DMA Webinar Series

R.E.S.C.U.M.E. Bundle

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Intelligent Transportation Systems Joint Program Office

February 18, 2015
TODAY’S AGENDA

- DMA Program Overview

- Prototype Design and Demonstration
  - R.E.S.C.U.M.E. Bundle Overview
  - Prototype Description and Current Project Status

- Impact Assessment
  - Current Project Status of Impact Assessment
  - Testing Results and Impacts/Benefits from IA

- Stakeholder Q&A
  - We can only answer the questions related to the DMA program.
  - We cannot answer any questions related to the CV Pilots.
DMA Program Overview
DYNAMIC MOBILITY APPLICATIONS PROGRAM

- **Vision**
  - Expedite development, testing, commercialization, and deployment of innovative mobility application
    - maximize system productivity
    - enhance mobility of individuals within the system

- **Objectives**
  - Create applications using frequently collected and rapidly disseminated multi-source data from connected travelers, vehicles (automobiles, transit, freight) and infrastructure
  - Develop and assess applications showing potential to improve nature, accuracy, precision and/or speed of dynamic decision
  - Demonstrate promising applications predicted to significantly improve capability of transportation system
  - Determine required infrastructure for transformative applications implementation, along with associated costs and benefits

- **Project Partners**
  - Strong internal and external participation
    - ITS JPO, FTA, FHWA R&D, FHWA Office of Operations, FMCSA, NHTSA, FHWA Office of Safety
DMA PROGRAM APPROACH TO OVERCOMING TWO KEY CHALLENGES TO APPLICATION DEPLOYMENT

- **Challenge 1 (Technical Soundness)**
  Are the DMA bundles technically sound and deployment-ready?
  - Create a “trail” of systems engineering documents (e.g., ConOps, SyRs)
  - Share code from open source bundle prototype development
    (OSADP website: [http://www.itsforge.net/](http://www.itsforge.net/))
  - Demonstrate bundle prototypes (in isolation)
  - Field test integrated deployment concepts from across CV programs

- **Challenge 2 (Transformative Impact)**
  Are DMA bundle-related benefits big enough to warrant deployment?
  - Engage stakeholders to set transformative impact measures and goals
  - Assess whether prototype show impact when demonstrated
  - Estimate benefits associated with broader deployment
  - Utilize analytic testbeds to identify synergistic bundle combinations
# DMA Bundles and Applications

<table>
<thead>
<tr>
<th><strong>FRATIS:</strong> Freight Advanced Traveler Information Systems</th>
<th>![Truck]</th>
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<tbody>
<tr>
<td><strong>Apps:</strong> Freight-Specific Dynamic Travel Planning and Performance, Drayage Optimization (DR-OPT)</td>
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<tr>
<th><strong>IDTO:</strong> Integrated Dynamic Transit Operations</th>
<th>![Bus]</th>
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<tbody>
<tr>
<td><strong>Apps:</strong> Connection Protection (T-CONNECT), Dynamic Transit Operations (T-DISP) Dynamic Ridesharing (D-RIDE)</td>
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<tr>
<th><strong>R.E.S.C.U.M.E.:</strong> Response, Emergency Staging and Communications, Uniform Management, and Evacuation</th>
<th>![Police Car]</th>
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<tbody>
<tr>
<td><strong>Apps:</strong> Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG) Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE) Emergency Communications and Evacuation (EVAC)</td>
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<tr>
<th><strong>MMITSS:</strong> Multimodal Intelligent Traffic Signal System</th>
<th>![Traffic Lights]</th>
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<tbody>
<tr>
<td><strong>Apps:</strong> Intelligent Traffic Signal System (I-SIG), Transit and Freight Signal Priority (TSP and FSP) Mobile Accessible Pedestrian Signal System (PED-SIG), Emergency Vehicle Preemption (PREEMPT)</td>
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<tr>
<th><strong>INFLO:</strong> Intelligent Network Flow Optimization</th>
<th>![Cars]</th>
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<tr>
<td><strong>Apps:</strong> Dynamic Speed Harmonization (SPD-HARM), Queue Warning (Q-WARN) Cooperative Adaptive Cruise Control (CACC)</td>
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<tr>
<th><strong>Enable ATIS:</strong> Enable Advanced Traveler Information Systems</th>
<th>![Smartphone]</th>
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<tbody>
<tr>
<td><strong>Apps:</strong> EnableATIS (Advanced Traveler Information System 2.0)</td>
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DMA Prototype Development Activity

EnableATIS: SmartTrAC (University of Minnesota)

EnableATIS CloudCar (MIT)

