Maricopa County
Department of Transportation

Adaptive Signal Control Technology (ASCT) for Rural Applications

Lessons Learned from the Bell Rd ASCT Pilot Project

NRITS & ITS AZ Annual Conference

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Presented by:

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ITS Project Manager

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Overview

- Bell Rd Background
- Project Details
- Systems Selected
- Preliminary Results & Lessons Learned

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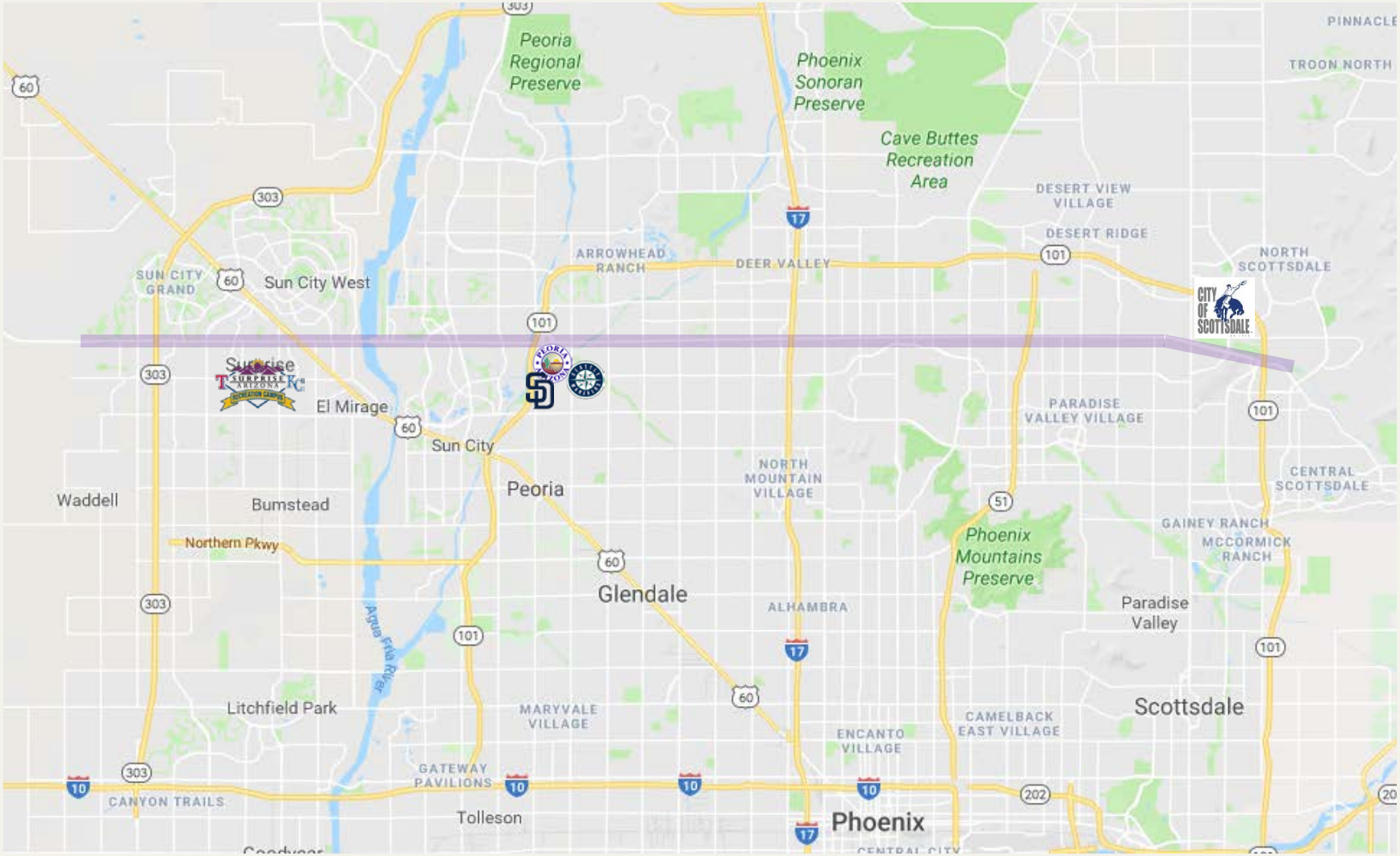
Bell Road Characteristics

