



I-35 Traveler Information During Construction

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Presentation Outline

Background

Needs Assessment

Concept of Operations

Design

Procurement

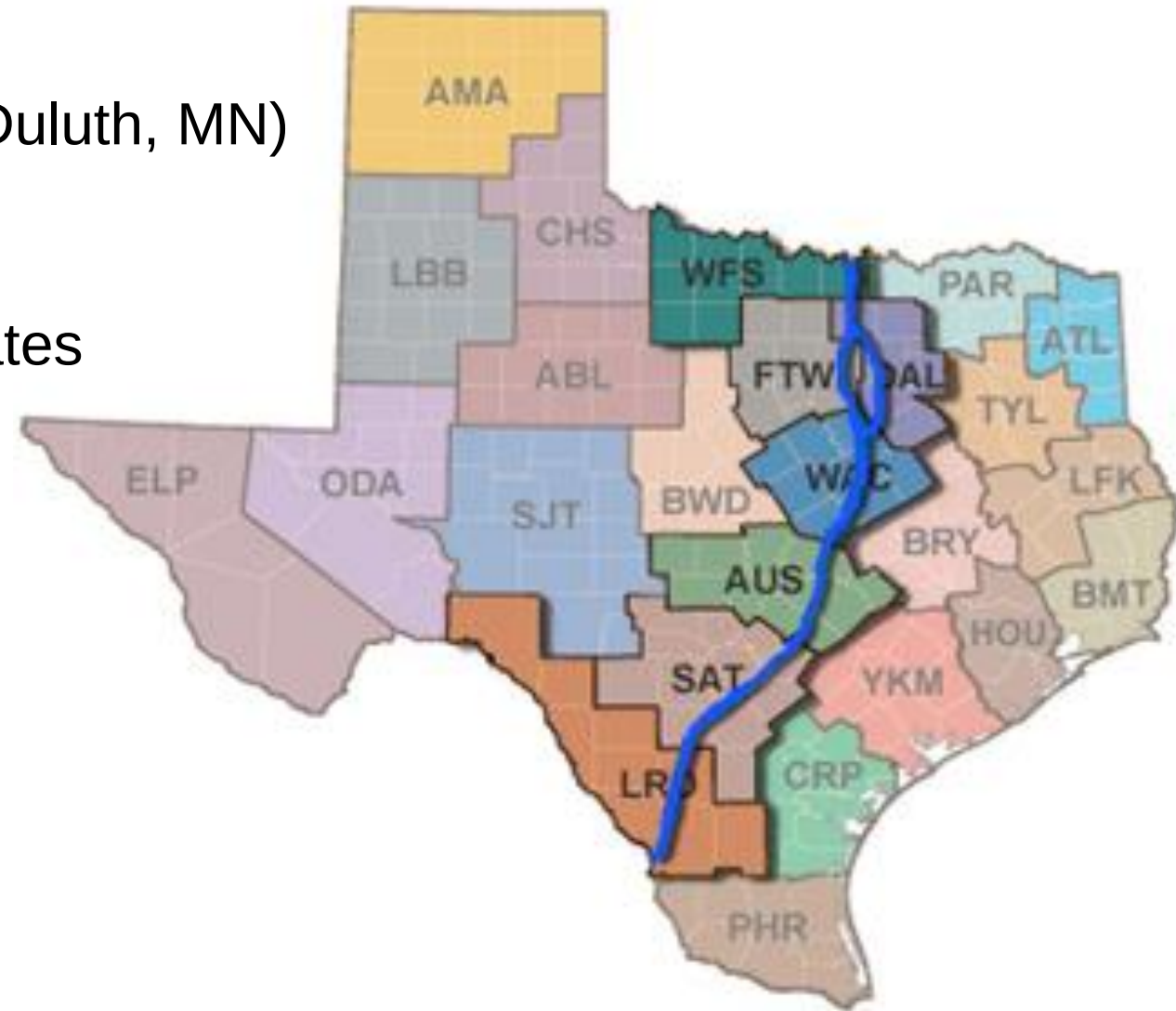
Deployment

Operations, Maintenance, Evaluation



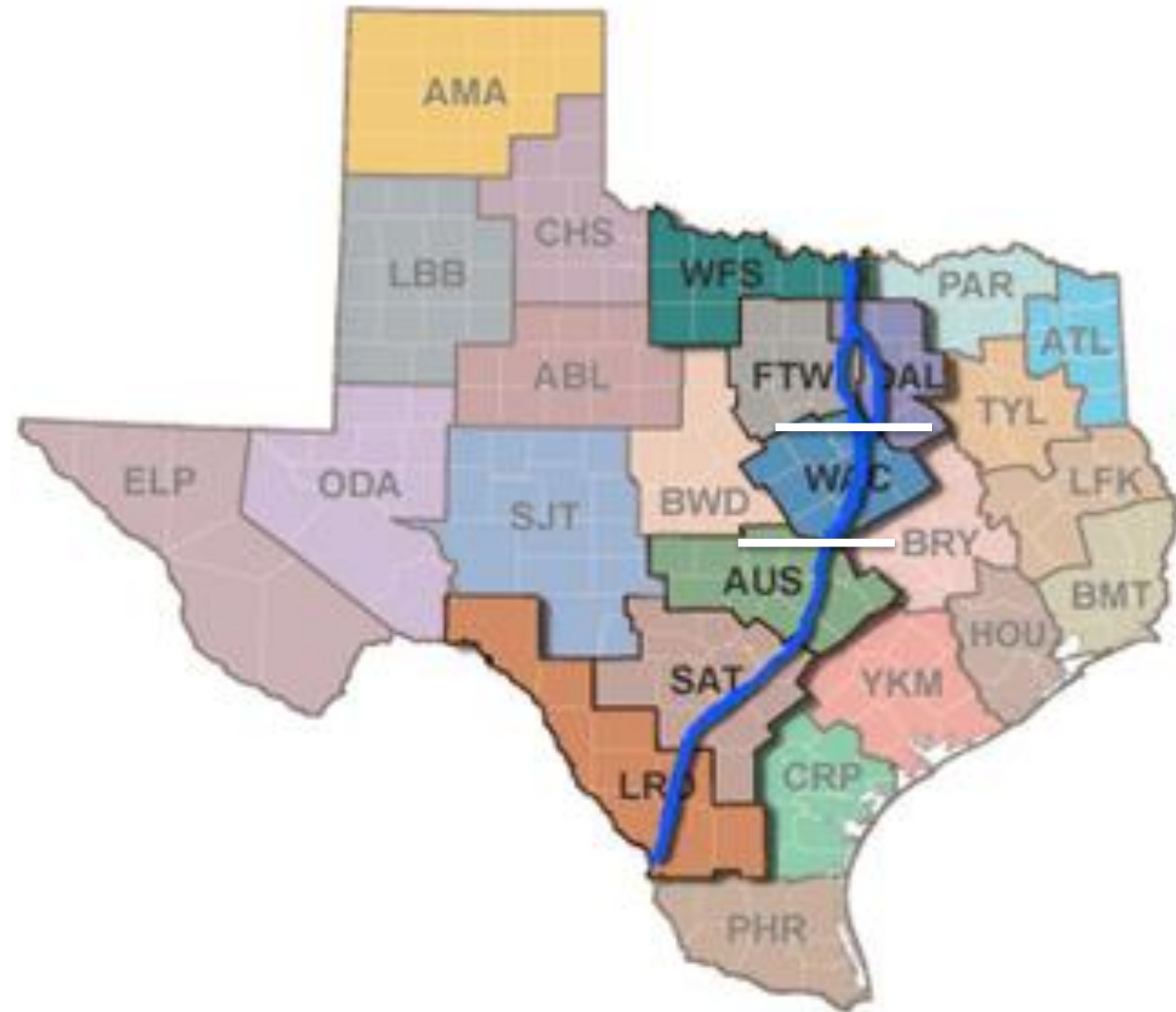
I-35 Overview

- 1,565 miles in length (Laredo, TX – Duluth, MN)
- 505 miles in Texas
- Multiple connections to other Interstates
Ex: 10, 20, 30, 40, 70, etc.
- 50% of Texas population lives within 50 miles
- Crosses 7 TxDOT districts
- Impacts *every* TxDOT district



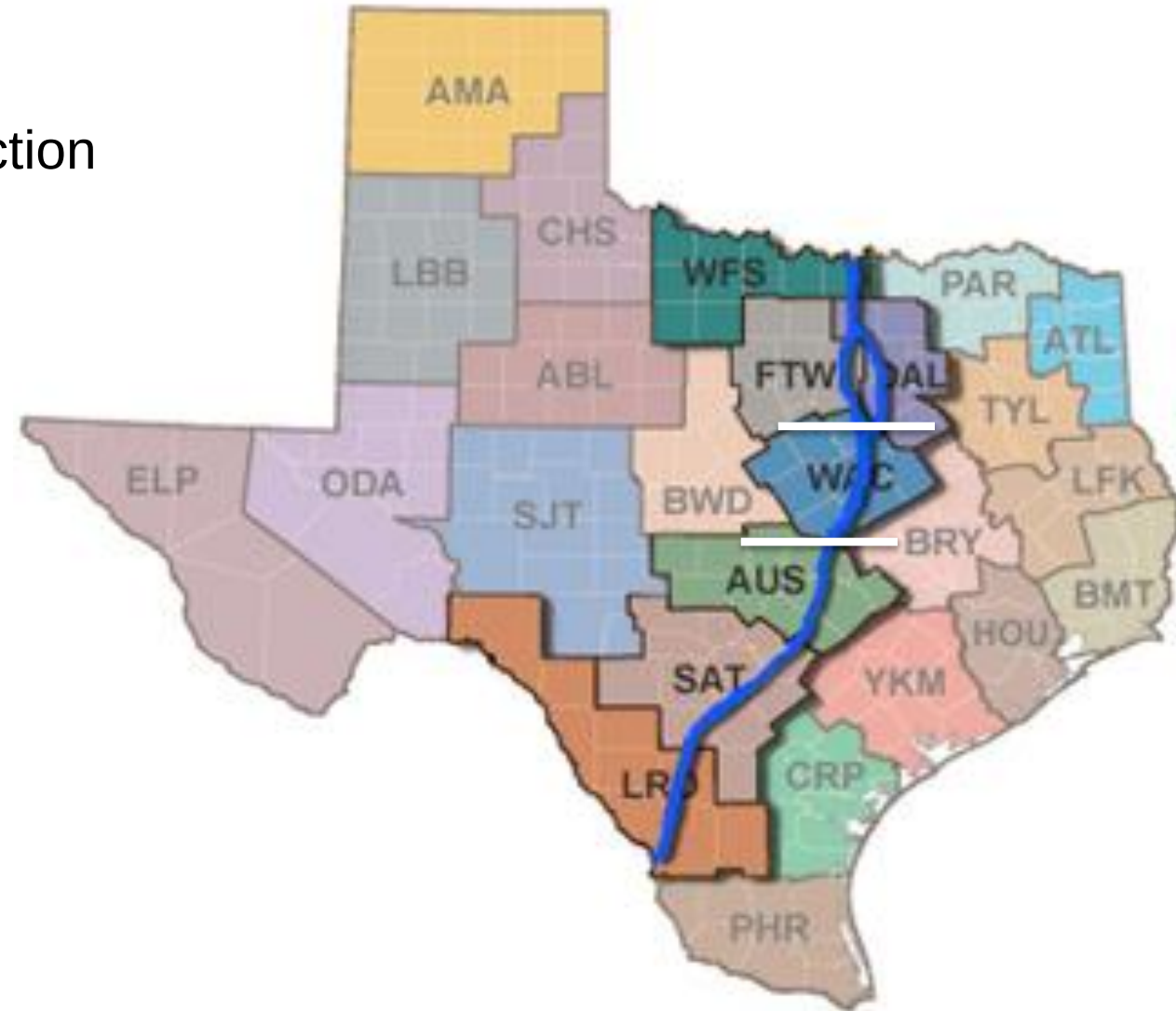
I-35 in Waco District Overview

- 96 miles
- ADT range: 50K to 110K (2010)
- >25% trucks
- 1,000 businesses front I-35
- 2/3rd through travel
- No ITS / comm infrastructure
- Major TMCs on either end



I-35 Construction Overview

- In rural sections
 - Widen from 2 to 3 lanes in each direction
- In urban sections (Waco, Temple)
 - Widen from 3 lanes to 4
- Continuous 1-way frontage roads
- Ramp improvements
- Largest project in TxDOT history
- A decade of construction



I-35 Construction Issues

- Localized congestion
- Multiple independent work zones
- Lane closure queues and speed differentials
- Lane closure delay
- Construction impacts
- Limited cross section for equipment deployments
- No power or comm



