Preparing for Connected Vehicles

National Rural ITS Conference
Chattanooga, TN
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Topics

• Planning and Preparing for Connected Vehicles
• Connected Vehicle Reference Implementation Architecture
• Rural-Related Applications
• National ITS Architecture / CVRIA
• Training Resources
Enabling Connected Vehicle Environment

• Communications Technology
  – Wide-Area Wireless Communication
  – Short Range Wireless Communication
  – Internet

• Institutional
  – Rise of the Smart Device
  – Expectation of Connectivity
  – Privacy
  – Security
Why Connect Vehicles Now?

• Improve vehicle safety
• Communications standardization
  – 5.9 GHz Dedicated Short Range Communications Family
  – SAE J2735 Message Set for Wireless Communication to/from the Vehicle
    o Basic Safety Message (BSM)
    o Various Vehicle Probe Data Communications
    o Others...
• Motivated coalition of stakeholders including automakers
More Connected Vehicle Information

• USDOT hosts a website with Connected Vehicle basics.
    o Includes topics such as
      • How CV works?
      • How CV will be used?
      • What are CV benefits?
    o 20 Questions about CV
Connected Vehicle is inherently complex

- **Improve Transit Reliability**
  - Connection Protection
  - Transit Signal Priority

- **Improve Pedestrian Safety**
  - Pedestrian in Signalized Crosswalk Warning
  - Intersection Movement Assist

- **Improve Air Quality**
  - Eco-Approach and Departure at Signalized Intersections
  - Eco-Traffic Signal Timing
Managing Complexity through Planning

- Planning breaks down complex systems into smaller, more manageable projects that are deployable.
- Breaking the complexity down requires a clear vision or structure to the overall approach as early as possible.
- The Connected Vehicle Reference Implementation Architecture (CVRIA) can be used to define the components involved in each CV application along with the institutional structure that supports the physical view.
We Need a Common Language

• CVRIA manages the complexity of Connected Vehicle

• CVRIA models the Connected Vehicle functions and communications on a number of levels

• CVRIA establishes a framework for
  – Integrating connected vehicle technologies and
  – Identifying interfaces for standardization
Background of CVRIA

- Landscape: Safety, Mobility & Environmental Applications with common supporting infrastructure
- Looking ahead … 10-20 years when majority of vehicles are equipped in some way – establishing a robust connected vehicle environment
- With so many applications exposing so many opportunities for integration, an architecture is needed to put the components together
CVRIA Views

- Used to capture stakeholders’ concerns
  - Enterprises to carry out applications
  - Functions to satisfy requirements
  - Physical objects to implement that functionality
  - Communications protocols necessary
CVRIA Enterprise View

- Depicts:
  - Relationships between organizations
  - Roles organizations play in delivery of services within the connected vehicle environment
- Addresses system life cycle:
  - Installation
  - Operations
  - Maintenance
  - Certification

Curve Speed Warning

<table>
<thead>
<tr>
<th>Curve Speed Warning</th>
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<tbody>
<tr>
<td>Enterprise Operations</td>
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Physical View – Curve Speed Warning Application

Traffic Management Center
- TMC Environmental Monitoring
- TMC Speed Warning

ITS Roadway Equipment
- Roadway Environmental Monitoring
- Roadway Speed Monitoring and Warning

Driver

Vehicle OBE

Vehicle Databus

Driver Input

Driver Updates

Flow Time Context
1 - Near
2 - Recent
3 - Historical
4 - Scalable

Flow Spatial Context
A - Adjacent
B - Local
C - Regional

Flow Security Context
Clear text, no padding
Encrypted, no padding
Clear text, authenticated, encrypted, authenticated

Curve Speed Warning

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CVRIA Communications View

• Depicts:
  – Layered communications protocols that support communications between physical devices

• Identifies options for…
  – Identity and appropriateness of protocols at all layers
  – How these protocols ensure or support:
    o Anonymity preservation
    o Non-repudiation
    o Message integrity
  – Status of protocols as standards or privately provided protocols and the implications of their use from an evolve-ability perspective
CVRIA Communications View Example
Rural-related Applications

• Rural Challenges
  – Rural Intersection Safety – line of sight issues
  – Run off Road Incidents
  – Road Weather Information Dissemination
  – Mayday or Collision Notification for Incident Response
  – Limited Transit Options

• Needs
  – Reduce Crashes
  – Improve Road Weather Information Collection/Dissemination
  – Improve Crash Notification and Emergency Response Time
  – Improve Accessibility
Curve Speed Warning

Traffic Management Center

TMC Environmental Monitoring

TMC Speed Warning

(2B) environmental sensors control

(2B) environmental sensor data

(2B) speed monitoring control

(2B) speed monitoring information

ITS Roadway Equipment

Roadway Environmental Monitoring

Roadway Speed Monitoring and Warning

(2A) environmental sensor data + reduced speed warning info

Roadside Equipment

RSE Environmental Monitoring

RSE Speed Warning

(2B) reduced speed warning info

(2B) reduced speed warning status

(2A) reduced speed notification

(1A) vehicle location and motion

Vehicle OBE

Driver

driver information

driver input

driver updates

Vehicle Databus

Vehicle Speed Management Assist

driver input information + host vehicle status

driver update information

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Spot Weather Impact Warning
Advanced Automatic Crash Notification Relay

