INNOVATIONS IN TECHNOLOGY

AUGUST 19, 2015 INNOVATION EXCHANGE

ABOUT ACTI

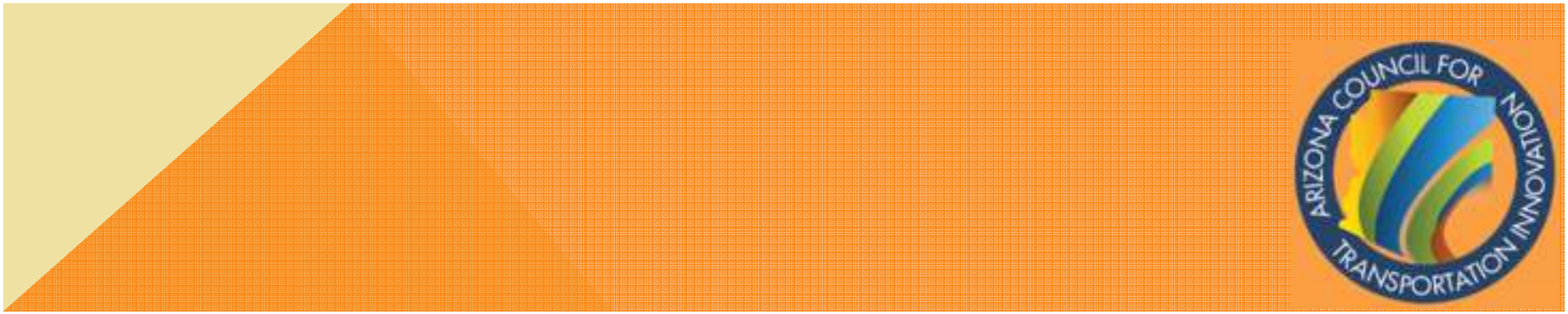
- Formed to support FHWA Every Day Counts
- Arizona's State Based Innovation Council
- Mission to Advance Innovation in Delivering the Transportation System
- Many Successes to Date including
  - Transportation Incident Management
  - Alternative Delivery
  - Safety Shoe
  - LPA Stakeholder Partnering
- Members from Private and Public Sector
- Host Innovation Exchanges like this one, and offer support and resources to encourage rapid deployment of innovation throughout the state

TODAY'S PANEL

- Dallas Hammit, Council Co-Chair and State Engineer, Deputy ADOT Director
- Karla Petty, Council Co-Chair and FHWA Arizona Division Administrator
- Richard Nassi, Pima Association of Governments
- Rudy Perez, Arizona Department of Transportation
- Faisal Saleem, Maricopa County Department of Transportation
- Reza Karimvand, Arizona Department of Transportation
- Larry Head, University of Arizona