Corridor Project Characteristics

**\$2.1
billion**

96-MILE

corridor
construction
project cost

Coordination
of **17**

DIFFERENT PROJECTS

with
multiple
contractors

**60,000
to
132,000**

VEHICLES

per day


**30+
million**

TRAVELERS

per year

**25%
to
35%**

TRUCK

traffic


Construction

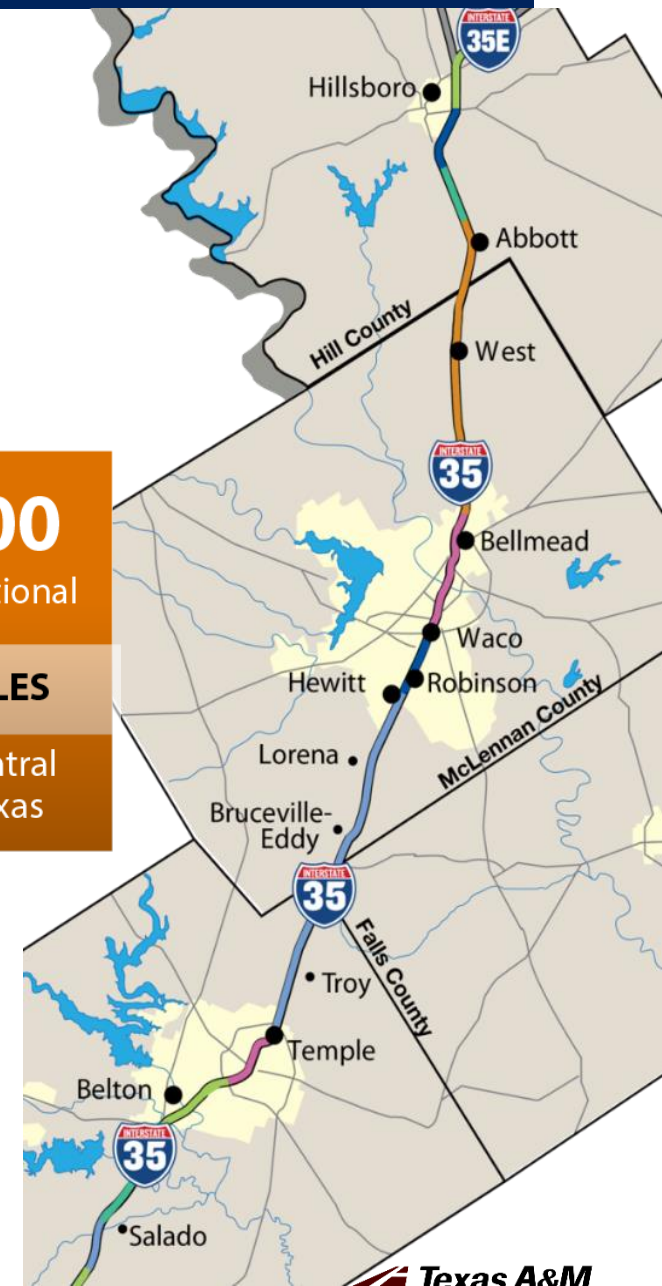
IN PROGRESS

estimated
complete
2019

200
directional

MILES

Central
Texas



Construction Requirements

- Lane closures limited to evenings
 - Sun 10:00 p.m.–Mon 7:00 a.m.
 - Mon - Fri, 7:00 p.m.–7:00 a.m.
- Lane rental fees
- Lane closure blackout dates
- Advance notifications
- 6-day work week
- Incentives for completing ahead of schedule



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The Work Zone ITS Process



U.S. Department of Transportation
Federal Highway Administration

Work Zone Intelligent Transportation Systems Implementation Guide

Use of Technology and Data for Effective
Work Zone Management

January 2014



Assessment of Needs

Concept Development and Feasibility

Detailed System Planning and Design

Procurement

System Deployment

System Operation, Maintenance, Evaluation



User Needs – Traditional Systems Engineering Approach

- Questions:
 - “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?”
- Vision:

During the 100-mile I-35 widening project....
provide an innovative capability, to present travelers information on:

 - current and projected travel conditions
 - (local, regional, and corridor-wide)
 - across multiple construction zones
 - that is timely, accurate, and useful
 - to provide a more safe and predictable travel experience on I-35

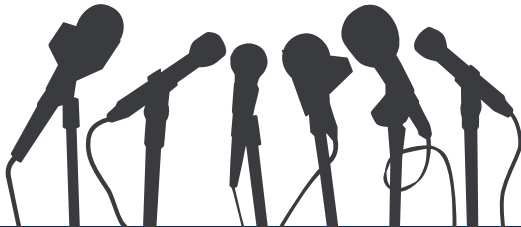


Project Goals

- Utilize a systematic process to build traveler information solutions
- Create a traffic conditions monitoring capability
- Integrate traffic conditions data
- Create a traffic conditions assessment capability
- Create a traveler information dissemination capability
- Operate and maintain the system
- Evaluate the effectiveness of the system



Corridor Stakeholders

User Needs: Local Traveler

- Corridor travel time/speed by segment
- Lane (and ramp) closure information, including locations, schedule, and current and projected delay.
- Incident information, including location, type, and status and impacts on corridor travel time
- Queue warning and end-of queue notification
- Obtain information both pre-trip and en-route



User Needs: Commercial Vehicle

- Corridor travel time/speed by segment, current and projected.
- Lane (and ramp) closure information, including locations, schedule, and current and projected delay.
- Incident information, including location, type, and status and impacts on corridor travel time
- Queue warning and end-of queue notification
- Obtain information both pre-trip and en-route
- Alternative routes and route status to potentially avoid congestion/delays
- Truck/heavy vehicle restrictions



(Additional) User Needs: TMCs

- Access to system information to determine corridor status, both historical and real-time
- Access to corridor devices if charged with after-hours management and operations



Aggregate User Needs

Travelers Contractors Mobility Coordinators TxDOT Traffic Management Centers					
 Travel Time/Speed	 Lane Closure Information	 Incident Information	 Queue Warning	 Information Pre-trip and En Route	 Alternate Routes
 System Information	 Management and Operations Devices	 Data Warehouse	 System Reports	 TMC Data Exchange	

I-35 Construction Issues/Solutions

Issue	Information Need	Solution	On-Road Deployment
Localized congestion	Current travel times on I-35	Present recent travel time information over next 5–10 miles	• BT readers • Travel time PCMS • CCTV
Lane closure – queues & speed differentials	Warning for slow/stopped traffic	Provide a mobile queue warning system, deployed nightly as needed	• Mobile queue warning system • Data driven PCMS messaging
Lane closures – delay	<u>Before departing</u> – Advance notice	Analyze lane closures for impact and disseminate	• Wavetronix
	<u>While traveling</u> – Expected delay updates	Communicate expected delays along I-35 corridor	• Wavetronix • On-call queue warning system • BT readers • Construction delay signs
Construction impacts	Detailed performance metrics	Collect, archive, and analyze lane closure activities and impacts	• Mobile queue warning system • BT readers • Wavetronix



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I-35 Traveler Information During Construction System (I35TIDC)

Corridor Data
Collection
Subsystem
(CDCS)

Construction
Traveler
Information
Subsystem
(CTIS)

Corridor
Performance
Metrics
Subsystem
(CPMS)

Incident
Messaging
Notification
Subsystem
(IMNS)

Data Storehouse Subsystem (DSS)

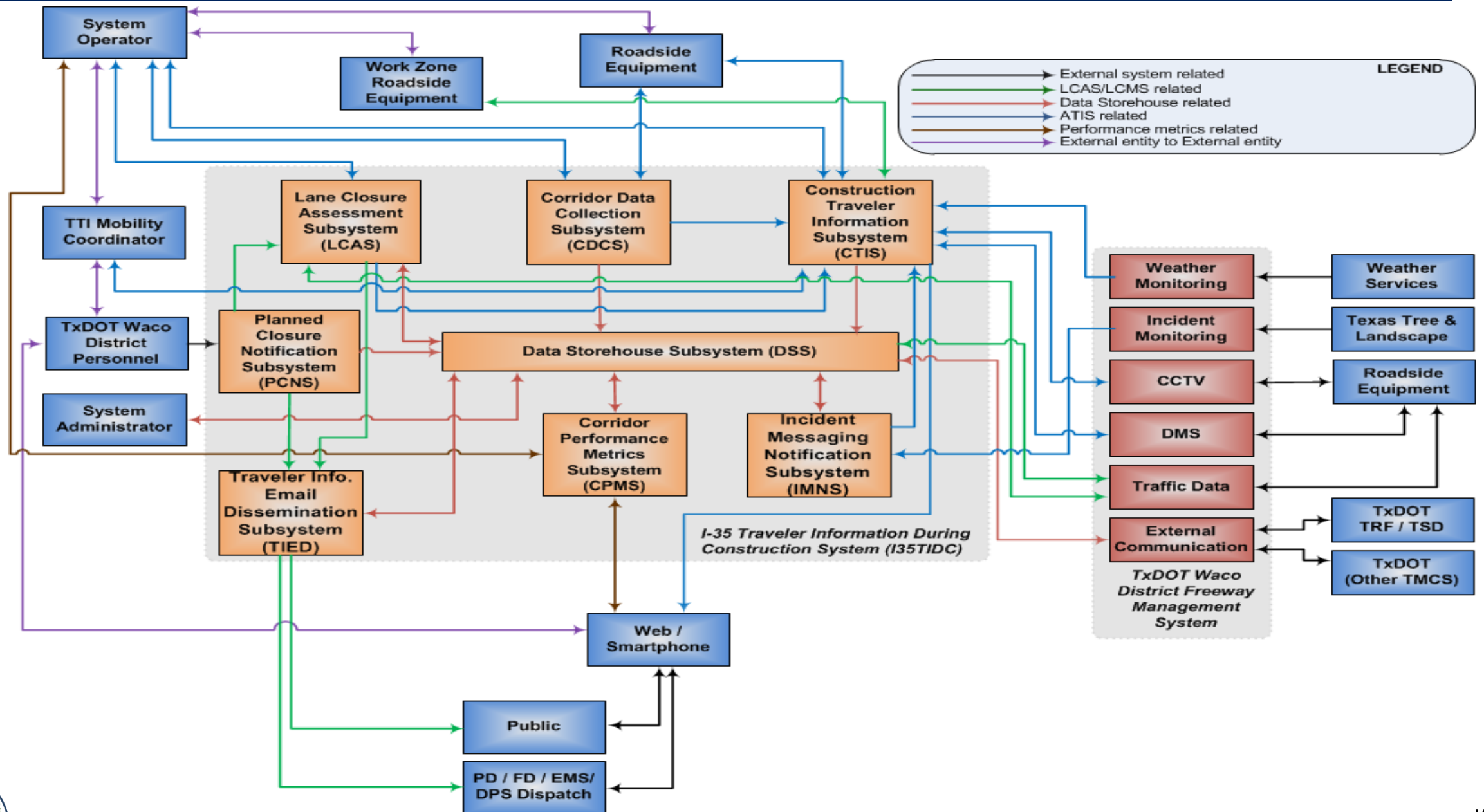
Lane Closure
Assessment
Subsystem
(LCAS)

Planned
Closure
Notification
Subsystem
(PCNS)

Trav. Info. Email
Dissemination
Subsystem
(TIED)







Operational Scenario: Normal Condition Assumptions

- Normal weather conditions
- No lane closure
- Congestion delay may be incurred from recurrent congestion where demand exceeds the available capacity
- En-route needs only travel time monitoring system



Normal Conditions: Primary Functions

- Provide users with current and projected travel conditions
 - Users likely to use it only for informational purposes
 - Travelers unlikely to alter their travel choices
- Provide travel time and speed data for archival purpose
- Provide travel time and speed data for predictive system components
- Provide travel time and speed data for performance monitoring and system evaluation



User Groups and Needs for Normal Operations

User Groups	Needs
TMC	• Corridor travel time and speed by segment to communicate to their customer base. • Access to system information to determine real-time and historical corridor condition. • Access to corridor devices if charged with after-hours management and operations.
Travelers – All	• Corridor travel time and speed by segment (current and projected).
Local Governments	• Corridor travel time and speed by segment (current and projected).
Media	• Corridor travel time and speed by segment (current).
Mobility Coordinator	• Access to data warehouse of corridor information. • Access and permissions to enter information into data warehouse. • Access to all pre-trip and en-route information dissemination mechanisms.
TxDOT	• Corridor travel time and speed by segment (current and projected). • Access to system information to determine corridor status, both historical and real-time. • Access to corridor devices for management and operations. • Access to data warehouse of corridor information. • Access to all pre-trip and en-route information dissemination mechanisms. • Access to periodic system operational performance reports.