R.E.S.C.U.M.E. National Capital Region

INFLO S/Q Seattle, WA

MMITSS Anthem, AZ Northern CA

FRATIS Los Angeles, CA South Florida Dallas, TX

IDTO Columbus, OH Orlando, FL

INFLO S/Q Seattle, WA

MMITSS Anthem, AZ Northern CA

FRATIS Los Angeles, CA South Florida Dallas, TX

IDTO Columbus, OH Orlando, FL

LIVE

DEMO

LIVE

DEMO

LIVE

DEMO

LIVE

DEMO

LIVE
R.E.S.C.U.M.E. Bundle Overview
R.E.S.C.U.M.E. BUNDLE DESCRIPTIONS

- **Objectives**
  - Transform the response, emergency staging and communications, uniform management, and evacuation (R.E.S.C.U.M.E.) process associated with incidents.
  - Leverage wireless connectivity, center-to-center communications, and center-to-field communications to solve problems faced by emergency management agencies, emergency medical services (EMS), public agencies, and emergency care givers, as well as persons requiring assistance.

- **Applications**
  - Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG)
  - Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)
  - Emergency Communications and Evacuation (EVAC)
R.E.S.C.U.M.E. Prototype
R.E.S.C.U.M.E. Prototype Objectives

- Design and develop prototype R.E.S.C.U.M.E. Applications
- Conduct a small-scale demonstration of the prototypes
- Collect data to support
  - Assessment of the impacts of the prototype
  - Regional deployment of the two applications
- Project Team
  - Battelle
  - University of Maryland – Center for Advanced Transportation Technology (CATT) / Capital Wireless Integrated Network (CapWIN)
INCIDENT SCENE PRE-ARRIVAL STAGING GUIDANCE FOR EMERGENCY RESPONDERS (RESP-STG)

- Situational awareness info to responders while en route
- Enabled through enhancements in existing public safety communications systems
- Input to responder vehicle routing, staging and secondary dispatch decisions
INCIDENT SCENE WORK ZONE ALERTS FOR DRIVERS AND WORKERS (INC−ZONE)

- In-vehicle messaging system, provides motorists with:
  - Merging and speed guidance as they approach an incident scene
  - Warnings if they approach the incident scene at an unsafe speed or trajectory
- Provides a warning for on-scene workers.

Source: Ron Moore
R.E.S.C.U.M.E. Prototype Development Activities

- System prototype developed and demonstrated
  - June 17, 2014 in Columbus, OH
  - November 13, 2014 at Maryland Police and Correctional Training Commission’s Driver Training Facility
  - February 2015 Small-scale demonstration for RESP-STG

- Potential inclusion in Connected Vehicle Regional Pilots (2015)

Lt. Michael Tagliaferri, Maryland State Police
Sgt. Dan Dytchkowskyi, Erie County, New York Sheriff’s Office
State and local agencies
- Maryland State Highway Administration (MDSHA)
- Maryland State Police (MSP)
- University of Maryland – Center for Advanced Transportation Technology (CATT) / Capital Wireless Integrated Network CapWIN
- Maryland Emergency Management Agency (MEMA)
- Sykesville – Freedom District Fire Department

Federal Agencies
- ITS Joint Program Office (ITS-JPO)
- Federal Highway Administration (FHWA)
- National Highway Traffic Safety Administration (NHTSA)
- Federal Motor Carrier Safety Administration (FMCSA)

Other organizations
- Transportation Research Board - Standing Committee on Traffic Law Enforcement (ANB40)
- Transportation Safety Advancement Group (TSAG)
- International Association of Chiefs of Police (IACP)
- Intelligent Transportation Society of America (ITSA)
- National Sherriff’s Association (NSA)

Local public safety agencies
- Erie County New York Sheriff’s Office
DEMONSTRATION LAYOUT

Blind Curve Incident Zone (Final Vehicle Circuit Only)

Staging Location for Oncoming Vehicles
Staging Location for Responder Vehicles
Incident Zone
Position A Trailer CapWIN Display
Position B Responder Vehicle Display
NOVEMBER 13, 2014 DEMONSTRATION

- 12 scenarios showing functionality of RESP-STG and INC-ZONE applications, viewed from three different perspectives

CapWIN Perspective (Position A)

Responder Perspective (Position B)

Example message displayed to driver

Oncoming Vehicle Perspective
Note: Initial warnings purposely ignored to demonstrate full-functionality of the application
INC-ZONE – THE RESPONDER’S PERSPECTIVE (POSITION B)
RESP-STG Prototype Summary

- CapWIN represents one platform in which to integrate RESP-STG application

- Current Functionality Includes:
  - AVL Broadcasting and Receipt from CapWIN Mobile Client
  - User-Controlled “On Scene” Broadcasting Option for First Responders at the Incident Scene and En Route to Scene
  - New Mapping Engine and Mapping Data
  - New Freeway Incident Traffic Management Plan (FITM) Layer
  - Enhanced User Control of GIS Layers
THE CapWIN PERSPECTIVE (POSITION A)
Developed the connected vehicle applications, which reside on separate vehicles (responder and oncoming).

