EM-1
EV-34	A member of the traveling public shall have the ability to provide information that can be used to assess shelter suitability through the Internet and smart phone applications.	EM-1
EV-35	A member of the traveling public should have the ability to provide information that can be used to assess shelter suitability through a telephone connection point.	EM-1

Table 5-8. EVAC Traceability Matrix (Continued)

Requirement ID	EVAC Functional Requirement Description	User Need ID
EV-36	The Shelter Matching Function shall use, at a minimum, the following information to determine appropriate shelter matches with a traveler request: • Shelter availability, • Shelter capacity, • Requestor's current location, • Travel distance to shelter, • Modes of transportation available to reach shelter, • Need for medical support, • Number of people in the requestor's group, • Travel time to the shelter from the requestor's current location.	EM-1
EV-37	The Shelter Matching Function shall provide at least one recommendation for a shelter for each request.	EM-1
EV-38	The Shelter Matching Function should provide multiple recommendations for shelters including estimated travel times and routes to the requestor.	EM-1
EV-39	The Dispatch and Routing Function will have access to a database(s) of information that contains information on the availability and capacity of transportation assets.	EM-1, EM-11
EV-40	The database(s) of information on capacity and availability of transportation assets will be updated in real-time	EM-1, EM-11
EV-41	The Dispatch and Routing Function will receive from the Mobility Needs Assessment and Staging Function requests for transportation assistance.	EM-1, EM-11
EV-42	Each request for assistance shall include a description of the type of resource that is requested, a timeframe for the request to be honored within, and identification of the mobility needs.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-43	The Dispatch and Routing Function shall include an algorithm(s) that can identify the transportation resource assets that capable of servicing each transportation request.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-44	The Dispatch and Routing Function shall include a decision algorithm that can prioritize, rank, and ultimately determine which transportation asset should be mobilized to each request.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-45	The Dispatch and Routing Function should employ algorithms that optimize the utilization of transportation assets.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-46	The Dispatch and Routing Function shall identify a recommended route for the identified transportation asset.	EM-1, EM-6, EM-9, EM-11, EM-12

Table 5-8. EVAC Traceability Matrix (Continued)

Requirement ID	EVAC Functional Requirement Description	User Need ID
EV-47	The recommended route shall be developed to account for the current state of the transportation system through identification of: • Traffic conditions, • Road closures, and • The persons who requested transportation assistance and are awaiting pick up.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-48	The Dispatch and Routing Function shall prepare a dispatch message with the following elements: • Time of the request, • Time of dispatch, • Recommended route, • Expected arrival time at pickup location, • Number of passengers that requested assistance at the pickup location.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-49	The Dispatch and Routing Function shall receive updates on the dispatched transportation assets through the Communications Functions that provide: • Current location • Distance to the pickup location.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-50	The Dispatch and Routing Function shall use the updated information to calculate an updated estimate time of arrival to the pickup location.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-51	The updated time of arrival will be packaged as a communications message that includes: • Estimated time of arrival, • Type of transportation asset (e.g., bus, van, etc.).	EM-1, EM-6, EM-9, EM-11, EM-12
EV-52	The communications message shall be submitted to the Communications Function for transmission to the requesting party.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-53	The Dispatch and Routing Function will be able to access real-time information on road closures, traffic conditions, special transportation assets, bus schedules, and transit options.	EM-1, EM-6, EM-9, EM-11, EM-12
EV-54	The Roadside Resource Identification Function will be able to access real-time information on road closures, traffic conditions, motel/hotel capacity, special transportation assets, bus schedules, and transit options.	EM-1, EM-4, EM-5
EV-55	The Roadside Resource Identification Function will be able to access information on gasoline availability and locations, location and status of automated teller machines, food, and hotels/motels along all evacuation routes.	EM-1, EM-4, EM-5
EV-56	The Roadside Resource Identification Function shall be accessible to the traveling public through an Internet connection.	EM-1, EM-4, EM-5

Table 5-8. EVAC Traceability Matrix (Continued)