Operational Scenario: Lane Closure Condition Assumptions

- Number of travel lanes is reduced due to construction
 - At least one lane is still open in each direction for traffic
 - Closure may involve a diversion to frontage road
- Schedule is planned in advance with at least 24-hour notice
- Congestion delay may be incurred from a combination of recurrent demand and reduced capacity

LANE CLOSURE CONDITIONS



Lane Closure Conditions: Primary Functions

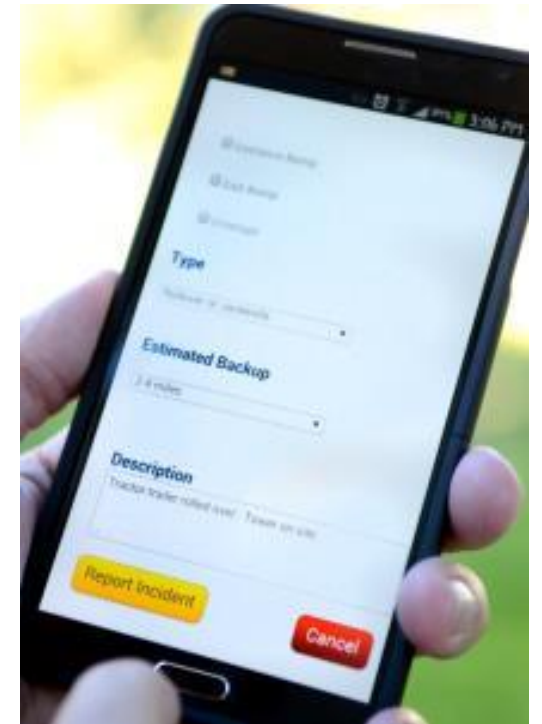
- Provide travelers with **advanced warning of queue condition**. The travelers are likely to use this information to adjust their travel speed as they approach the end of queue.
- Provide travelers with **expected delay** that may be incurred from the lane closure. The travelers are likely to use this information and decide if the route diversion and/or change of departure time are necessary.
- Provide travel time, speed, and queue data for archival purpose.
- Provide travel time, speed, and queue data for regular operations and lane closure planning.
- Provide travel time, speed, and queue data for performance monitoring and system evaluation.



Operational Scenario: Incident Condition Assumptions

- An incident blocking travel lanes has occurred and a significant reduction in roadway capacity or complete blockage is expected
- Congestion delay may be incurred from a combination of recurrent demand and reduced roadway capacity

INCIDENT CONDITIONS



Presentation Outline

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Procurement

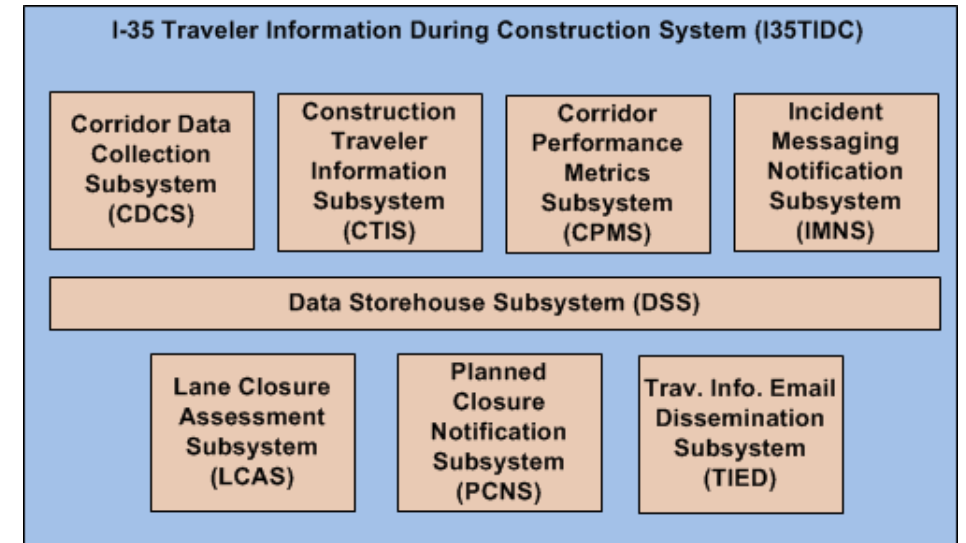
Deployment

Operations, Maintenance, Evaluation



I35TIDC Subsystems

- Map data flow between systems at the onset
- Data get entered once
- Data transferred via open source data formats
- Consistency in programming base not as important as absolute consistency in data exchange
- Build +90% base – enhance throughout project as needed
- Build separate production and development environments



I35TIDC Subsystem Naming

- Planned Closure Notification System (PCNS)
- Lane Closure Assessment System (LCAS)
- Traveler Information Email Distribution System (TIED)
- Corridor Data Collection System (CDCS)
- Construction Traveler Information System (CTIS)
- Incident Messaging Notification System (IMNS)
- Corridor Performance Metrics System (CPMS)
- Data Storehouse System (DSS) (virtual)



PCNS – Planned Closure Notification Subsystem

- **PURPOSE:** central point for all lane closure information
- Built off of Houston Transtar work
- Handles:
 - Construction, Maintenance, Special Events, Accident Investigation, etc.
 - Multiple “major roads” (I-35, I-35E, etc.)
 - Unlimited cross streets
 - Unlimited # of closures
 - Recurring, Permanent, Continuous, etc.
- Underlying geobase contains:
 - Roadway, cross streets, lat/long, MM, county, job section, etc.
- Special flag situations for:
 - High Impact Hold, Cancellations, Ending Early, Exceptions
- **PROVIDES:** lane closure XML data feed to other subsystems
- **STORES:** all received lane closure activity



PCNS – How Does It Work?

- Manual data entry
 - Don't make TxDOT do dual data entry to Drive Texas
 - Closures updated at least 2x per day (7 a.m., 3:30 p.m.)
- Database with web page interface
- Automation tasks in background
- Resulting XML data feed of all current and future lane closures gets updated 1x per minute
- Data feed can be queried by date for past closures
- Database records with complete history can be exported via web interface
- Each closure has and maintains a unique ID number



PCNS (Continued)

- Production Environment:
 - <https://www.my35closurenotification.org/>
 - Available outside of TAMU/TTI
 - Password protected
- Production Data Stream:
 - https://www.my35closurenotification.org/i-35/data/i-35_lane_closures_out.xml
 - No restrictions on data stream access (currently)



```

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<lane6>False</lane6>
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<lane8>False</lane8>
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<description>Bridge construction.</description>

```



LCAS – Lane Closure Assessment Subsystem

- **PURPOSE:** predict impacts (queues and delay) for each main lane closure in PCNS
- Built off of Ullman QDAT work
 - Expected (Normal Parameters)
 - Worst (Volume +10%, Capacity -10%)
- Handles:
 - Main lane closures on I-35
 - Doesn't assess ramps, frontage roads, cross streets, etc.
 - Breaks multiple night closures into nightly impacts
- **PROVIDES:** queue and delay estimates by hour of closure, to other subsystems.
- **STORES:** assessment report for each closure
 - XML and HTML



LCAS – How

- Completely a
- 1x per minute
- If new or upd
- Output data t
- Produces rep

Closure Impact Assessment Report

Construction on I-35

Northbound

Full-Lane Closure (Modified)

From: At E FM 2837 - Rosenthal Rd, McLennan (Mile Marker: 322.0)

To: At W FM 2837 - Old Lorena Rd, McLennan (Miler Marker: 323.0)

As of 11/13/2013

Closure ID: 1491

Last Modified: 11/13/2013 1:19:36 PM by d-middleton@tamu.edu

Planned Start Time: 11/25/2013 07:00 PM (Modified)

Planned End Time: 11/26/2013 07:00 AM (Modified)

Duration: Nightly

Number of Main Lanes: 2 (Modified)

Lane(s) Closed: Left Shoulder; Left Lane; Right Lane; Right Shoulder (Modified)

Closure Length: 1.0 mi.

Date: Monday, 11/25/2013

Maximum Queue Length

- Expected: 0.4 mi.
- Worse Case*: 2.1 mi.

From	To	Expected Queue (mi)	Expected Delay (min/veh)	Worse Case* Queue (mi)	Worse Case* Delay (min/veh)
07:00 PM	08:00 PM	0.3	2.4	1.0	7.4
08:00 PM	09:00 PM	0.4	3.5	1.9	13.5
09:00 PM	10:00 PM	0.1	1.4	2.1	15.7
10:00 PM	11:00 PM	0.0	0.0	1.8	14.6
11:00 PM	12:00 AM	0.0	0.0	0.6	4.6
12:00 AM	01:00 AM	0.0	0.0	0.0	0.0
01:00 AM	02:00 AM	0.0	0.0	0.0	0.0
02:00 AM	03:00 AM	0.0	0.0	0.0	0.0
03:00 AM	04:00 AM	0.0	0.0	0.0	0.0
04:00 AM	05:00 AM	0.0	0.0	0.0	0.0
05:00 AM	06:00 AM	0.0	0.0	0.0	0.0

S



LCAS

- **Initial** production version utilized 2009 ADT counts at count station along corridor and adjusted volumes by section
- **Current** production version utilizes rolling 10-week historical average of Wavetronix volume data from 19 count stations along corridor
 - Took time to get all the data collection stations installed



CDCS – Corridor Data Collection Subsystem

- Multiple components:
 - BT, Wavetronix, CCTV
- **PURPOSE:** provide data from corridor equipment
- **RECEIVES:** data from equipment deployed to provide travel time monitoring
- **PROVIDES:** data to other subsystems and for analysis
- **STORES:** raw and processed data
 - by locations, segment, TOD/DOW, etc.
- Each component utilizes its own data store



CDCS – How Does It Work?

- Each component (BT, Wavetronix, etc.) act independently for data collection, analysis, and storage
- 24/7 archiving, logging, monitoring
- Each component shares data and/or configuration information as needed via a data stream
- All components are leave-in-place for Waco ITS
- All components have/will be integrated into Lonestar



CDCS - Outputs

- BT and Wavetronix have heartbeat and performance monitoring systems
- Comprehensive data stores
- O&M logging for all field issues
- Web site interface to data
 - Downloadable data via query
 - Graphic outputs in multiple formats
 - Data available in XML feeds

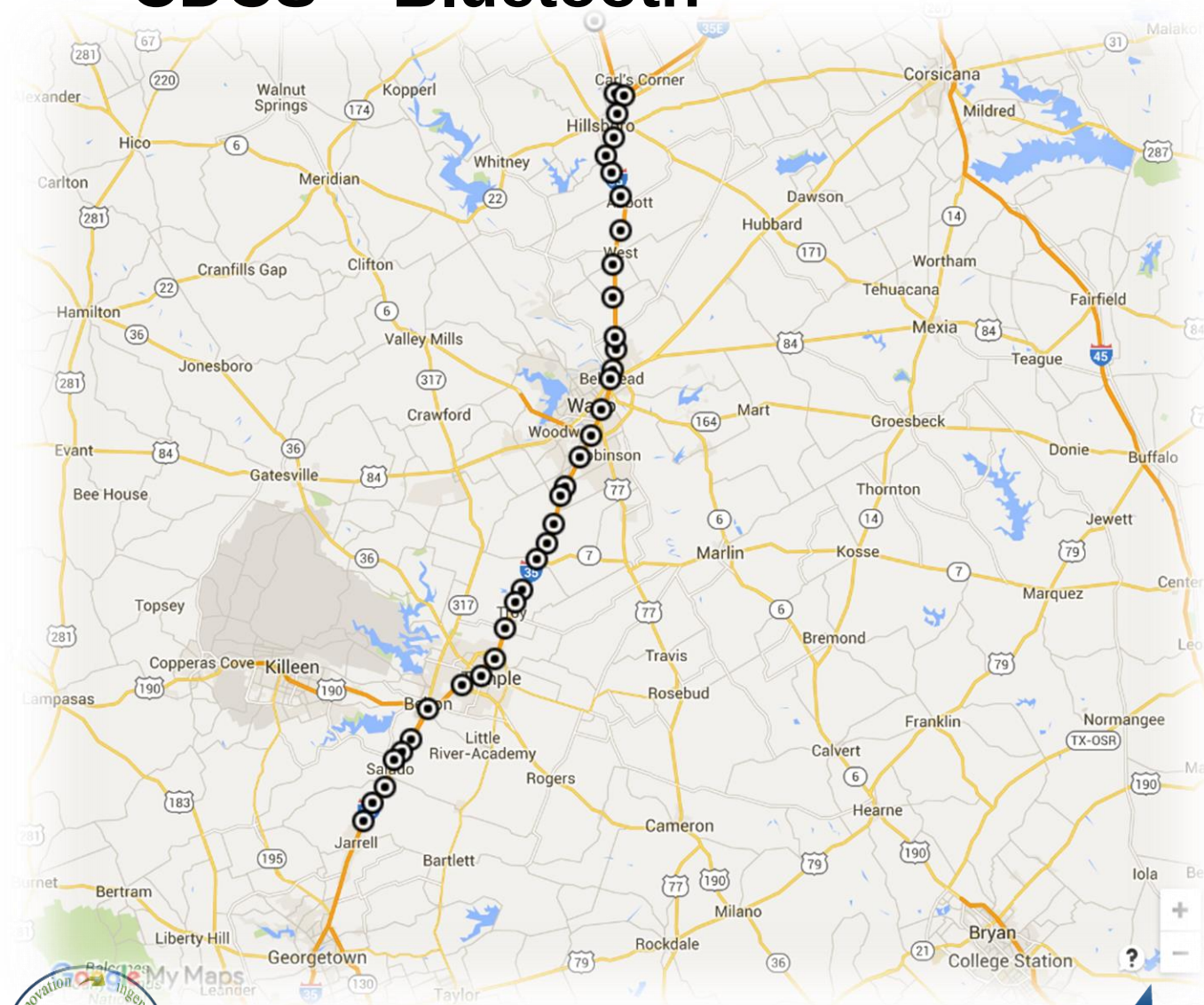


CDCS - CCTV

- District operational use
- TxDOT has full operational control either direct via OEM software or via LoneStar
- TxDOT takes snapshots
- TTI does not access, PTZ, store images, etc.
 - BRB Camera exception
- Statewide ITS website
 - <http://its.txdot.gov/WAC/WAC.htm>