- 6 lane regional linkage to multiple cities
- Serving up to 65,000 vehicles per day
  (Capacity for 6-lanes is 45,000-48,000 vpd)

Bell Road Characteristics



Bell Rd Coordination Committee

SURPRISE
ARIZONA

MARICOPA COUNTY
1871
ARIZONA

PEORIA
ARIZONA

GLENDALE
AZ

CITY OF SCOTTSDALE
ARIZONA

ADOT

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Bell Rd Coordination Committee Goals

- Ensure drivers had a **seamless commute**
- Help provide better signal timing **progression**
- Keep up with the **changing traffic** patterns created by seasonal traffic and **special events**
  - (i.e. Spring Training Baseball)
- Improve travel time and safety

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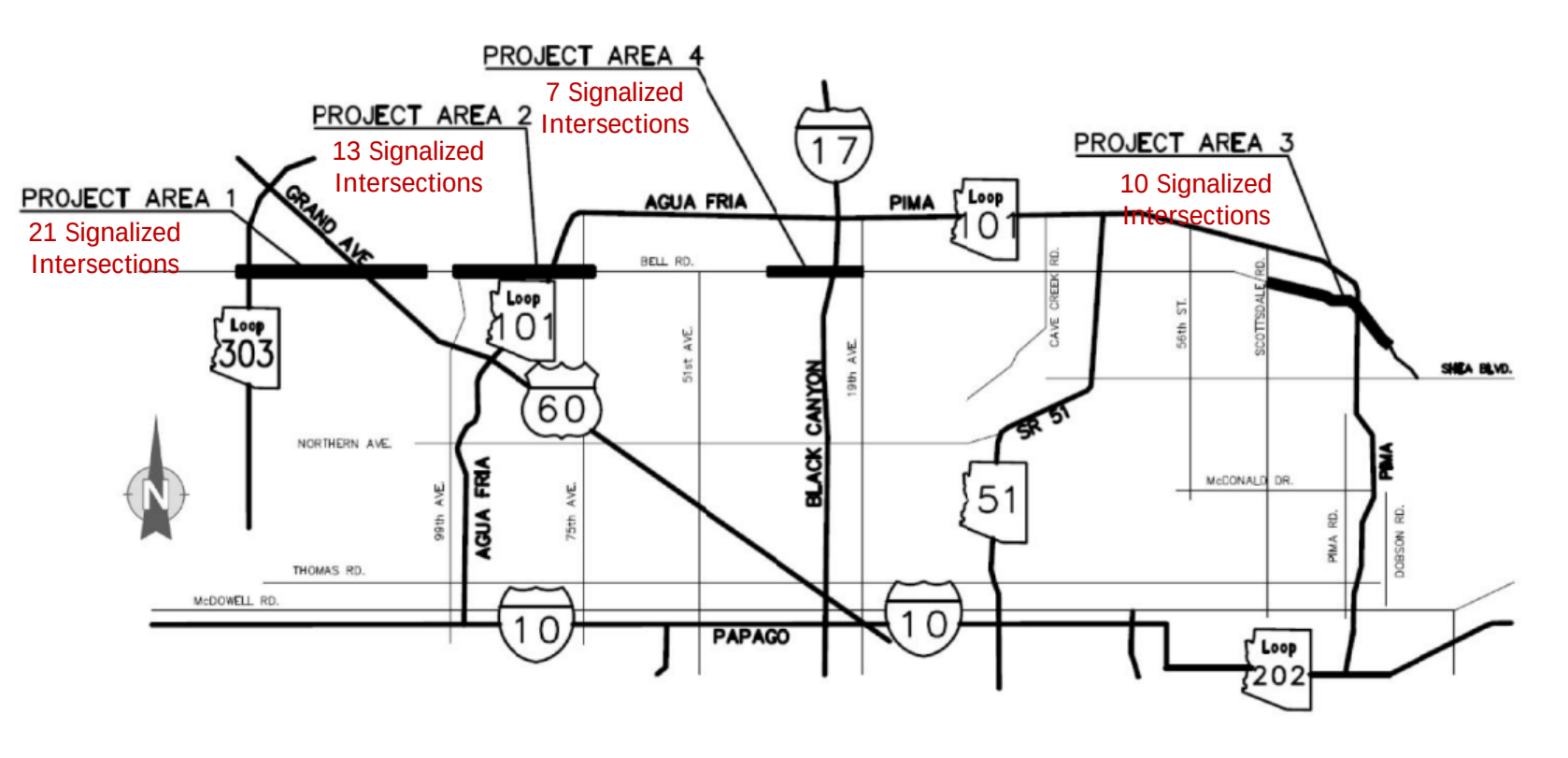
Project Details