BICYCLE AND PEDESTRIAN INTEGRATION

Richard Nassi, P.E. Ph.D.
Pima Association of Governments



BIKE/PEDESTRIAN CROSSING BEACONS

SPECIAL THANKS: DESIGN TEAM

City of Tucson

Diahn Swartz, P.E.,

Ann Chanecka, &

Paul Burton

Pima Association of Governments

Paul Casertano

Gabe Thum

ADOT and FHWA

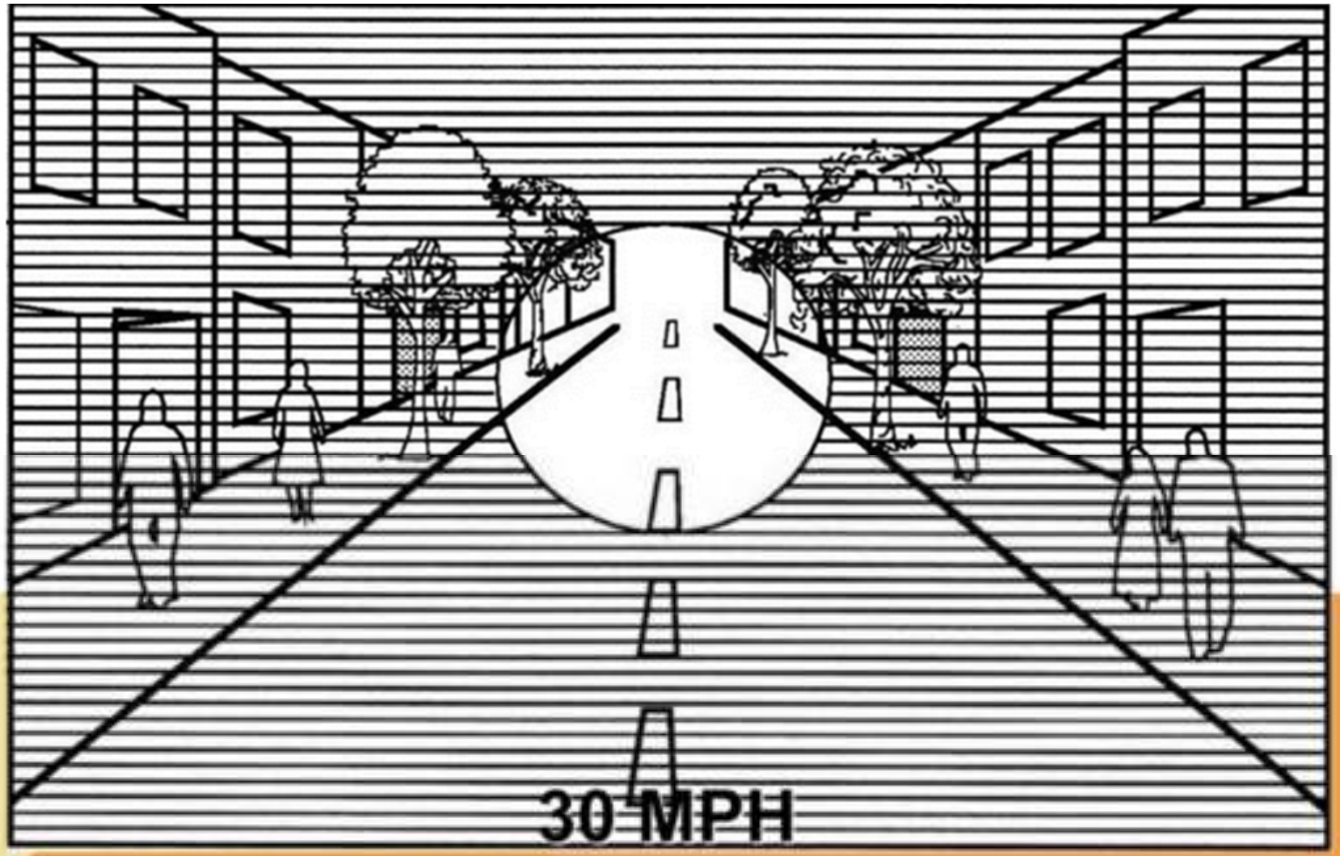
Pedestrian Hybrid Beacon—HAWK

The name came from the City of Tucson pedestrian safety program in 2000
"Watching over the pedestrian like a HAWK"

ARIZONA COUNCIL FOR TRANSPORTATION INNOVATION

HAWKS AND BIKEHAWKS MAKE CROSSERS MORE VISIBLE TO DRIVERS

Especially on High Speed, Wide Streets where Drivers Focus Less on the Surroundings as Speed Rises



From: Zegeer, "Designing for Pedestrian Safety"