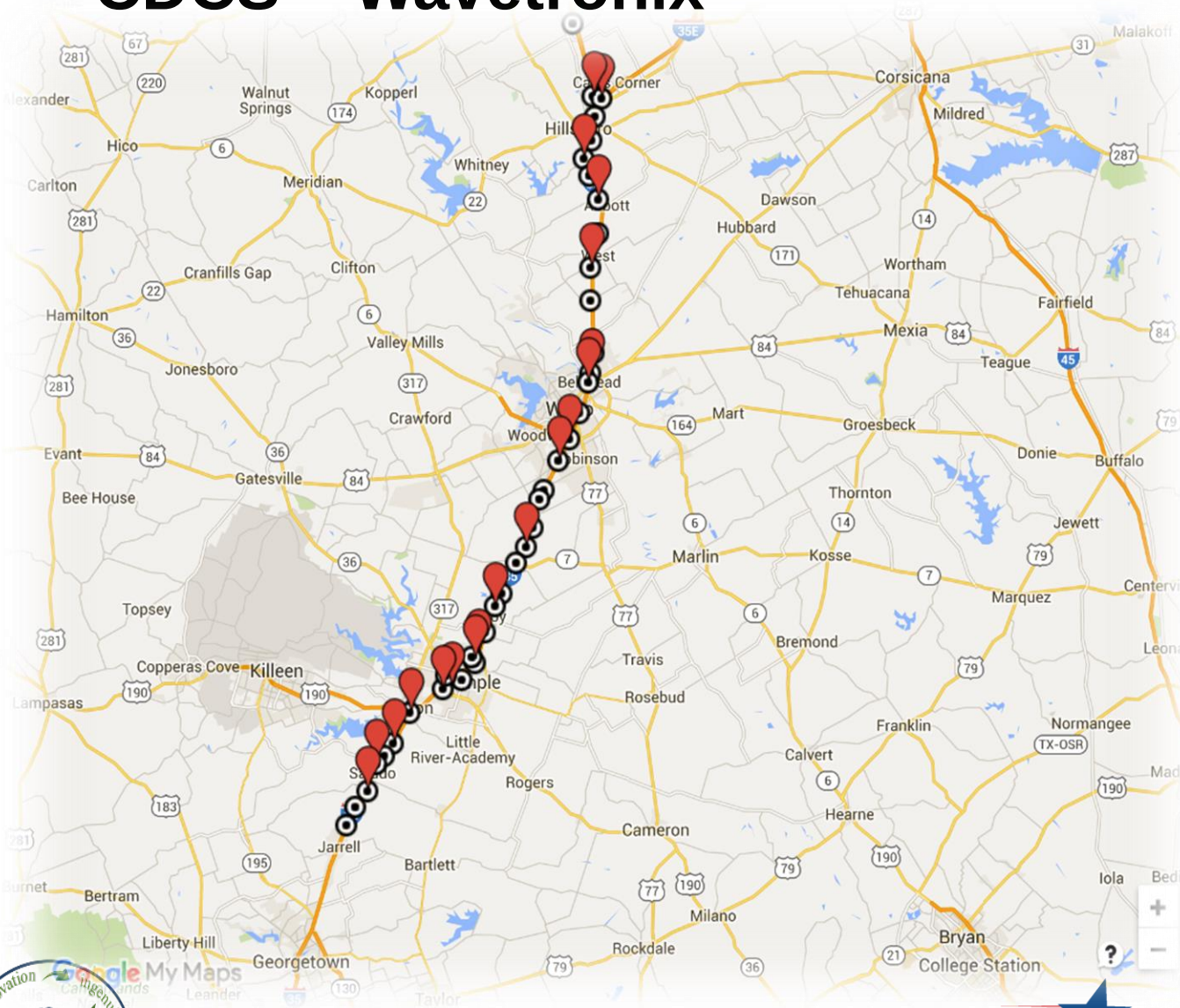
CDCS – Bluetooth



- 43 sites on I-35 throughout WAC
- Meets FTW, DAL, AUS infrastructure
- Several thousand matches per day at most sites
- Used for:
 - Travel times
 - Incident analysis
 - Daily operations report
 - Corridor delay
- 6 year data archive



CDCS – Wavetronix



- 19 sites on I-35
- Bi-directional counts and classifications
- Used for:
 - Lane closure impact assessment
 - Projections of least impact
 - End-of-queue analysis
- 6 year data archive

- 

CDCS: I-35 Field Deployments

- In total, more than 150 data collection sites
- San Antonio past Hillsboro (both E/W split to meet DAL, FTW)
- Co-location of equipment where possible
- Solar power based
- Cellular connectivity
 - 3G for data
 - 4G for CCTV
- Significant alternate route deployment



CTIS – Corridor Traveler Information Subsystem

- Multiple components:
 - Travel Time (Destination, Comparative)
 - Corridor Delay
 - End of Queue
- **PURPOSE:** computes and distribute en-route traveler information messages
- **RECEIVES:** data from other systems (travel time, projected delays, existing delays and queues, volumes, etc.)
- **COMPUTES:** traveler information for dissemination. May be by segment, location, or corridor and with different time horizons
- **PROVIDES:** en-route traveler information to other subsystems and for external dissemination by multiple techniques
- **STORES:** data per segment, by time of day or by activity
 - Each component utilizes its own data store



CTIS – How Does It Work?

- Each component acts independently for data computation, output, logging, and storage
- 24/7 archiving, logging, monitoring
- Each component shares data and/or configuration information as needed via a data stream
- Utilizes Lonestar for communication to roadside equipment



CTIS – Travel Time System

- Builds upon links defined in BT travel time output file
- Links may be proportional based upon location of PCMS with respect to BT segments
 - Links *may* change when BT readers or PCMS change locations
- Multiple configurations defined for each travel time segment
 - BT reader outages
 - Insufficient or improper quality data
- Destinations:
 - Iteration 1: Mix of major roadways and city destinations
 - Iteration 2: City destinations



CTIS – Travel Time System

- Communications:
 - System communicates to Lonestar via C2C
 - Lonestar handles all communications to PCMS
 - In beginning of project, Lonestar was enhanced to deal with PCMS on cell communications
 - Waco runs out of the Fort Worth parent TMC
- Messages
 - Travel times generated every 5 minutes for every PCMS
 - Messages sent with an expiration time of 20 minutes
 - Travel time messages sent at lower priority
 - Allows higher priority messages (incident, etc.) to override
 - System reverts to lowest priority when higher priority expires or is removed
 - District can take over PCMS for significant situations (defined business rules)



CTIS

- Log

- E

- M

- N

	A	B	C	D	E	F	G	H	I	J	K	L
1	Started on: 3/14/2013 12:00:27 AM											
2	PCMS-ID	% Online	Online Co	Error Cou	Offline Co	Total Cou	Location	Destinati	Direction	Distance	Lat	Lon
3	WAC.TT.PCMS.NB-1	100	288	0	0	288	IH-35	BELTON	North	11	30907509	-9.8E+07
4	WAC.TT.PCMS.NB-10	100	288	0	0	288	IH-35	I35 E/W	North	12	31896852	-9.7E+07
5	WAC.TT.PCMS.NB-2	100	288	0	0	288	IH-35	TEMPLE	North	6	31058945	-9.7E+07
6	WAC.TT.PCMS.NB-3	100	288	0	0	288	IH-35	TROY	North	11	31091695	-9.7E+07
7	WAC.TT.PCMS.NB-4	99.30556	286	2	0	288	IH-35	LORENA	North	17	31154627	-9.7E+07
8	WAC.TT.PCMS.NB-4B	100	288	0	0	288	IH-35	HEWITT	North	18	31230803	-9.7E+07
9	WAC.TT.PCMS.NB-5	100	288	0	0	288	IH-35	WACO	North	15	31346362	-9.7E+07
10	WAC.TT.PCMS.NB-6	100	288	0	0	288	IH-35	WACO	North	5	31480868	-9.7E+07
11	WAC.TT.PCMS.NB-7	100	288	0	0	288	IH-35	ELM MOTI	North	12	31504613	-9.7E+07
12	WAC.TT.PCMS.NB-8	100	288	0	0	288	IH-35	WEST	North	12	31625778	-9.7E+07
13	WAC.TT.PCMS.NB-9	100	288	0	0	288	IH-35	HLLSBORC	North	15	31802388	-9.7E+07
14	WAC.TT.PCMS.SB-1	100	288	0	0	288	IH-35	WEST	South	16	32029963	-9.7E+07
15	WAC.TT.PCMS.SB-10	100	288	0	0	288	IH-35	SALADO	South	7	31023425	-9.7E+07
16	WAC.TT.PCMS.SB-2	100	288	0	0	288	IH-35	ELM MOTI	South	20	31947592	-9.7E+07
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20	WAC.TT.PCMS.SB-7	100	288	0	0	288	IH-35	TEMPLE	South	10	31226472	-9.7E+07
21	WAC.TT.PCMS.SB-7B	0	0	0	288	288	IH-35	TEMPLE	South	19	31351566	-9.7E+07
22	WAC.TT.PCMS.SB-8	100	288	0	0	288	IH-35	BELTON	South	10	31125058	-9.7E+07
23	WAC.TT.PCMS.SB-9	100	288	0	0	288	IH-35	SALADO	South	12	31074531	-9.7E+07
24	Closed on: 3/15/2013 12:00:31 AM											
25												
26												

