I-35 Connected Work Zone

Project Status Overview

March 26, 2018

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Introduction and Welcome

Background

What have we done so far?

Identified issues and mitigations

Proposed two-tier approach

Where are we now?

Next tasks
“What are traffic conditions like now?”
“What will traffic conditions be like on any portion of my drive?”
“Where might I be delayed by work zone lane closures?”
Collaboration and Testbed Opportunities

- Federal Highway Administration impressed by depth and breadth of work zone information.
- Developed $2M grant to test concepts of connected vehicles with work zones in the I-35 corridor.
- Three focus areas:
  - Corridor optimization: freight
  - Connected work zone: different daily setups
  - Virtual connected vehicle testbed: test multiple applications
Freight 7-Day Closure Forecast

LISTING COVERS 7AM FRIDAY, NOVEMBER 24 THROUGH 7AM FRIDAY, DECEMBER 1

This listing is subject to change due to inclement weather or other unforeseen events that may occur.

HILLSBORO THRU WAXAHACHIE (I-35E)

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<thead>
<tr>
<th>DATES/TIMES</th>
<th>LOCATION</th>
<th>ROADWAY</th>
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| DELAY       | 7PM      | 8PM     | 9PM 10PM 11PM 12AM 1AM 2AM 3AM 4AM 5AM 6AM |
| 11/29       |          |         | 10      | 15 | 15 |

| 11/30 - 12/1, 9PM - 6AM | I-35 at US-287, Waxahachie | I-35 E Mainlanes (MM 402.0) | All lanes closed | LINK |
| DELAY       | 7PM      | 8PM     | 9PM 10PM 11PM 12AM 1AM 2AM 3AM 4AM 5AM 6AM |
| 11/30       |          |         | 5       | 10 | 10 |

Current Delay as of 3:30 PM

- Hillsboro (MM 368) to Waco (MM 334): 0 min
- Waco (MM 334) to Temple (MM 301): 75 min
- Temple (MM 301) to Salado (MM 279): 0 min

Delay Times:

- SB Northbound: 5 min
- NB Southbound: 5 min
Lane closure and delay information are generally available for the next 7 days and may change frequently. Trip times do not include incident delays. Please consider all information sources in your trip planning.

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<td>Expected Delay: 10 min -- Sterrett Rd to FM 387, Waxahachie: 10/25/2017 8:00:00 PM - 10/27/2017 6:00:00 AM, MM 407.5 - 405.0, Asphalt paving.</td>
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<td>Expected Delay: 30 min -- I-35 E AT US-287, Waxahachie: 10/26/2017 8:00:00 PM - 10/27/2017 6:00:00 AM, MM 404.7 - 403.3, Relocating traffic barrier.</td>
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<td>Expected Delay: 10 min -- Brookside Rd to Cantrell, Waxahachie: 10/26/2017 8:00:00 PM - 10/27/2017 6:00:00 AM, MM 402.5 - 398.0, Placing traffic barrier.</td>
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<td>Expected Delay: 0 min -- Pecan Tree Rd to Pecan, Waxahachie: 10/25/2017 6:00:00 PM - 10/27/2017 7:00:00 AM, MM 397.3 - 391.0, Pavement striping.</td>
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<td>Expected Delay: 0 min -- Derr's Chapel Rd to FM 934 (SSE), Italy: 10/26/2017 6:00:00 PM - 10/27/2017 7:00:00 AM, MM 384.0 - 375.0, Pavement striping.</td>
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<td>Expected Delay: 0 min -- FM 308 to FM 556, Milford: 10/26/2017 6:00:00 PM - 10/27/2017 7:00:00 AM, MM 382.0 - 373.0, Removing traffic barrier.</td>
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<td>Expected Delay: 30 min -- Private Dr. to Hart/Berger Rd, North of Temple: 10/26/2017 7:00:00 PM - 10/27/2017 6:00:00 AM, MM 306.0 - 305.0, Asphalt Paving.</td>
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GOAL (Focus Area 2)

Deploy and test the Reduced Speed Zone Warning / Lane Closure (RSZW/LC) application

- Real-world work zone situations
- Interstate 35
Multiple Objectives to Get to Goal

*Establish methodologies to create, deliver, and test work zone information to connected vehicles*

1. Utilize existing I-35 lane closure information as start
2. Establish methodology(ies) to map work zone
3. Augment database with mapping information
4. Augment Lonestar™ with a connected vehicle module
5. Create connection from lane closure database to Lonestar™
6. Build connected work zone (RSU deployment)
7. Operate connected work zone via Lonestar™
8. Build reference vehicle(s)
9. Test connected work zone (using reference vehicle)
10. Operate RSZW/LC application / collect data / analyze
I-35 Connected Work Zone

- Work Zone Ahead
- Right Lane Closed Ahead
- Lane Ends Merge Left
- Slow Down To 55 mph

Vehicle to Infrastructure (V2I) Consortium

CAMP LLC

Texas Department of Transportation

Texas A&M Transportation Institute
What Have We Done So Far?