- 50 Traffic Signals
  - Not inclusive of all traffic signals on Bell Rd
  - Focusing on areas around freeway interchanges
- 15.6 Miles
- 7 Agencies
  - MCDOT, ADOT, Surprise, Peoria, Glendale, Phoenix and Scottsdale
- Pilot Project to test ASCT under different scenarios

Project Areas



Project Area Needs

- Area 1 (Surprise)
  - Keep Spring Training and special event traffic moving smoothly
- Area 2 (MCDOT, ADOT, Peoria, & Glendale)
  - Distributed system, special event traffic in Peoria
- Area 3 (Scottsdale)
  - Manage vehicular & high pedestrian traffic at special events
- Area 4 (Phoenix)
  - Improve progression across the freeway interchange without overextending staff resources

Project Vision

The vision of the ASCT system is to provide an advanced traffic control system that automatically responds to changing traffic conditions, and **reduces delays and corridor travel times, while managing queues and improving safety** for each of the four (4) project areas.

Project Goals

To **improve the overall traffic flow efficiency and safety** of Bell Road by:

- **Providing coordination across jurisdictions** at key locations on Bell Rd.
  - This project will add adaptive capabilities to the existing signal system and offer signal coordination between agencies that currently does not exist in each area.
- **Reducing recurring and non-recurring congestion** on Bell Rd and intersecting roadways.
- **Mitigating the effects of non-recurring congestions** on Bell Rd, intersection roadways and intersection freeways.
- Improving freeway and arterial operations at traffic interchanges and ramps.

Project Objectives

- Adjust operation to changing conditions
- Reduce delay
- Reduce travel times
- Provide the same level of or improvements in safety provided by the existing system to vehicles, pedestrians, transit, and emergency services
- Reduce vehicle emissions through improvements in appropriate determinants such as vehicle stops and delays

Funding & Federal Interest

- Federally & Maricopa Association of Government (MPO) CMAQ Program funded project with a small agency match
- FHWA Project of Division Interest (PoDI)
  - Level of complexity, multiple jurisdictions, and risk associated
  - National Interest

Project Procurement

Two-Step Process

1. Procurement of ASCT Systems
   - RFP Process
2. Procurement of Detection & ARID
   - Low Bid Process (Construction)

Total Project Costs

- Total Overall Project Budget
  - $2.7 million
- Total Cost for all the ASCT Systems
  - $1.8 million
- Total Detection & ARID Costs
  - $865,000
- Includes Maintenance & Support Services for initial year + 5 Years

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Project Area 1

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System 1 General Overview

- Centralized Solution
  - No Field Hardware – Software only
  - Expandable agency wide for low additional cost
- “Deep Learning” Feature
  - Saves new baseline timing plans by learning from experience
  - Solves for new cycle, split, offset and sequence every 3 – 5 cycles, & downloads new Timing Plans
- Lots of User-Definable Parameters