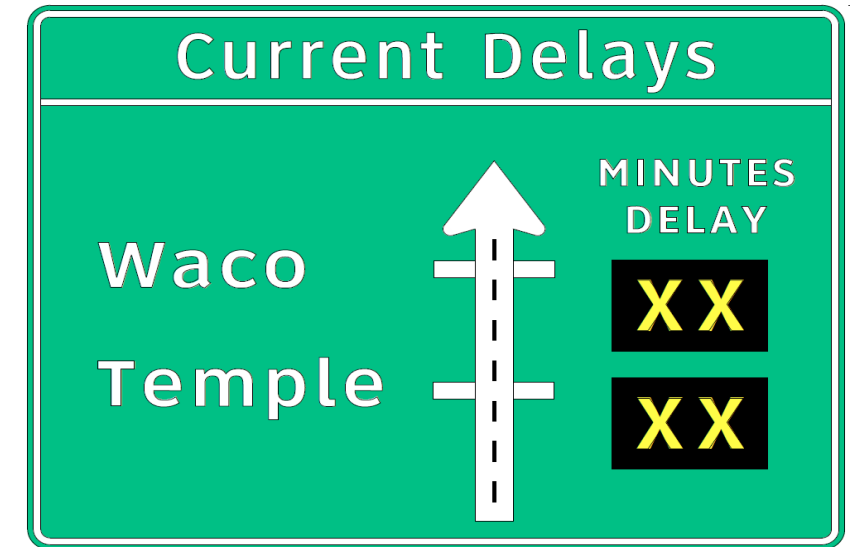
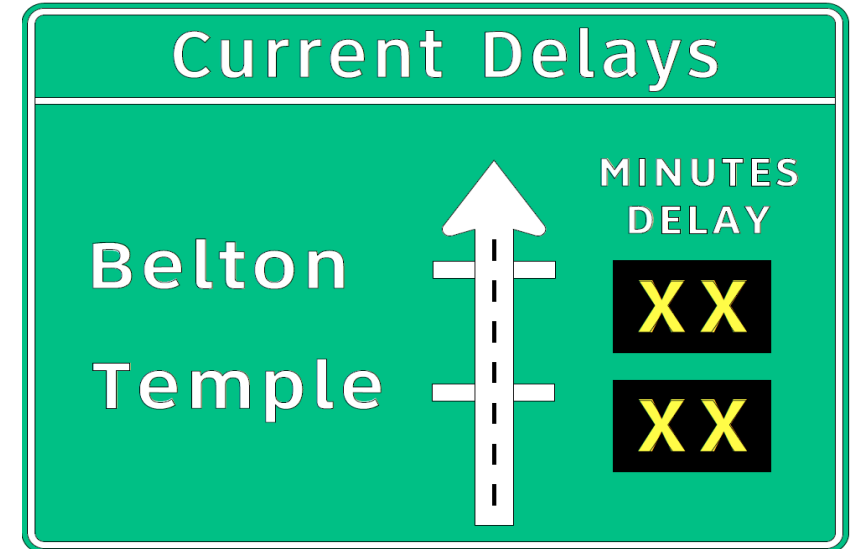


CTIS – Comparative Travel Times



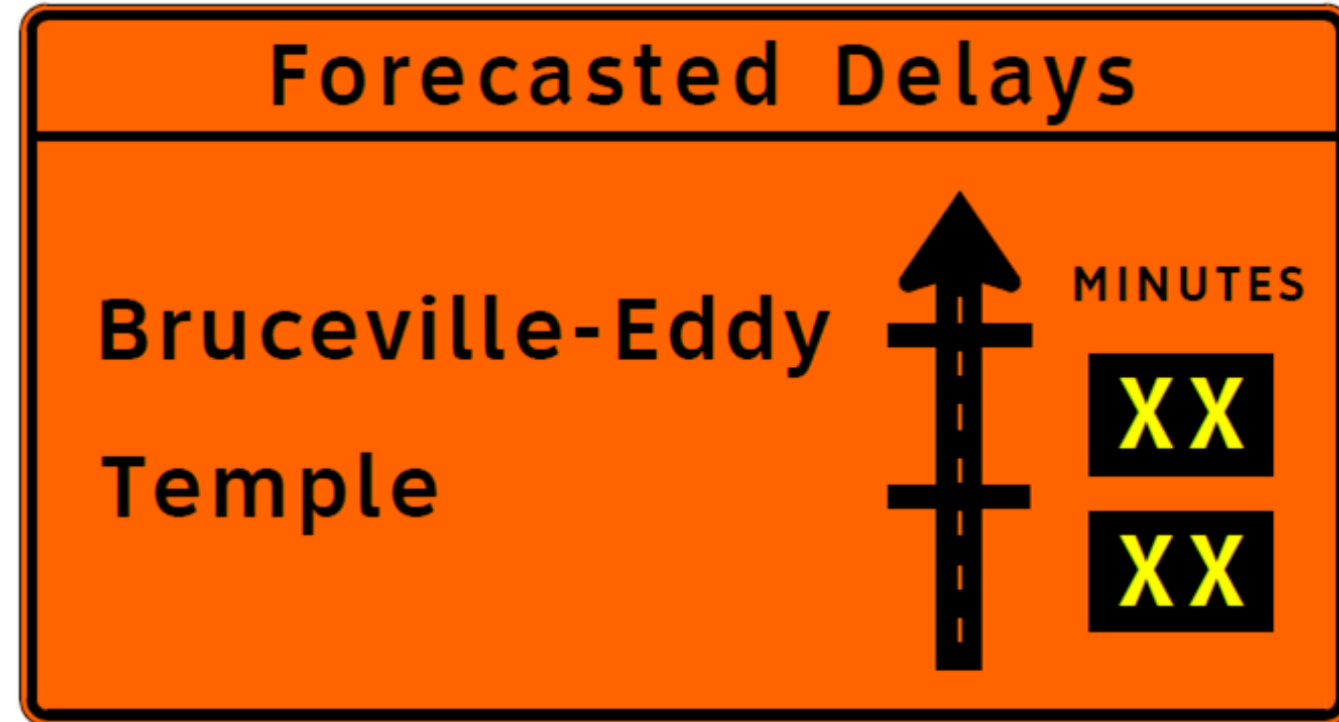
CTIS – Current Delay

- Supports on-going construction between Belton and Waco
- Utilizes Bluetooth infrastructure
- Correlates to delay on real-time map
- Solar powered



CTIS – Construction Delay Forecast Signs

- System predicts short-term delays due to construction
- Requires real-time data from
 - End-of-queue
 - Bluetooth
 - Wavetronix
- Algorithm varies greatly when lane closure timeframes vary from scheduled times
- Implementation cancelled



What Was the I-35 Need for EOQ?

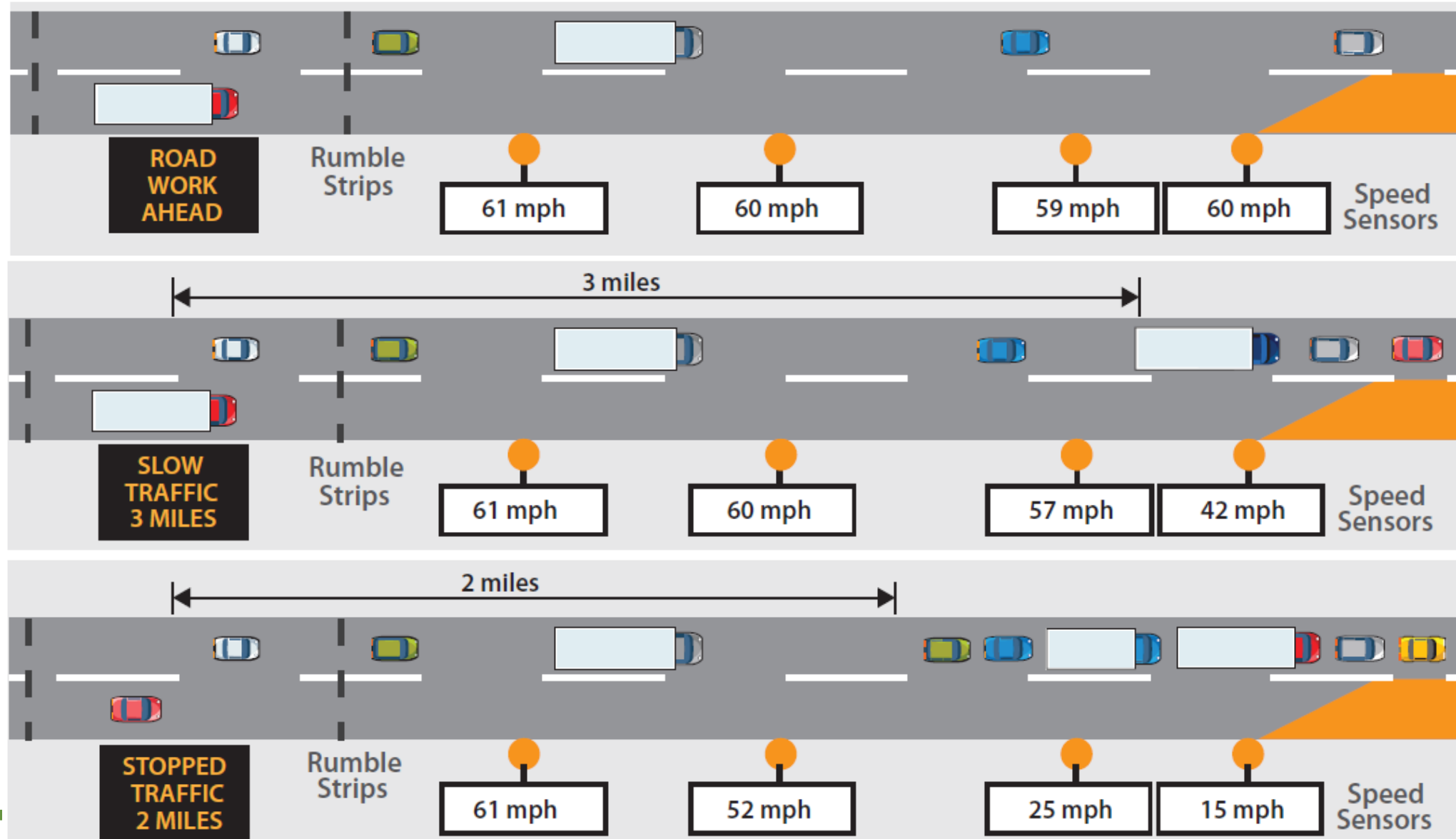


What Is an End of Queue Warning System?

Portable changeable message signs linked to radar speed sensors to proactively warn drivers of queueing and slowed conditions ahead



How Does It Work?

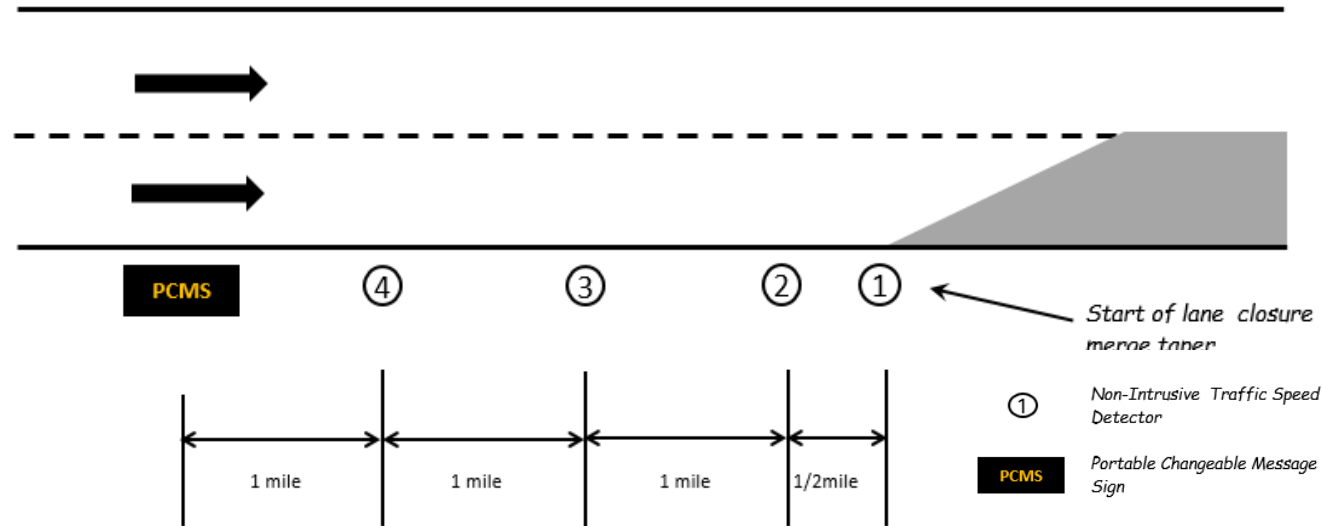


Planning and Designing the System

- System layout and operation
- Testing plan
- Operations and maintenance plan
- Training plan
- Security plan
- Outreach plan
- Evaluation plan
- Requirements and specifications



Standard Layouts and Message Sets



Plan 1

- 4 Sensors
- Detection to 2.5 miles
- 1 PCMS @ 3.5 miles

Plan 2

- 8 Sensors
- Detection to 6.5 miles
- 1 PCMS @ 3.5 miles
- 1 PCMS @ 7.5 miles

PCMS 1	Q	④	③	②	①
{Blank}	= 0	F	F	F	F
SLOW TRAFFIC 3 MILES	= 0.25	F	F	F	M
SLOW TRAFFIC 2 MILES	= 1	F	F	M	IS
SLOW TRAFFIC 1 MILE	= 2	F	M	IS	IS
SLOW TRAFFIC AHEAD	= 3	M	IS	IS	IS
STOPPED TRAFFIC 3 MILES	= 0.25	F	F	F	S
STOPPED TRAFFIC 2 MILES	= 1	F	F	IF	S
STOPPED TRAFFIC 1 MILE	= 2	F	S	A	A
STOPPED TRAFFIC AHEAD	>= 3	IF	S	A	A

Specifications

- Performance specifications
- Physical requirements (equipment, method of payment, etc.)
- Ensure that requirements are germane to the functionality of the system

Special Specification 6079

Automated Portable Smart Traffic Monitoring System



1. DESCRIPTION

Furnish, install, relocate, operate, service, and remove various components of an automated, quickly deployable, portable, real time smart traffic monitoring system (STMS) meeting the requirements noted herein, and providing the maintenance of the complete system for the duration of the project or as directed by the Engineer.