Requirement ID	EVAC Functional Requirement Description	User Need ID
EV-57	The Roadside Resource Identification Function shall be accessible to the traveling public through a mobile device such as a smartphone.	EM-1, EM-4, EM-5
EV-58	The Roadside Resource Identification Function shall be able to receive traveler provided updates that change the status of a resource.	EM-1, EM-4, EM-5
EV-59	The Roadside Resource Identification Function should utilize algorithms to confirm and validate the traveler supplied information prior to reporting the updated information to other travelers.	EM-1, EM-4, EM-5
EV-60	The Roadside Resource Identification Function shall update the status of roadside resources using updates provided from the Information Broker entities.	EM-1, EM-4, EM-5
EV-61	The Roadside Resource Identification Function shall update the status of roadside resources using updates provided by travelers.	EM-1, EM-4, EM-5
EV-63	The Roadside Resource Identification Function shall provide updates to the Information Broker indicating and describing the change in status of a roadside resource.	EM-1, EM-4, EM-5
EV-63	The Roadside Resource Identification Function shall obtain route information from the Dispatch and Routing Function from a Traveler's location to a roadside resource when the Traveler requests assistance in finding Roadside Resources.	EM-1, EM-4, EM-5
EV-64	The Traveler shall have the ability to specify the type of resource to which routing directions are desired.	EM-1, EM-4, EM-5
EV-65	The list of resource types shall include at least the following: Gas Station; Hotel, Transit, ATM, Bank, Grocery Store, Restaurant.	EM-1, EM-4, EM-5
EV-66	The Evacuee Return Support Function shall be accessible from the Internet and a mobile device.	EM-1, EM-4, EM-5
EV-67	The Evacuee Return Support Function shall display information on current alerts, policies, emergency levels, etc. that indicate whether an evacuee can return to their residence.	EM-1, EM-4, EM-5, EM-12
EV-68	The Evacuee Return Support Function shall include the ability to have an evacuee type or select a specific geographic location such as a household address and provide information for that address.	EM-1, EM-5, EM-12
EV-69	The Evacuee Return Support Function shall utilize the Dispatch and Routing function to calculate a route for the evacuee from their current location to the geographic location of interest.	EM-1, EM-5, EM-12
EV-70	The routes should be determined through using real-time information on the availability and closure of transportation roadways, and systems.	EM-1, EM-5, EM-12

Table 5-8. EVAC Traceability Matrix (Continued)

Requirement ID	EVAC Functional Requirement Description	User Need ID
EV-71	The Evacuee Return Support Function shall indicate those routes that are unavailable for evacuation return to the user.	EM-1, EM-5, EM-12
EV-72	If no available routes can be identified, the Evacuee Return Support Function shall indicate to the user that there are no safe routes that are available for their return.	EM-1, EM-5, EM-12
EV-73	The Evacuee Return Support Function will receive information on evacuation from a number of different sources.	EM-1, EM-5, EM-12
EV-74	The Evacuee Return Support Function shall identify when it receives conflicting information from different sources on the availability of transportation assets, systems, infrastructure components, and policy/orders.	EM-1, EM-12
EV-75	If conflicting information is identified, the Evacuee Return Support Function shall submit a conflict notification message to the Communications Function to be sent to the information sources.	EM-1, EM-12
EV-76	The conflict notification message shall identify the information provided as well as the conflicting information provided by the other source.	EM-1, EM-12
EV-77	The conflict notification message shall identify the sources of the information in conflict.	EM-1, EM-12
EV-78	If conflicting information is identified, the Evacuee Return Support Function shall display the information received last.	EM-1, EM-12

Source: Battelle

Appendix A: List of Acronyms

Abbreviation or Acronym	Description
AACN	Advanced Automatic Collision Notification
AACN-RELAY	Advanced Automatic Collision Notification Relay (a R.E.S.C.U.M.E. application)
AASHTO	American Association of State Highway and Transportation Officials
ABR	Alternate Bus Routing
ALI	Automatic Location Information
ANI	Automatic Number Identification
APCO	Association of Public Safety Communications Officials
ATIS	Advanced Traveler Information Systems — or — Multi-Modal Real-Time Traveler Information (an Enable ATIS application)
ATM	Automated Teller Machine
AVL	Automatic Vehicle Location
CAD	Computer-Aided Dispatch
CAP	Common Alerting Protocol
CCTV	Closed-Circuit Television
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CMAS	Commercial Mobile Alert System
CMS	Changeable Message Sign
ConOps	Concept of Operations
CRS	Congressional Research Service
DACA	Deployable Aerial Communications Architecture
CV	Connected Vehicle
DBS	Direct Broadcast Satellite
DHS	Department of Homeland Security
DMA	Dynamic Mobility Applications
DMS	Dynamic Message Sign
DoD	U.S. Department of Defense