- Established multi-agency working relationships
- Developed and refined project timeline
- Established on-going technical communication process

Communicated technical details on:

- I-35 lane closure database
- I-35 lane closure real-time work zone feed
- RSZW/LC concept of operations
- Initial mapping needs and procedures
- Initial elaboration of RSZW/LC application detail
- Initial concept of operations for TxDOT Lonestar™ CV module
- Shared initial equipment list for revised concept of reference vehicle “briefcase based”

Initial collaboration with TxDOT districts for ultimate work zone placement
Issue #1

Work Zones on I-35 are significantly different from those tested in Michigan

• Short-term (from 7 or 10 pm until 7 am next morning)
• Dynamic (different lanes may be closed the same night)

Impact:

• Mapping of work zone may be difficult to accomplish prior to placement

Potential mitigation strategies:

• Search for locations where closure would be same for multiple nights
• Use less fidelity in mapping
Issue #2

Current lane closure database provides only approximate location of scheduled lane closures

- Existing information is geared for traveler information
- Not a complete map of the affected roadway geometry

Impact:

- Not enough existing detail to explicitly map locations at level RSZW/LC needs

Potential mitigation strategies:

- Increase level of detail in lane closure database
- Reduce level of detail needed for RSZW/LC application
Issue #3

Exact location of reference point at start of closure (work zone taper) is not known until the closure is actually deployed

Impact:

- Critical information to RSZW/LC application is missing

Potential mitigation strategies:

- Approximate reference point information
- Create smart barrel technology for reference point
- Reduce information needs for RSZW/LC application
Different lanes closed at the same location during the same timeframe requires re-mapping the roadway

Impact:

- Critical information to RSZW/LC application is missing or delayed until a re-mapping procedure is completed

Potential mitigation strategies:

- Approximate reference point information
- Reduce information needs for RSZW/LC application
- Don’t test/use application on nights where this occurs (not realistic for wide-spread use)
Lane Closure Configurations on I-35

Most Common:

One of two lanes closed

Others:

Different Lanes Closed at Different Times

- 7 pm – 12 pm: Right-Lane Closed
- 1 am – 7 am: Left-Lane Closed

Full Closure with Diversion to Frontage Rd

Frontage Road
Recapping the Issues …..

- Desire exists to test RSZW/LC to the fullest potential
- Information doesn’t (yet) exist to do so
- Developing that is a complicated (and time consuming) process that
  - involves multiple parties,
  - would change how construction is contracted,
  - and performed in the state of Texas
Approach: Two-Tiered Solution

High fidelity scenario

- Detailed lane-level mapping of the roadway and work zone is possible
- Reference point (beginning of lane closure taper) can be accurately defined
- Full information load for RSZW/LC application is supported

Lower fidelity scenario

- Less detail mapping of the roadway and work zone
- Reference point is estimated
- Reduced information load for RSZW/LC application is supported

Additionally

- CAMP has developed multiple mapping procedures which can be used to support the above fidelity points
High-Fidelity Scenario

Lane-Level Mapping of the Roadway

WZ Lane Closure Data
- Lane Closure location and length
- Which lane is closed
- Time and duration of closure

Approach Lane Geometry Points + Work Zone Lane Geometry Points

Complex messages set that depends on
- vehicle’s lane position/occupancy
- distance from Ref. Point (lane closure taper)

Inactive Map Points

Work Activity
Lower Fidelity Scenario

Road-Level (Center-Line) Mapping of the Roadway

WZ Lane Closure Data
- Lane Closure location and length
- Which lane is closed
- Time and duration of closure

Simple Messages (e.g. Right Lane Closed Ahead)
- Does NOT depend on lane position/occupancy
- May depend on distance from lane closure
Multiple Mapping Procedures

**Instrumented vehicle**
- Drive work zone area
- Stay in lane
- 10 Hz data collection
- CAMP data reduction routine to ensure contiguous points and geometry stay in lane
- Identify offsets to other lanes and replicate
- Identify reference point and WZ end points
- Process XML for RSU upload

**Google Earth**
- Virtually drive work zone area
- Identify reference point and WZ end points
- Pick lane geometry node points for each lane
- Relies on updated imagery
- CAMP data reduction
- Process XML for RSU upload
Current Status

- Progressively elaborating technical issues
- Successfully collaborating between agencies
- Establishing definitive direction for a complex issue
- Creating plans and timelines for next steps
### Next Steps

1. Baseline information needs between high and lower fidelity scenarios
2. Establish procedure for locating mapping data
3. District and contractor look-ahead/coordination
4. Multi-agency meeting and field visit (THIS MEETING!)
5. Equipment procurement (possibly significant lead times)
6. Equipment testing
QUESTIONS