Furnish an on-site System Coordinator. The Contractor is to maintain this system and shall be locally available to service and maintain system components, move portable devices as necessary and respond to emergency situations. The Contractor has oversight responsible for directing placement of devices in the project area. The Contractor is to be accessible seven days a week and twenty-four hours a day while the system is deployed. The Contractor shall provide contact information for the system coordinator and others responsible for maintenance of the system prior to installation of the system. The STMS is to be monitored throughout any period of deployment.

Furnish a system capable of providing advance traffic information to motorists when there is a slowing of traffic due to congestion resulting from lane reductions or other conditions. The condition-responsive notification to the motorist occurs with the use of Portable Changeable Message Signs (PCMS) activated through real-time traffic data collected downstream of the PCMS location. This equipment must be a packaged system that operates as a stand-alone STMS meeting this specification. Conditions might exist that require multiple deployments of this system at a given time. The Department reserves the right to terminate this item at any time if it determines this STMS is not performing in accordance with this specification or the Contractor has met the responsibilities identified in this specification.

Provide an STMS that consists of the following field equipment: portable /battery (solar optional) powered non-invasive vehicle detection devices and solar/battery powered PCMS's. Provide a system capable of withstanding inclement weather conditions and can continue to provide adequate solar and battery power. The system must calculate and notify drivers via PCMS's of the traffic delay conditions ahead. All message dialog is to be approved by the Engineer prior to use. The number and location of detection, and message trailers are defined in the plans and as directed by the Engineer.

The decision to deploy or relocate field equipment is made by the Engineer and instrumented through the System Coordinator. The decision for equipment removal is made by the Inspector after work is complete.

The detector is capable of collecting traffic speed data. The processed data is used to remotely control PCMS's to display user definable, Engineer approved and locally stored messages. The message trigger state thresholds are user configurable. The STMS will provide the means to transmit the processed speed data to an external host and in accordance to the communication scheme and data format as defined in the plans.

The PCMS will be the line matrix type, at a minimum, in accordance with Item "Portable Changeable Message Sign" and all its required provision, with the additional capability of supporting communications via modem/radio/CDMA/GPRS, remote message and flashing-beacon control.

2. MATERIALS

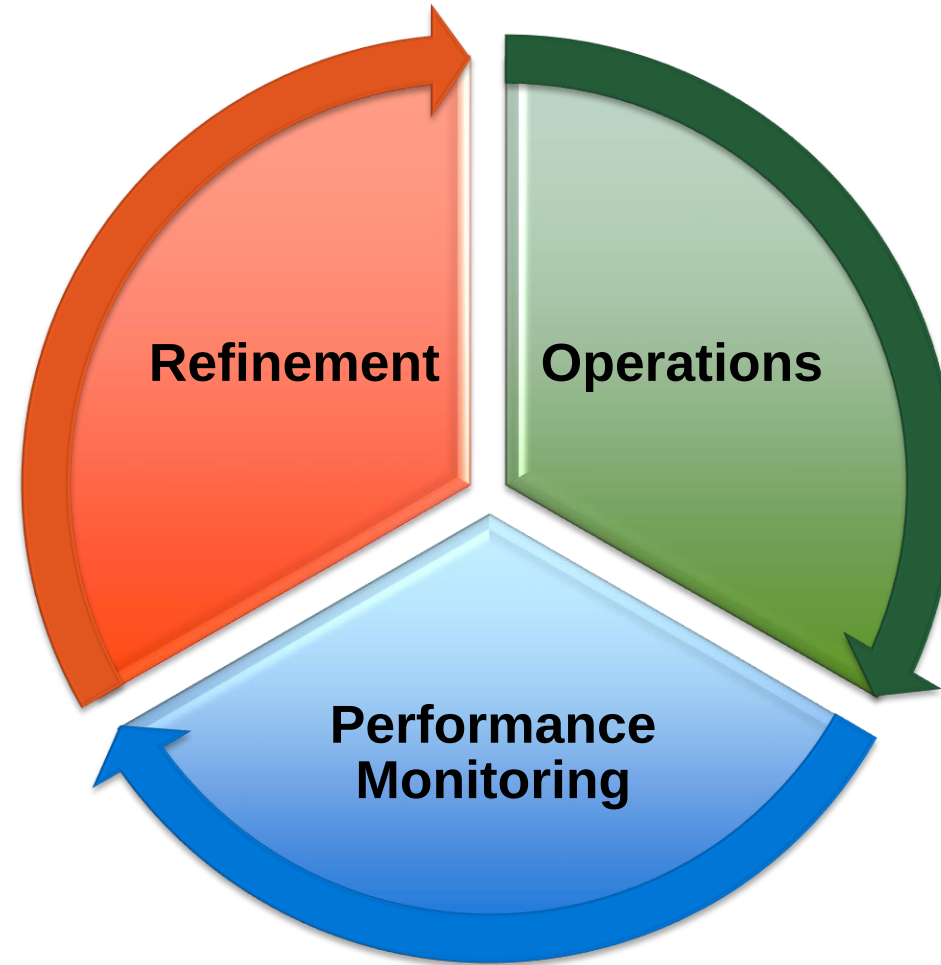
Provide material that complies with the requirements of this Item and the details shown on the plans. All materials used shall meet the manufacturer's specifications and recommendations. The Contractor must maintain an adequate inventory of parts to support maintenance and repair of the STMS.

1 - 2

04-15
OTU



Operate, Maintain, Evaluate



EOQ –

Today's Closure Information, Wednesday, April 29, 2015

WEST TO WACO



FM 3149/Tours Rd to Hilltop St, Ross

ID: 2937

ROADWAY: I-35 Mainlanes (starting at MM 347.0)

DIRECTION: Southbound

PROJECT: 5A

CLOSED: Various lanes closed

CONDITION: Construction

X-STREET START: At FM 3149/Tours Rd

X-STREET END: At Hilltop St

LAT/LONG START: 31.7286 and -97.10259

LAT/LONG END: 31.6879 and -97.09949

TIME: Nightly, 4/29 - 5/1, 7PM - 7AM

ACTIVITY: Move concrete barrier and restripe.

MAP: [Click here to see closure map](#)

ON HOLD: No

EXPECTED MAX Q: 0.50 @ 07:00 PM

WORST MAX Q: 2.58 @ 09:00 PM

EXPECTED MAX DELAY: 3.34 @ 07:00 PM

WORST MAX DELAY: 12.07 @ 09:00 PM

PLAN: 1

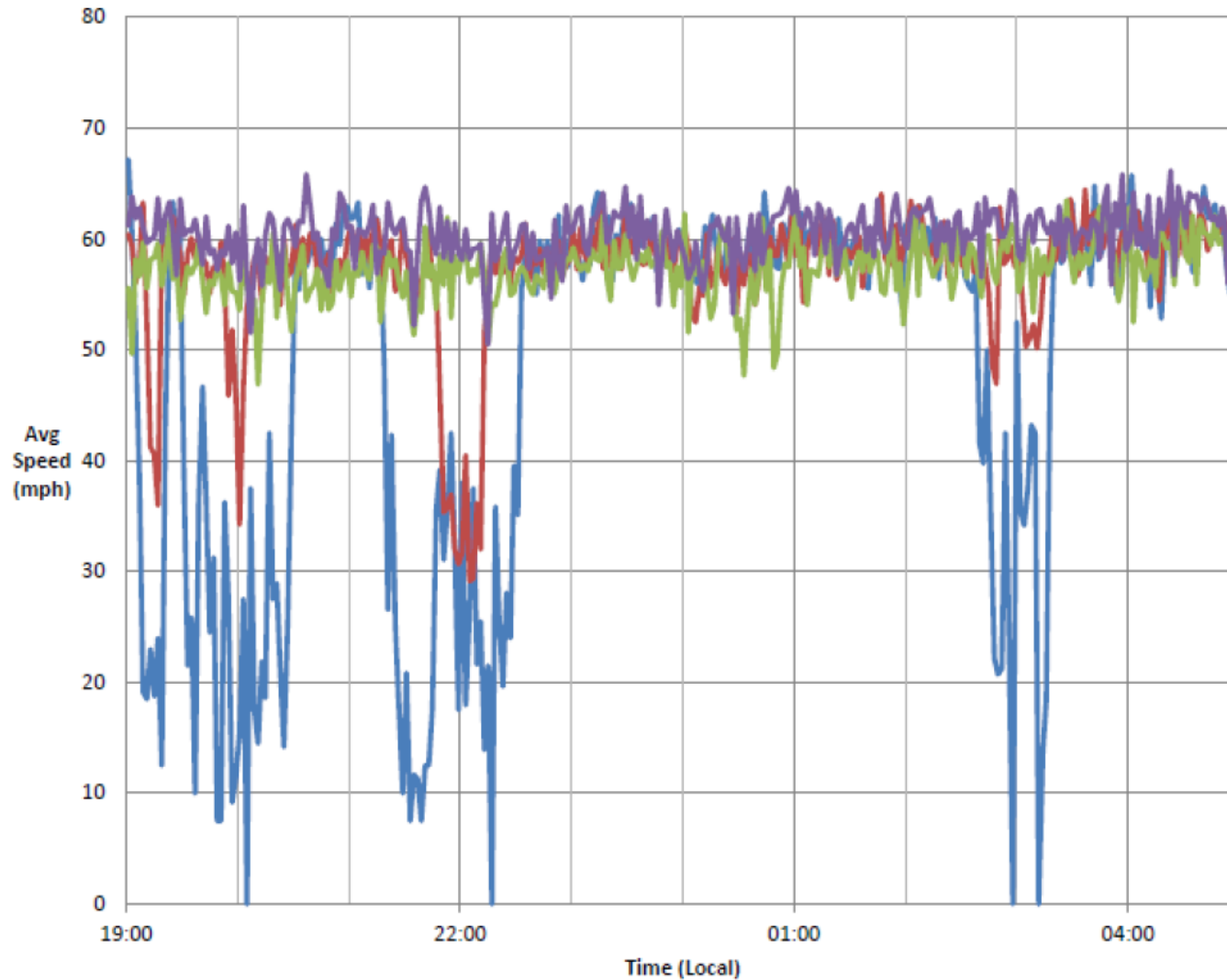
IMPACTS: [Click to view Impacts Assessment](#)

Operations



TEMPLE

Comprehensive Data Analysis



- iCone 1
- iCone 2
- iCone 3
- iCone 4

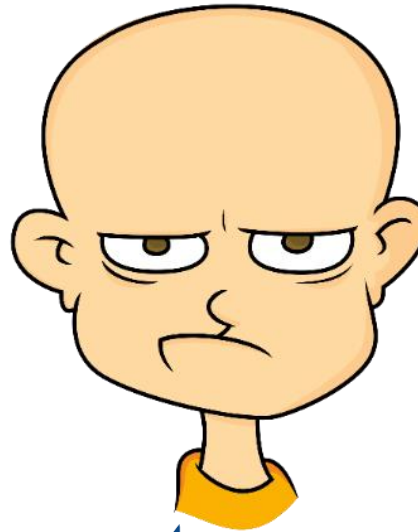


Disappointments Have Also Occurred...

- System not deployed in time
- Malfunctioning sensors affected reporting and accuracy
- System operation degraded over time



TCP Improvements
Vendor Improvements



Refinement

Does Work Zone ITS Work?

- Queue lengths reduced
- 55–60% reduction in crashes, when queues were present, over what would have occurred if EOQ systems not in place
- Crashes that do take place are less severe
- \$6,300 per night in societal benefits
 - Compared to \$600 nightly deployment cost (Plan 1), \$1,200 (Plane 2)



TIED – Traveler Information Email Distribution

- **PURPOSE:** creation and distribution routines for all TIDC email distributions
- Handles:
 - Job creation
 - Template selection
 - TOD/DOW/DOM distributions
 - Direct addressing or via TAMU listserv
- **PROVIDES:** central management of email distributions
- **STORES:** all sent messages



TIED – How Does It Work?

- Create a template for email distribution
 - Test, Test, Test, Test....multiple clients
- Templates are built on concept of successive filters
 - Consume a data stream and filter to template needs
 - Ex: Lane closures, Construction only, HI only, in Project 5B on Tuesday nights
- Set up a job (cron) in TIED manager (Cadbury)
- Jobs execute on server at specified time
 - Any job can be manually pushed at any time
- Some jobs depend on others
 - 5 a.m. daily / 4 p.m. update
- Cadbury provides basic interface to archived sent messages



TIED – How Do We Email?