Implemented Dedicated Short-Range Communications (DSRC) Messaging between responder and oncoming vehicles to support threat and imminent crash warnings.

Implemented lane level mapping and Global Positioning System (GPS) positioning accuracy system.
R.E.S.C.U.M.E. Prototype
Development Challenges and Solutions

- Developed and integrated DSRC, Cellular, and Bluetooth communications in both oncoming vehicle and responder vehicle systems.

- Range of integration activities:
  - Applications onto existing responder portable laptop and existing consumer smart phones
  - Responder alerts and warnings in existing systems
  - RESP-STG and INC-ZONE applications for compatibility and coordination

- Use of existing public safety communications equipment
Applications being prepared for posting on the Open Source Application Development Portal (OSADP):
- Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)
  - Responder Vehicle Application
  - Oncoming Vehicle Application

Data being prepared for posting on the Research Data Exchange (RDE):
- Maryland Demonstration Message Exchange
R.E.S.C.U.M.E. Prototype Description
High Value Enhancements

- Further refinements are suggested to more fully capture benefits.

- Address human factors components if delivering information, alerts, and warnings.

- Investigate timing and nature of alerts and warnings during highway incidents.

- Current prototype development efforts do not restrict development of future enhancements for additional safety benefits.
R.E.S.C.U.M.E.
Impact Assessment
R.E.S.C.U.M.E. Impact Assessment Team:

- Assessment of INC-ZONE and RESP-STG: Booz Allen Hamilton
- Assessment of EVAC: Booz Allen/AECOM/Prof. Brian Wolshon (LSU)
- Overall R.E.S.C.U.M.E. IA Team Lead: Gustave Cordahi (Booz Allen Hamilton)
ASSESSMENT OF INC-ZONE & RESP-STG
MODELING AND SIMULATION

- INC-ZONE and RESP-STG functionalities simulated.
- Simulation Conditions
  - Roadway Conditions:
    - Dry
    - Rainy
  - Operational Scenarios:
    - Short Incident (30-minutes)
    - Long Incident (60-minutes)
  - Market Penetration:
    - 10%, 25%, 50% and 100%
- Primary functionalities used:
  - Lane-changes prior to incident zone to avoid incident-lane.
  - Speed-changes around incident zone to enhance safety.

- 5-hour PM peak simulation (2:30PM to 7:30PM) with NB congestion.
- VISSIM 7.00 Model used
## ASSESSMENT OF INC-ZONE & RESP-STG SIMULATION FUNCTIONALITIES

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Corresponding Modeling Strategy</th>
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<tbody>
<tr>
<td><strong>INC-ZONE</strong></td>
<td>-------------------------------------------------------------------------------------------------</td>
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<tr>
<td>1. Threat determination</td>
<td>Using instantaneous vehicle-positions, link ID, and lane ID.</td>
</tr>
<tr>
<td>2. Oncoming Vehicle Alerts and Warnings</td>
<td>Vehicle ‘commands’ are used instead of alerts and warnings and a compliance rate is used to specify compliance to alerts and warnings.</td>
</tr>
<tr>
<td>3. Responder Alerts and Warnings</td>
<td>Surrogate safety measures are analyzed.</td>
</tr>
<tr>
<td><strong>RESP-STG</strong></td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1. Staging Plans</td>
<td>Modeled using vehicle commands to stage the emergency vehicle to the incident zone.</td>
</tr>
<tr>
<td>2. Emergency Responder Status Reporting</td>
<td>Modeled as a performance monitoring variable.</td>
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ASSESSMENT OF INC-ZONE & RESP-STG

PERFORMANCE MEASURES

Direct Performance Measures:
- These measures are collected directly from the simulation:
  - Network mobility measures such as latent demand served etc.
  - Average Vehicle Delay
  - Average Number of Stops
  - Average Travel-Speed of Vehicles
  - Throughput of Incident Zones
  - Average Fuel Consumption
  - Average Emissions

Indirect Performance Measures:
- These measures are computed from direct simulation results using post-processing:
  - Surrogate safety measures derived from trajectory analysis.
  - Lane-changes in the vicinity of the incident-zone.
  - Speed-differential in the vicinity of the incident zone.
  - Improvement of response vehicle travel-time.

Performance Measurement:
- Comparison of Baseline measures (without R.E.S.C.U.M.E.) to measures with R.E.S.C.U.M.E.
- Regional extrapolation of impacts using RITIS Incident Statistics
Assessment of EVAC

Emergency Communications for Evacuation in Greater New Orleans
The overall objective is to estimate the potential impacts of Emergency Communications and Evacuation (EVAC) strategies on evacuees’ mobility and evacuation clearance time.