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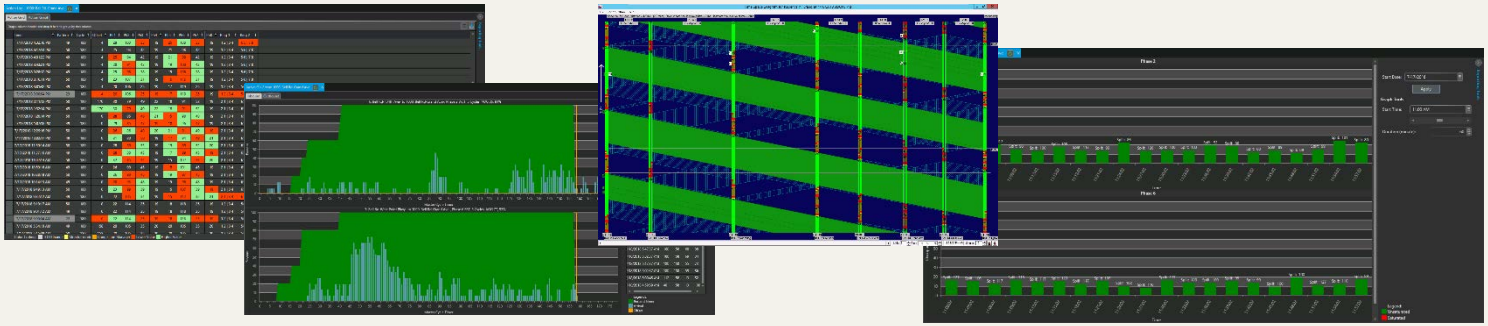
System 1 Detection Needs

- Lane-by-lane detection configurations
- Detects the presence of queues by measuring the average occupancy on a detector
- New vehicle detection was procured as part of this project
  - Set up by vendor and City of Surprise staff

System 1 Performance Data

- Arrivals on green for every cycle for coordinated phases
- Phase utilization for every phase for every cycle
- Width of green band for all coordinated arterial segments for every cycle
- Travel times for major corridor every 10 minutes
- All parameter changes logged (cycle, splits, offsets, sequence, plan)
- Occupancy percentage of all advance detection zones
- Detector failure events



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System 1 Maintenance & Support

- Local support
- History in working with the regional partners

Project Area 2

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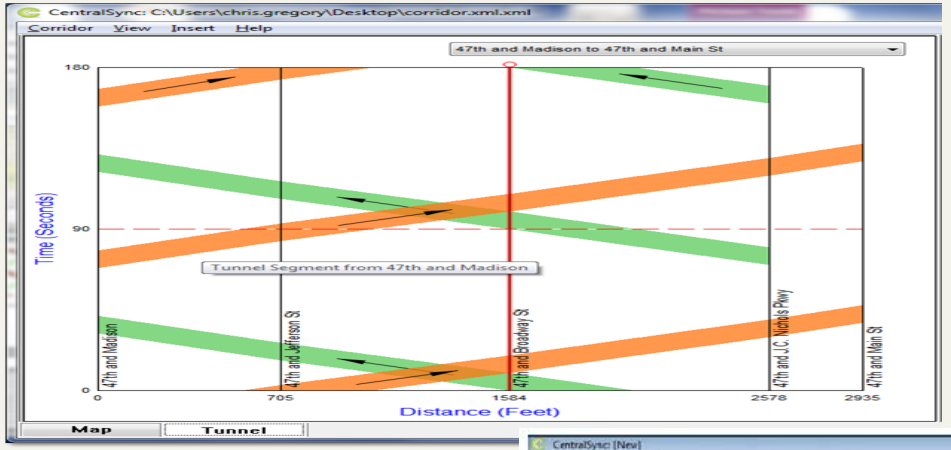
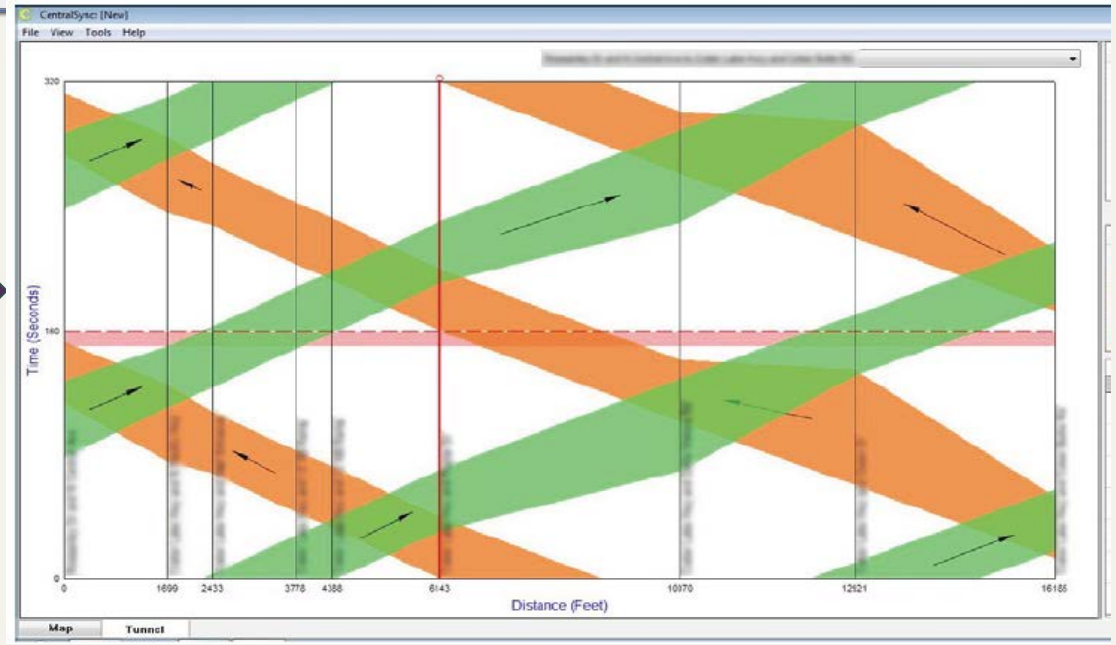
System 2 General Overview