Abbreviation or Acronym	Description
DOT	Department of Transportation
DSRC	Dedicated Short-Range Communications
DSS	Decision Support System
E9-1-1	Enhanced 9-1-1 (phone service)
EAS	(National) Emergency Alert System
ECC	Emergency Communications Center
EDR	Event Data Recorder
EMA	Emergency Management Agency
EMS	Emergency Medical Services
Enable ATIS	Enable Advanced Traveler Information Systems (a DMA bundle)
EOC	Emergency Operations Center
ePCR	Electronic Patient Care Record
ESP	Electronic Shipping Papers
ETA	Estimated Time of Arrival
ETO	Emergency Transportation Operations
EVAC	Emergency Communications for Evacuation (a R.E.S.C.U.M.E. application)
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FOIA	Freedom of Information Act
FOP	Fraternal Order of Police
FOT	Field Operational Test
FRATIS	Freight Advanced Traveler Information Systems (a DMA bundle)
GIS	Geographic Information System
GPS	Global Positioning System
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HIPAA	Health Insurance Portability and Accountability Act

Abbreviation or Acronym	Description
HSPD	Homeland Security Presidential Directive
I2V	Infrastructure-to-Vehicle
IACP	International Association of Chiefs of Police
IAFC	International Association of Fire Chiefs
IAFF	International Association of Fire Fighters
ICS	Incident Command System
IDTO	Integrated Dynamic Transit Operations (a DMA bundle)
IEEE	Institute of Electrical and Electronics Engineers
INC-ZONE	Incident Scene Work Zone Alerts for Drivers and Workers (a R.E.S.C.U.M.E. application)
INFLO	Intelligent Network Flow Optimization (a DMA bundle)
IT	Information Technology
ITS	Intelligent Transportation Systems
JPO	Joint Program Office
MDT	Mobile Data Terminal
MMISIG	Multi-modal Intelligent Traffic Signal System (a DMA bundle)
MPO	Metropolitan Planning Organization
NAEMT	National Association of Emergency Medical Technicians
NEMSA	National Emergency Medical Services Association
NENA	National Emergency Number Association
NG9-1-1	Next Generation 9-1-1 (phone service)
NGO	Non-governmental Organization
NHTSA	National Highway Traffic Safety Administration
NIMS	National Incident Management System
NOAA	National Oceanographic and Atmospheric Administration
NPI	National Provider Identifier
NRF	National Response Framework
NSS	National Shelter System
NTIMC	National Traffic Incident Management Coalition

Abbreviation or Acronym	Description
NUG	National Unified Goal
NWS	National Weather Service
PDOF	Principal Direction of Force
PKEMRA	Post-Katrina Emergency Management Reform Act
PLAN	Personal Localized Alerting Network
PPD	Presidential Policy Directive
PSAP	Public Safety Answering Point
PSE	Planned Special Event
R&D	Research and Development
R.E.S.C.U.M.E.	Response, Emergency Staging, Communications, Uniform Management, and Evacuation (a DMA bundle)
RESP-STG	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (a R.E.S.C.U.M.E. application)
RFID	Radio Frequency Identification
RITA	Research and Innovative Technology Administration
SCDOT	South Carolina Department of Transportation
SDARS	Satellite Digital Audio Radio Service
SOP	Standard Operating Procedure
SOW	Statement of Work
SPaT	Signal Phase and Timing
TCP-IP	Transmission Control Protocol/Internet Protocol
T-DISP	Dynamic Transit Dispatch (an IDTO application)
TIH	Toxic Inhalation Hazard
TIM	Traffic Incident Management
TMC	Traffic Management Center
TRB	Transportation Research Board
TSP	Telematics Service Provider
TTC	Temporary Traffic Control
U.S. DOT	United States Department of Transportation
V2I	Vehicle-to-Infrastructure

Abbreviation or Acronym	Description
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Infrastructure or -Vehicle
VMS	Variable Message Sign
VoIP	Voice over Internet Protocol
WSP	Wireless Service Provider

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