Reduced Speed/Work Zone Warning Concept
V2I Deployment Coalition Discussion
August 18, 2015
Acknowledgement and Disclaimer

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Agenda

- Background
- V2I Safety Applications Project
- Reduced Speed/Work Zone Warning
  - Concepts
  - Testing & Evaluation
  - Example Deployment Scenarios
- Some Open Questions
The Federal Highway Administration (FHWA) is conducting a research program to develop Vehicle-to-Infrastructure (V2I) applications that could potentially provide safety, mobility, and environmental improvements to the national highway transportation system.

- ‘Applications’ refers to vehicle- and infrastructure-based electronic systems that utilize wireless communications between vehicles and infrastructure components to provide information / warnings to the driver and/or potential control actions.

- Program began January 2014 and is planned to run for five years
- The CAMP V2I Consortium (FCA, Ford, GM, Honda, Hyundai-Kia, Mazda, Nissan, Subaru, Volvo Truck, and VW/Audi) is responsible for the execution of the various projects authorized under a CAMP/FHWA Cooperative Agreement
- The initial set of projects in this program is expected to focus on Cooperative Adaptive Cruise Control, V2I Safety Applications, Road Weather Management Program, Data Capture and Management, and Eco-Driving
A representative cross section of applications to explore implementation of V2I communication-based safety systems

Three applications addressing intersections, vehicle speed, and localized variances in normal traffic flow chosen as pilot applications for further investigation:

1. Intersection Safety – Red Light Violation Warning (RLVW)
2. Vehicle Speed – Curve Speed Warning (CSW)
3. Traffic Variances – Reduced Speed/Work Zone Warning (RSZW)
   a. Reduced Speed in Work and School Zone (RSZW-RS)
   b. Reduced Speed in Work Zone with Lane Closure (RSZW-LC)

Prototype implementations of each application will be developed for evaluation in OEM test vehicles

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Reduced Speed/Work Zone Warning Concept (1)

- Designed to warn drivers of speed in excess of the posted speed limit in reduced speed zones and changed roadway configurations

- Infrastructure Application Component
  - RSE connection to TMC and/or local network in work zone
  - Speed limit/work zone information provided to vehicle

- Vehicle Application Component
  - OBE issues alert to driver to reduce speed or change lanes

TMC – Traffic Management Center

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Reduced Speed/Work Zone Warning Concept (2)

1. **Relevance**
   - Evaluate relevance of the surrounding work zones
   - Determine work zone based on vehicle approach

2. **Map Matching**
   - Work/School zone map
   - Determine vehicle position
     - Road level for RS
     - Lane level for LC
3. **Warning Level Assessment**
   - For Reduced speed
     - Vehicle speed
     - Distance from start of work zone
     - Speed limit in work zone / presence of workers
   - For Lane Closure
     - Vehicle lane position
     - Lane closure
     - Vehicle speed
     - Distance from start of lane closure
     - Vehicle status (e.g. turn signal)

4. **Inform/Warning Generation**
   - Inform: Work/School zone / Lane closure
   - Warning: Reduce Speed / Lane closure warning (if necessary)
RSZW Testing & Evaluation

Test Goal:
Validate time and location of the issuance and/or suppression of the application’s “Inform” and “Warning” messages to the driver under various test conditions and approach speeds
RSZW Testing

Closed Test Track (Fowlerville, MI)
– Six test scenarios will be conducted at the test track to validate the application performance
– Test scenarios will cover variable speed approaches for reduced speed zone (work/school zone) and lane closures with and without presence of workers
RSZW Evaluation

Public Road:

Application evaluation for infrastructure interaction:

I. Reduced Speed: Hills Tech Dr., near CAMP facility
II. Lane Closure: Farmington Road at W. 13 Mile Road

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Hills Tech Dr.     Farmington Rd at W. 13 Mile
Potential Work Zone Warning
Deployment Scenarios

Examples Based on the European Approach
Example Work Zone Deployment Scenarios

A. Stand-alone trailer
B. Backend-based interface approach
C. Integrated approach
Example Work Zone Deployment Scenario  
(A) Stand-alone Trailer 

A self contained trailer consisting of: 

- GPS 
- DSRC communication equipment 
- Work zone configuration interface
Example Work Zone Deployment Scenario (A) Stand-alone Trailer

Pros:
• No communication with backend required
• Easy setup and configuration (e.g. in conjunction with trailer display)
• Appropriate for dynamic (moving) road works (e.g. hard shoulder cleaning, grass cutting)

Cons:
• May provide limited information about the work zone (lane level map may not be available)
• Speed limit information may not be available (if not configured in the trailer)
Example Work Zone Deployment Scenario

(B) Backend-based Interface Approach

Pros:
• Information can be communicated to RSU at the work zone
• Trailer not required at work zone

Cons:
• Deployment of RSU with communication is required
• May require additional equipment such as power for RSU
Example Work Zone Deployment Scenario (C) Integrated Approach

• Work zone Trailer hardware:
  • GPS
  • DSRC communication equipment
  • Work zone configuration interface
• Communication interface with backend server
Example Work Zone Deployment Scenario
(C) Integrated Approach

Pros:
• Work zone location validation can be achieved
• Additional information can be transmitted (speed limits, work zone map data, ...) to the RSU

Cons:
• Communication (Cellular) connection required
• Interface with TMC required
Some Open Questions

• In case of stand-alone trailer (A) solution:
  – How would the broadcast of the work zone messages be triggered?
  – What information could an operator input that could improve warning to the driver?
  – What would be the interface for the operator look like?
  – Where would the trailer be placed with reference to the start of the work zone?

• In case of back-end interface (B) or integrated (C) solution:
  – How would the validation of the data be performed?
    • Actual position the work zone vs. TMC assumed position
    • Accurate position of lane closures