- For all public distributions, we use TAMU's listserv
- Why?
 - Free
 - Easy to manage
 - Was much faster than creating or purchasing a software solution to manage email address, user preferences, etc.
 - Easy migration path to other systems if necessary
 - export our listservs subscription base to CSV
 - provide CSV file new system
 - change 1 delivery address per template

LISTSERV
MANAGEMENT SYSTEM



TIED – Environments

- Production Environment:
 - Not available outside of TAMU/TTI
 - Can EASILY spam thousands of people if not careful
- Development Environment:
 - Not available outside of TAMU/TTI
 - Used to test out new templates
 - Debugging
 - Consume new data feeds
 - Test interface enhancements





DAILY CLOSURES CENTRAL TEXAS

LISTING COVERS 7AM THURSDAY, MARCH 29 THROUGH 7AM FRIDAY, MARCH 30

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

NB NORTHBOUND **SB** SOUTHBOUND **CR** CROSS ROAD **HIGH IMPACT CLOSURE**

AT A GLANCE

WEST to WACO

- Meyers Ln to Craven Ave
- FM-2114 to Wiggins Rd

TEMPLE to SALADO

- Tahuaya Rd to Tahuaya Rd
- Spur-253 to FM-436
- Tahuaya Rd to Tahuaya Rd



CONTACT

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I-35 Information Specialist
TxDOT Waco District
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Waco, TX 76704
254/867-2836
jodi.wheatley@txdot.gov



WEST TO WACO



Meyers Ln to Craven Ave

ROADWAY: I-35 Mainlanes (starting at MM 339.5)

CLOSED: Right lane, Right shoulder

TIME: Nightly, 3/28/12 - 3/30/12, 7PM - 7AM

ACTIVITY: Project 5A: Restripe and set traffic barriers to close Craven on-ramp.



FM-2114 to Wiggins Rd

ROADWAY: I-35 Mainlanes (starting at MM 351.5)

CLOSED: All lanes closed

TIME: 3/29/12 - 3/30/12, 7PM - 7AM

ACTIVITY: Project 5A: Bridge work at FM-1858/Tokio Rd Traffic detoured to frontage road



Tahuaya Rd to Tahuaya Rd

ROADWAY: I-35 Mainlanes (starting at MM 289.5)

CLOSED: All main lanes

TIME: 3/29/12 - 3/30/12, 7PM - 7AM

ACTIVITY: Project 1C: Work on Tahuaya Rd bridge Traffic detoured to frontage road



Spur-253 to FM-436

ROADWAY: I-35 Frontage Road (starting at MM 294.0)

CLOSED: Left lane

TIME: Daily, 3/26/12 - 3/30/12, 8AM - 5PM

ACTIVITY: Project 4C: Bridge work at FM-436



7-DAY CLOSURES CENTRAL TEXAS

LISTING COVERS 7AM TUESDAY, APRIL 28 THROUGH 7AM TUESDAY, MAY 5

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

NB NORTHBOUND **SB** SOUTHBOUND **CR** CROSS ROAD **HIGH IMPACT CLOSURE**

HILLSBORO TO WEST

	DATES/TIMES	LOCATION	ROADWAY	CLOSED	MAP
NB	4/30 - 5/1, 7PM - 7AM	Tokio Rd to Falls County Line, West	I-35 Mainlanes (MM 351.0)	Various lanes closed	LINK
SB	4/30 - 5/1, 7PM - 7AM	FM 1304 to Tokio Rd, North of Abbott	I-35 Mainlanes (MM 359.0)	Various lanes closed	LINK

WEST TO WACO

	DATES/TIMES	LOCATION	ROADWAY	CLOSED	MAP
CR	Continuously, Ends 5/15 @ 7AM	WB Ross Rd at I-35, Ross	Ross Rd	All lanes closed	LINK
NB	Nightly, 7PM - 7AM. Ends 4/29	Hilltop St to FM 3149/Tours Rd, North of Elm Mott	I-35 Mainlanes (MM 345.0)	Left lane	LINK
SB	Nightly, 4/29 - 5/1, 7PM - 7AM	FM 3149/Tours Rd to Hilltop St, Ross	I-35 Mainlanes (MM 347.0)	Various lanes closed	LINK

WACO

	DATES/TIMES	LOCATION	ROADWAY	CLOSED	MAP
SB	3/9 @ 7AM - (Permanently closed)	Forrest St to MLK Jr Blvd/Lake Brazos Pkwy, Waco	I-35 Frontage Road (MM 336.0)	All lanes closed	LINK
NB	3/9 @ 7AM - (Permanently closed)	after MLK Jr Blvd/Lake Brazos Pkwy to before Forrest St, Waco	I-35 Frontage Road (MM 335.0)	All lanes closed	LINK
NB	Continuously,	MLK Jr Blvd/Lake Brazos Pkwy to before Forrest St, Waco	I-35 Frontage Road (MM 335.0)	Various lanes closed	LINK

IMNS – Incident Message Notification Subsystem



I-35 at Industrial Blvd, Hewitt

MILE MARKER: MM 327 (McLennan County)

VEHICLE(S): Single

SEVERITY: Minor

AFFECTED:

TYPE:



Vehicle Collision

EST. TIME TO CLEAR: 15-30 min

EST. BACKUP: 0.5-1.0 miles

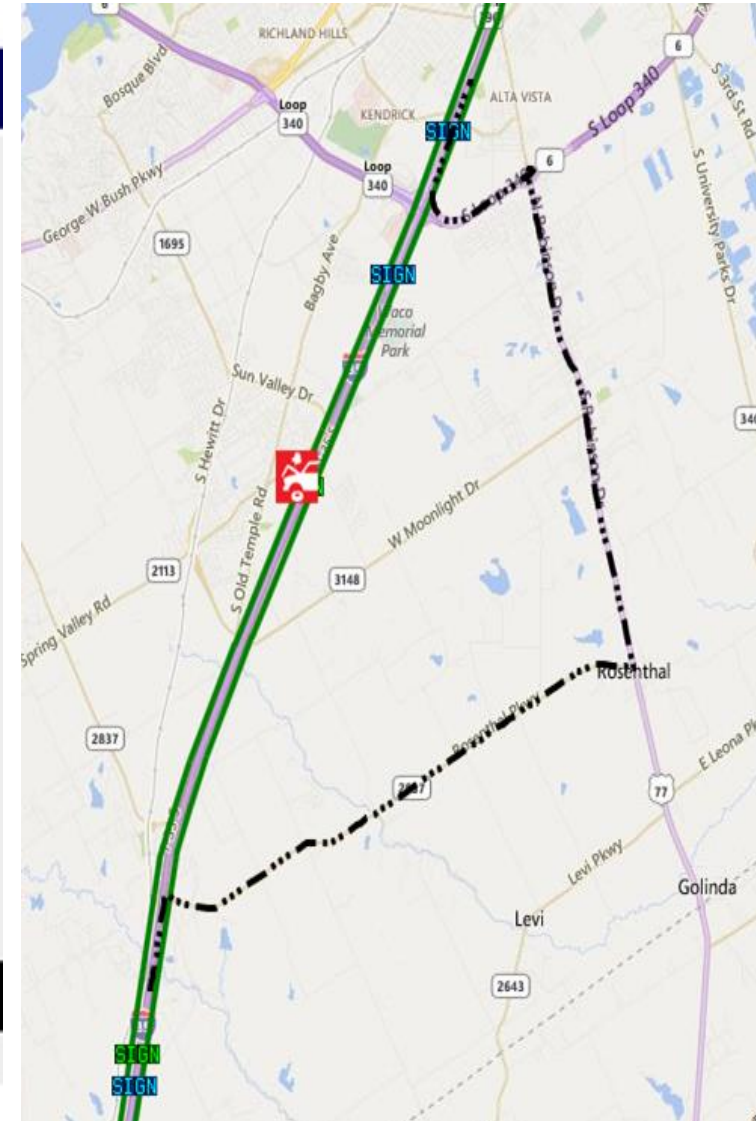
MAP: [Click to see map](#)

- NB ALT. ROUTE:**
1. Exit 322 to E
 2. FM 2837/Rosenthal Rd
 3. Turn right and drive 7.5 miles to US 77
 4. Turn left and drive 5.75 miles to Loop 340
 5. Take right cloverleaf turn and drive 1.75 miles to I-35
 6. Turn right and drive to on-ramp.

ALT. ROUTE INFO: [Click to see alternate route info](#)

LAST UPDATE

SEP 25 9:29 AM Verified



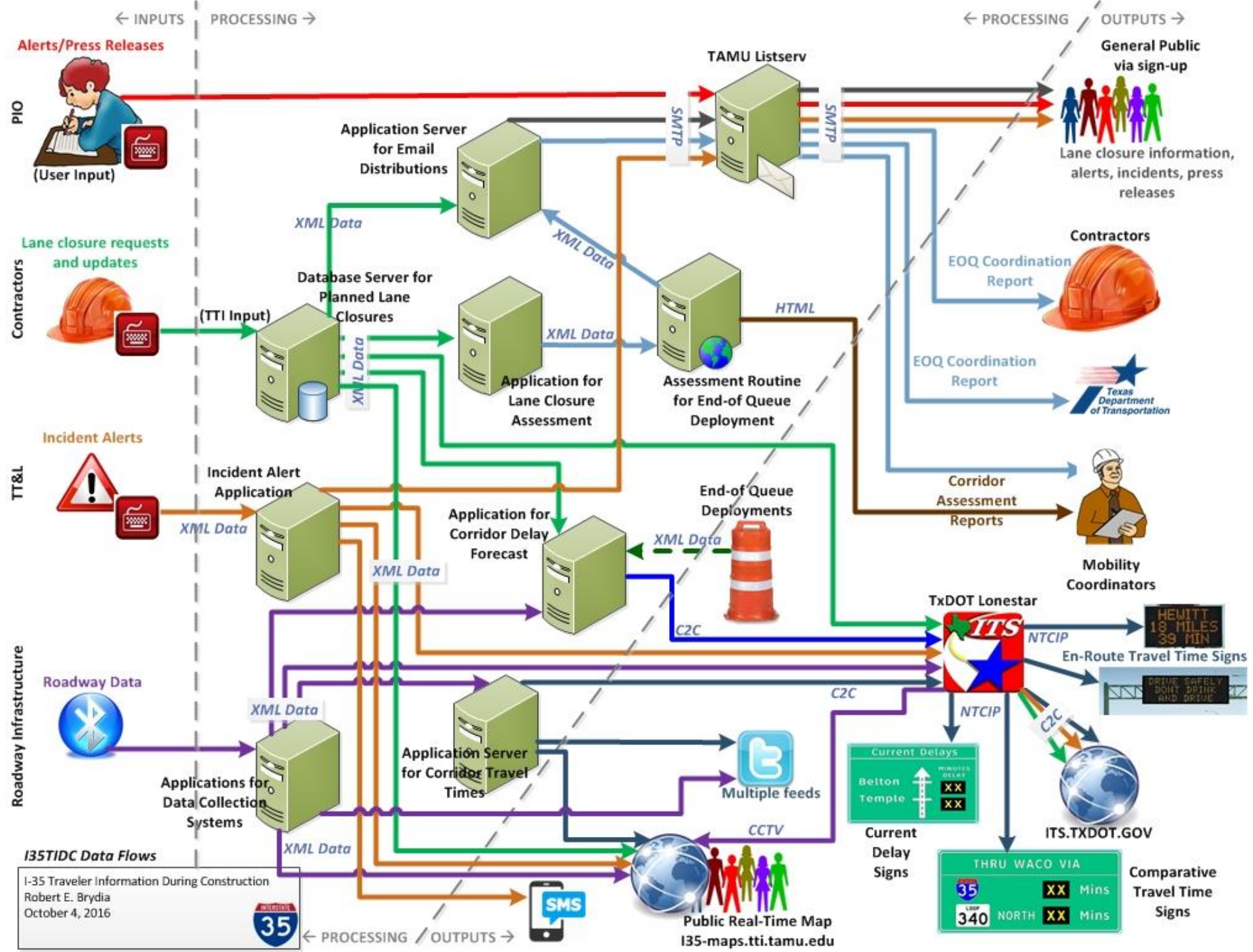
Overall Information Outputs

- Mobility Coordination
 - 14-day forecast
 - Lane closure assessment reports
 - Multiple closure delay projections
 - End-of-queue deployments
 - End-of-queue checks
- Operations
 - Infrastructure deployments
 - Alternate routes
 - Daily travel time system performance
 - Daily post-mortem of corridor delay by section
 - Incident analyses
 - High-impact closure analyses
 - Incident analyses
 - Travel time sign operations
 - Construction delay sign operations
 - Incident (traffic) alerts
 - Feeds to Lonestar / state-wide TMC
 - Safety Measures (sample)
 - Red border speed limit
 - Speed trailers
 - Performance reporting
 - Closure statistics, delay, etc.