- Second by second adaptive system
- Reduces/eliminates signal cycle transitioning
- Progression Aspects
  - Varying green bands
  - Lead/lag & double cycling optimization
- Intersection Aspects
  - Green time allocation
  - Dynamic sequence/phase optimization



← Traditional

System 2 →



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System 2 Detection Needs

- Detection system supplied as part of system
- Lane-by-lane detection configurations
  - Installation & configuration completed by vendor
- Special event timings can be trigger based on detection setups


Intersection:
RT 29_Cedar Run
Camera:
South Bound
version 1.33
45

System 2 Performance Data

- Logs all parameter changes
  - Historical data logs of each red, yellow, and green duration and time
- 15 min. lane-by-lane turning movement counts
- Backup of the processor (i.e. Detection zone set up/configurations)

System 2 Maintenance & Support

- 24/7 Helpline
- Cost per intersection based
- Support is able to remote into the ASCT system
- Hands free maintenance approach

Project Areas 3 & 4

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System 3 General Overview

- Centralized Solution
  - No Field Hardware – Software only
  - Expandable agency wide for low additional cost
- NTCIP Compatible
  - Uses ATC-Lite features (data key needed)
  - Leverages NEMA-TS2 actuated control operations to update cycle length, offset, and splits
- Calculates new timing based on prevailing conditions
  - Evaluated in user defined interval

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System 3 Detection Needs

- Lane-by-lane detection is preferred
- Special event timings can be trigger based
  - Pedestrian Actuations
  - Vehicle Actuations
- New vehicle detection was procured as part of this project

System 3 Performance Data

- Detector volume & occupancy data stored in 30 second intervals
- All parameter changes logged (cycle, splits, offsets, sequence, plan)
- Uploads new signal timing to controllers