The hurricane Katrina evacuation model of the Greater New Orleans area is used as a baseline for the assessment of EVAC.

Transformative targets:
- EVAC is expected to expedite the evacuation process, improve the mobility of transit-based evacuees, and reduce congestion and fuel consumption.
ASSESSMENT OF EVAC

KEY HYPOTHESES AND PERFORMANCE MEASURES

- Key Hypotheses
  - A percentage of evacuees will follow the EVAC recommendations and adjust their behavior accordingly;
  - EVAC will enable evacuees to reach destinations faster;
  - EVAC will reduce the overall congestion level and delay;
  - EVAC will enable evacuees to find hotel accommodations faster;
  - EVAC will reduce the number of stops for re-fueling vehicles

- Performance Measures
  - Network congestion measures: total travel time; congestion duration; total delay
  - Strategy effectiveness measures: average travel time to lodging; number of fueling failures; average wait time for buses
ASSESSMENT OF EVAC
TESTBED AND ANALYSIS TOOLS

- Testbed specifications
  - The hurricane Katrina evacuation model of the Greater New Orleans area was originally developed by LSU
  - About 400,000 evacuees over a 48 hour period
    - 96% auto-based and 4% assisted transit evacuations
  - Evacuation destinations, departure times and mode shares are derived from observed data collected during the Katrina evacuation

- Modeling Tool: TRANSIMS
  - An open-source dynamic transportation modeling tool developed and maintained by AECOM for FHWA
    - Dynamic routing of individual travelers and 48 hour regional simulations
    - Randomly select travelers to receive and act on EVAC information
    - Vehicle trajectories, traveler plans, disaggregate travel times and flow rates
    - Outputs can be visualized in geospatial packages such as ArcGIS
GREATER NEW ORLEANS TESTBED: NETWORK
EVACUATION DESTINATIONS AND DEPARTURE TIMES

- 42.4% (Auto-Based)
- 26.1% (Auto-based)
- 13.5% (Auto-based)
- 18.0% (Auto-based)
Assessment of EVAC
Impact Assessment Approach

- Use the Katrina evacuation data as the baseline scenario

- Assume that a percentage of evacuees will follow the EVAC recommendations or use EVAC information to adjust their travel plans; other travelers will not change their travel plans (i.e., route, destination or departure time)

- Multiple percentage assumptions will be used to estimate a range of potential impacts

- Assume no gaps in EVAC communications

- Calculate the performance measure differences between the EVAC strategy and the baseline conditions
ASSESSMENT OF EVAC
IMPACT ASSESSMENT SCENARIOS

- Seven scenarios will be tested to quantify the effects of individual strategies and the synergetic effects of combining strategies.
  - Scenario 1 ~ Baseline Scenario (i.e. the Katrina scenario without EVAC)
  - Scenario 2 ~ EVAC route information and guidance under no-incident conditions
  - Scenario 3 ~ Incidents and road closures are added to Scenario 2
  - Scenario 4 ~ EVAC assistance in locating lodging and shelter options
  - Scenario 5 ~ EVAC assistance in locating fuel, food, water, cash machines and other necessities (current phase only considers fueling locations)
  - Scenario 6 ~ EVAC communications about pickup time and location options for special needs evacuees (i.e., transit services)
  - Scenario 7 ~ A combination of route information and guidance, location of available lodging and shelter; location of fuel; and transit pickup time and location options
ASSESSMENT OF EVAC
Lodging Assumptions

- The literature suggests that 25% of auto-based evacuees require hotel accommodations.

- Hotel accommodations must be found outside of the study area in towns along major interstates up to 300 miles from New Orleans:
  - I-10, I-55, I-59 and I-49
  - Baton Rouge, Lafayette, Alexandria, Shreveport, Jackson, Hattiesburg, Houston, etc.

- Travelers will select a hotel that minimizes their total trip time.

- EVAC is capable of obtaining accommodation information outside of the study area and directing travelers to destinations with available capacity.
EXTERNAL HOTEL CAPACITY

Circle size proportional to the number of hotel rooms
ASSESSMENT OF EVAC

FUEL ASSUMPTIONS

- Fuel consumption rates are based on travel speed
- Some evacuees will not have a full tank of gas when they start
- Evacuees start seeking fuel when the tank is one quarter full
- Fueling locations are assumed at each interstate interchange, but some locations will no longer have fuel available
- EVAC can direct travelers to locations with available fuel
- Other travelers may fail to acquire fuel after one or more attempts
- Travelers that fail to acquire fuel before running out will block a travel lane for a period of time
- EVAC will provide and position fuel trucks for emergency re-fueling
Stakeholder Q&A

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