Traveler Information

- En-route
 - Travel times
 - Construction delay signs
 - Rest area signage (inside and out)
- Email and web Information
 - Real-time map
 - Closures, travel times, delays, trip planner
 - Limit by direction
 - Coming soon – CCTV, Corridor delay, revised menuing
 - Lane closure information
 - Daily, 4pm update, 7-day, High-Impact Only
 - More than 4,000 subscribers
 - Traffic alerts
 - End-of-queue warning systems
 - Contractor coordination report
 - Twitter
 - BT reader segments (operational)
 - Travel times (public)
 - Web site coordination
 - DriveTexas
 - My35
 - Brazos River Bridges camera





Presentation Outline

Background

Needs Assessment

Concept of Operations

Design

Procurement

Deployment

Operations, Maintenance, Evaluation



Procurement Notes

- Purchase on TTI contract with TxDOT
- Leave-behind for all equipment
- Spares (account for O&M)
- TTI let statewide contract for deployment services and closures
- Piggyback where possible on other state contracts
- EOQ specific notes:
 - Initial attempt to obtain per night deployment bids
 - Switched to
 - Mobilization bid for capital costs/maintenance/loss
 - Per night deployment for labor



Presentation Outline

Background

Needs Assessment

Concept of Operations

Design

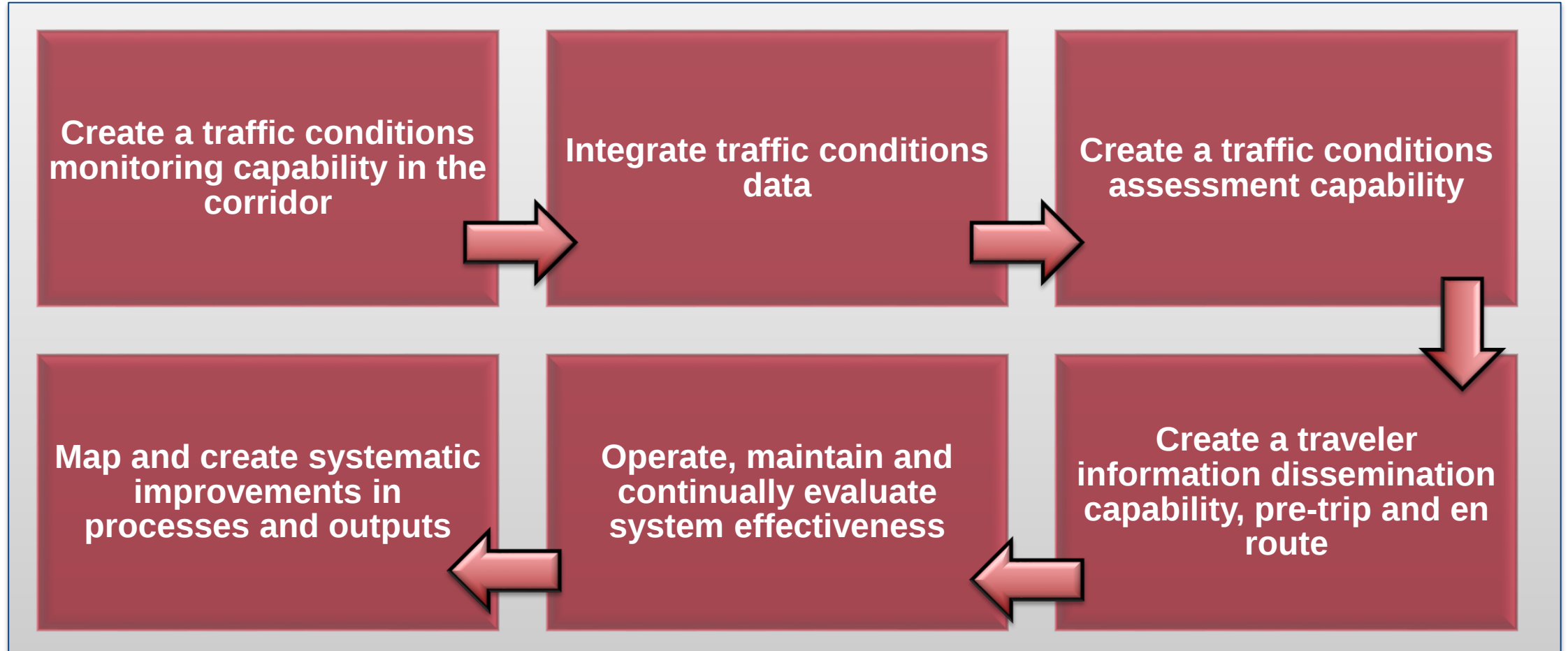
Procurement

Deployment

Operations, Maintenance, Evaluation



Deployment



Presentation Outline

Background

Needs Assessment

Concept of Operations

Design

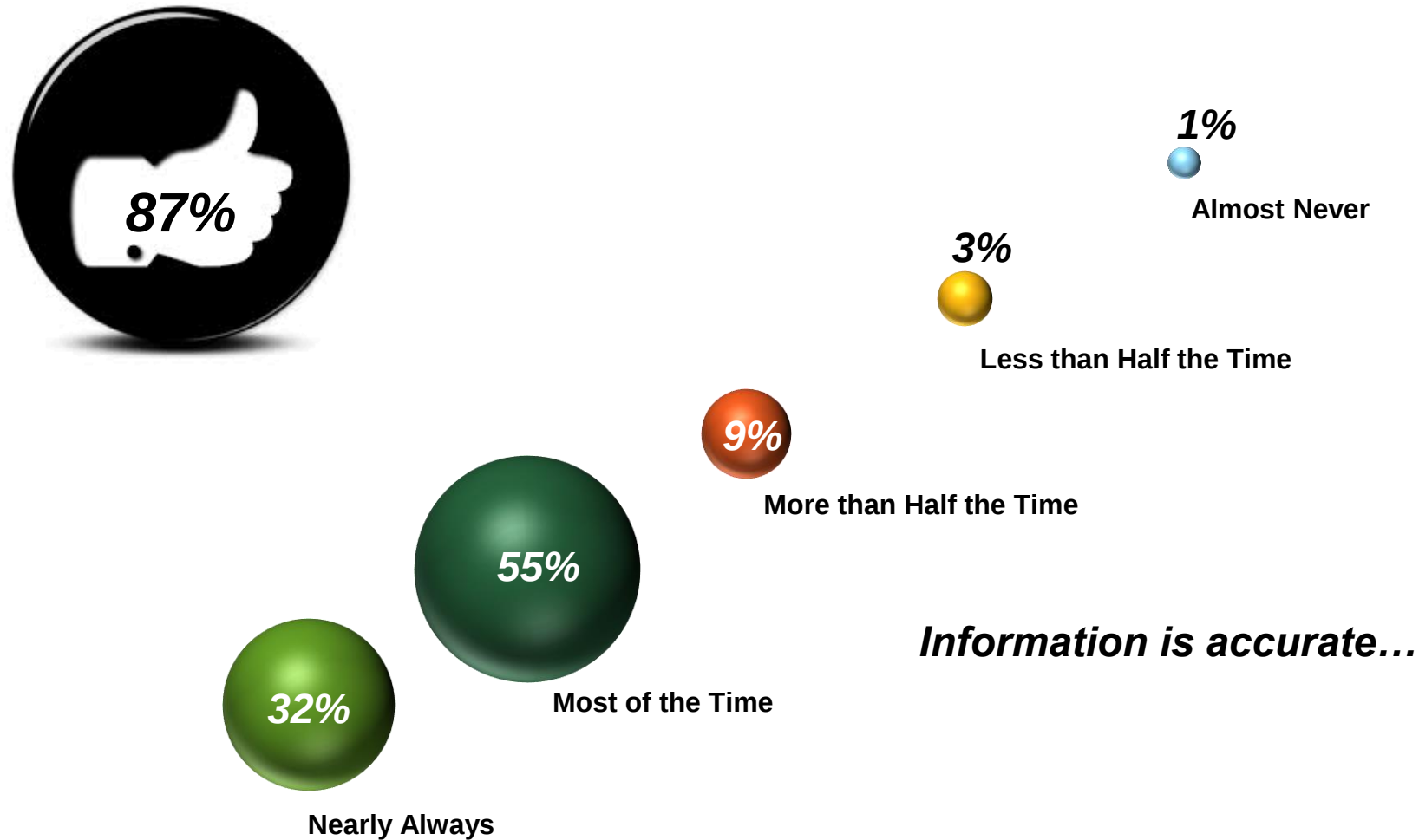
Procurement

Deployment

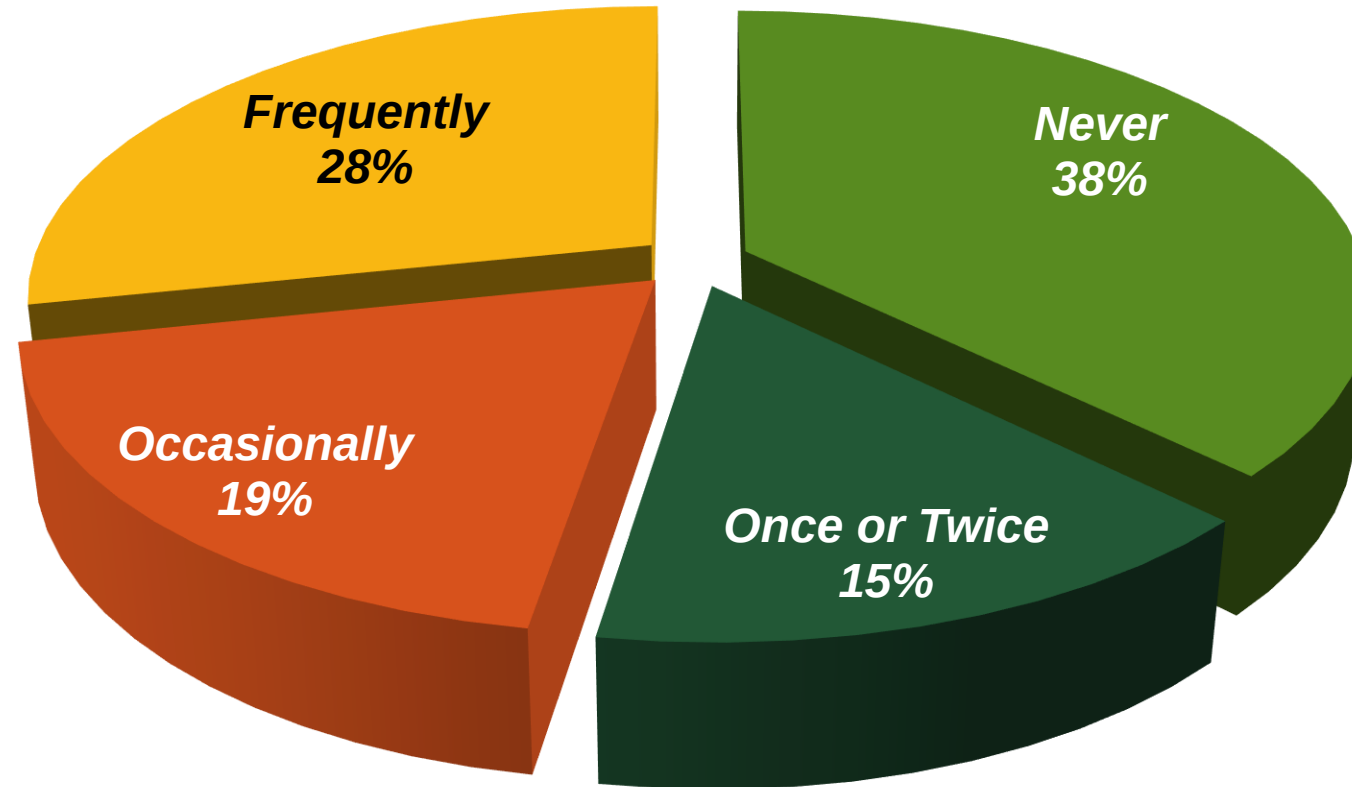
Operations, Maintenance, Evaluation



Evaluation – Public Perception of Information Accuracy



Evaluation – Have You Changed Plans Based on the Information?



Total (Since January, 2013)