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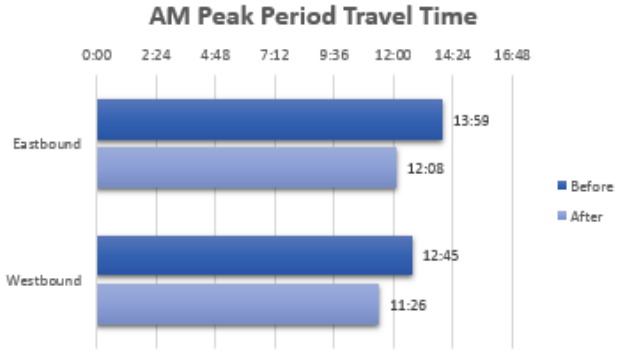
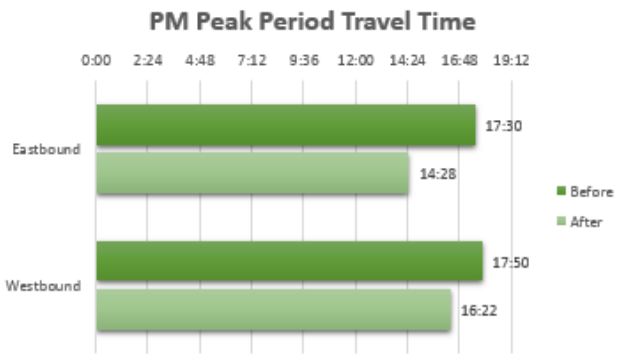
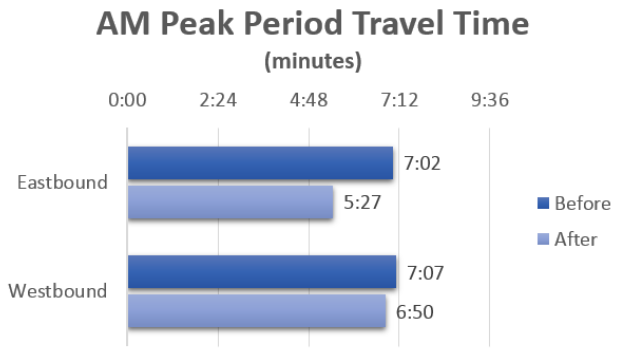
Preliminary Results



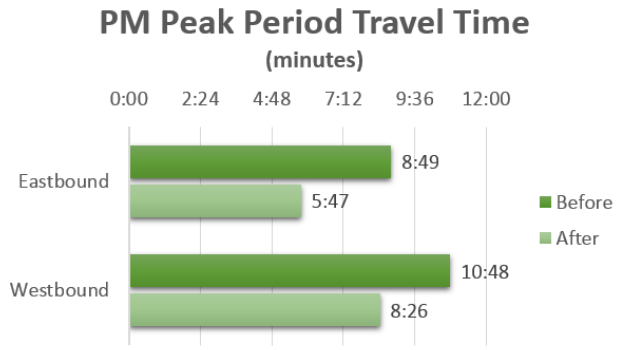
	Before	After	Improved By	% Change
Eastbound	13:59	12:08	1:51	13%
Westbound	12:45	11:26	1:19	10%



	Before	After	Improved By	% Change
Eastbound	17:30	14:28	3:02	17%
Westbound	17:50	16:22	1:28	8%



	Before	After	Improved By	% Change
Eastbound	7:02	5:27	1:35	23%
Westbound	7:07	6:50	0:17	4%



	Before	After	Improved By	% Change
Eastbound	8:49	5:47	3:02	34%
Westbound	10:48	8:26	2:22	22%

Average of about
16% Travel Time Improvement

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ASCT Rural Setting Applications

- Unanticipated changes in traffic patterns
  - Traffic can change quickly due to unplanned incidents
  - Need for signal timing and phasing to be changed quickly due to unplanned incidents
- Queue management at isolated intersections
  - Ensuring all vehicles clear upon the first cycle of arrival and arrive during a green indication
  - Improving signal intersection performance
- Helps support the need for more robust vehicle detection systems

Lessons Learned

- Too many user definable parameters can be intimidating and difficult to understand
  - Extensive training from the vendor is necessary
- Understanding the Maintenance & Support of each vendor is important
  - Should fit agency needs
- Project limits of some areas should have been expanded
- All ASCT systems have performance metrics and a historical log – Great for troubleshooting
- Install ARID first for performance measuring
  - Like kind data for before and after

Questions?

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