Emergency System Operator
- Emergency operations input
- Emergency operations status

Emergency Management Center
- Emergency Call-Taking
- Emergency Notification Support
- Other Emergency Management Centers

Emergency Vehicle OBE
- EV On-Board En Route Support

Roadside Equipment
- RSE Emergency Notification Support

Driver
- Driver input + request for service
- Driver updates

Vehicle OBE
- (1A) emergency notification + emergency notification relay
- (1A) emergency notification + emergency notification relay
- (2A) emergency acknowledge
- (2A) emergency acknowledge

Vehicle OBE
- (2C) emergency notification relay
- (2B) emergency notification + emergency notification relay

Vehicle OBE
- (2C) incident report
- (2B) incident report

Transit Vehicle OBE
- Transit Vehicle Passenger Counting

Commercial Vehicle OBE
- CV On-Board Cargo Monitoring

Vehicle Databus
- Driver input information + host vehicle status
- Driver update information

Remote Vehicle OBEs
- (1A) emergency notification + emergency notification relay
- (1A) emergency notification + emergency notification relay
- (2A) emergency acknowledge

Two-way flows on the Remote Vehicle OBE interface reflect the fact that the Vehicle OBE could be the disabled vehicle, the passing vehicle, or a relay vehicle. This diagram supports all scenarios and can be used to construct scenarios with any combination of vehicles.

While this application is focused on the Vehicle OBE, a mobile Personal Information Device could also relay a notification. The interfaces would be identical to those shown for the Vehicle OBE.

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Physical
Jul 8, 2015
NAT

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Dynamic Transit Operations
Preparing for Connected Vehicle

- Educate yourself about Connected Vehicle solutions and concepts
- Follow your concept development and planning processes
- Identify your transportation needs
- Evaluate available solutions
- Develop system concept and structure over the life cycle
- Execute your transportation planning process
CVRIA Website

- Organizes the architecture content in a layered hypertext format
- Allows for easy and quick targeted access to topics of interest
- Is updated as CVRIA evolves

http://www.iteris.com/cvria/
SET-IT

• Systems Engineering Tool for Intelligent Transportation (SET-IT)
  – Purpose: Develop project architectures for pilots, test beds and early deployments of connected vehicles
  – Applies CVRIA – build project specific architectures based on a common reference
    o Drawings and database definitions organized into one framework
    o Document generator builds Concepts of Operation using data and diagrams
  – Start with CVRIA and customize it with your names for Elements and Stakeholders
  – Available for free download from CVRIA website
Features of SET-IT

- Create physical, enterprise and communications views of a connected vehicle project architecture based upon CVRIA
- Create physical, enterprise and communications diagrams
- Copy and customize connected vehicle applications and needs from CVRIA
- Output diagrams and tables of architecture components
- Create a concept of operations document for a project
- Provides search box at the bottom of the Overview/Applications page where you first select applications
  - Provides a good way to narrow down the CVRIA applications that pertain to things you are interested in
National ITS Architecture and CVRIA

• CVRIA is being integrated with the National ITS Architecture
  – Available in early 2017

• New software tool set will also be developed
  – SET-IT will be revised for ITS content to apply to project development
  – New software tool being developed to support regional ITS architecture development and maintenance for planning support
    o Replaces functionality found in today’s Turbo Architecture software tool
CVRIA Training and Resources

• CVRIA website at [www.iteris.com/cvria/](http://www.iteris.com/cvria/)
• On-line Training Courses
  – Introduction to CVRIA
  – Introduction to SET-IT

Training on CVRIA and SET-IT is absolutely an essential use of your time if you are going to be developing an architecture involving connected vehicles.
CVRIA Training and Resources

• CVRIA Webinar Series

1. Red light Violation Warning
2. Curve Speed Warning
3. Speed Harmonization
4. Intelligent Traffic Signal System
5. Emergency Vehicle Priority
6. ECO Approach and Departure
7. Weather Responsive Traffic Management
8. Enhanced Maintenance Decision Support
9. Smart Roadside Initiative
10. Freight Advanced Traveler Information Systems
11. Data Distribution
12. Communications Support
13. Core Authorization
14. Pedestrian in Signalized Crosswalk Warning
15. Integrated Multi-Modal Payment
16. Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
17. Incident Scene Work Zone Alerts for Drivers and Workers
Connected Vehicle is Coming

• It is building on ITS with provision of new data sources
• To prepare, we need to…
  – Understand Connected Vehicle Applications
  – Educate ourselves about the CV Environment including support
    o Data Distribution
    o Security and Credentials Management
  – Establish Connected Vehicle vision/approach that meets transportation needs
  – Plan evolutionary deployment of Connected Vehicle
Thank You!

Questions?