HAWKS AND BIKEHAWKS MAKE CROSSERS MORE VISIBLE TO DRIVERS

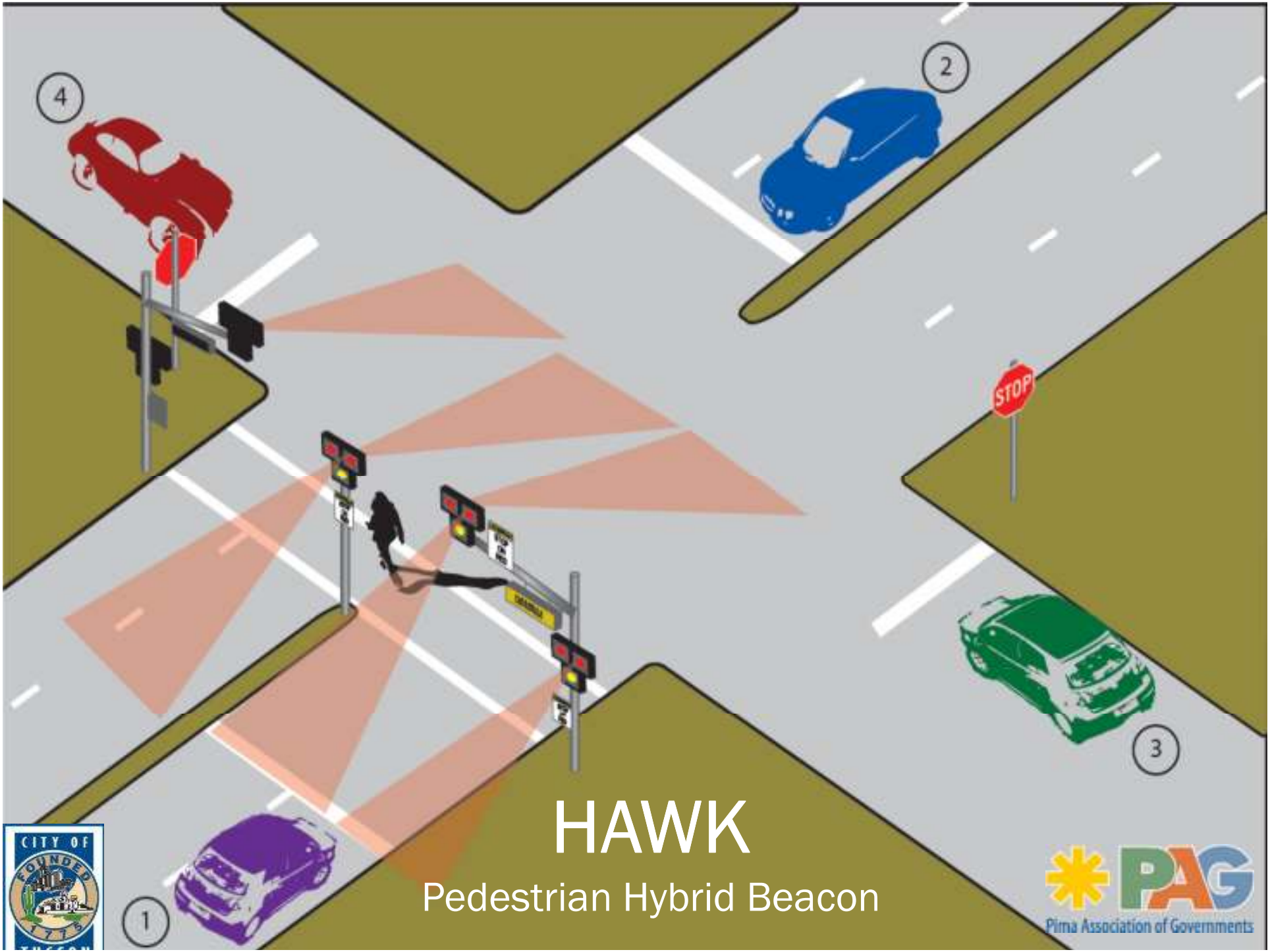
HAWKs take the driver's view of pedestrians from this perspective…

HAWKS AND BIKEHAWKS MAKE CROSSERS MORE VISIBLE: *BRINGING THEM TO THIS GREATER PERSPECTIVE*

HAWKS AND BIKEHAWKS MAKE CROSSERS MORE VISIBLE

Drivers are already required to stop for pedestrians in crosswalks…. but now RED lights tell drivers that PEDESTRIANS ARE CROSSING & THEY MUST STOP

ADOT played a major role early, back in 2002, to help protect children crossing Ajo (SR 89) at an elementary school crossing.


4
2
STOP
3
1
HAWK
Pedestrian Hybrid Beacon
CITY OF
FOUNDED
1775
TUCSON
PAG
Pima Association of Governments

OBEDIENCE OF THE HAWK

97% Driver Compliance to RED

69% Pedestrian Crash Reduction

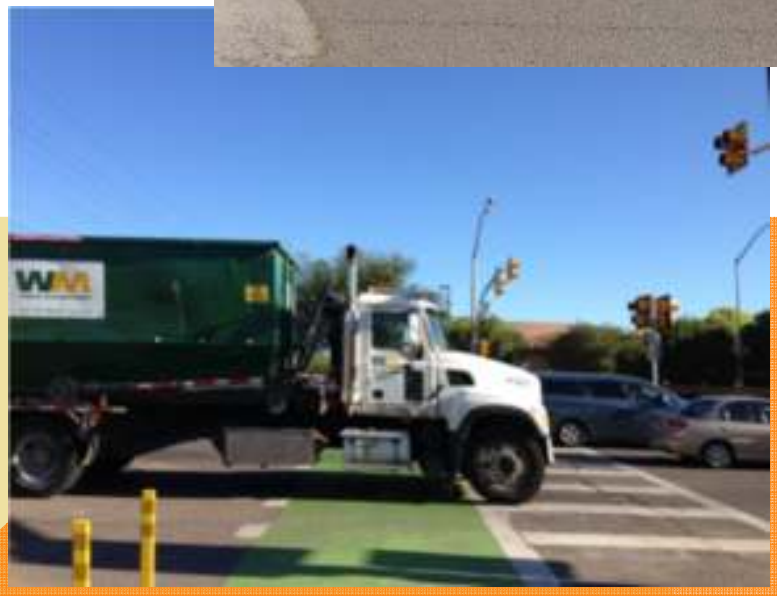
29% Total Crash Reduction

15% Reduction in Serious Crash Levels

One of the Most Effective Pedestrian Crossing Devices

FHWA 2010 study

DEVELOPMENT OF THE BIKEHAWK

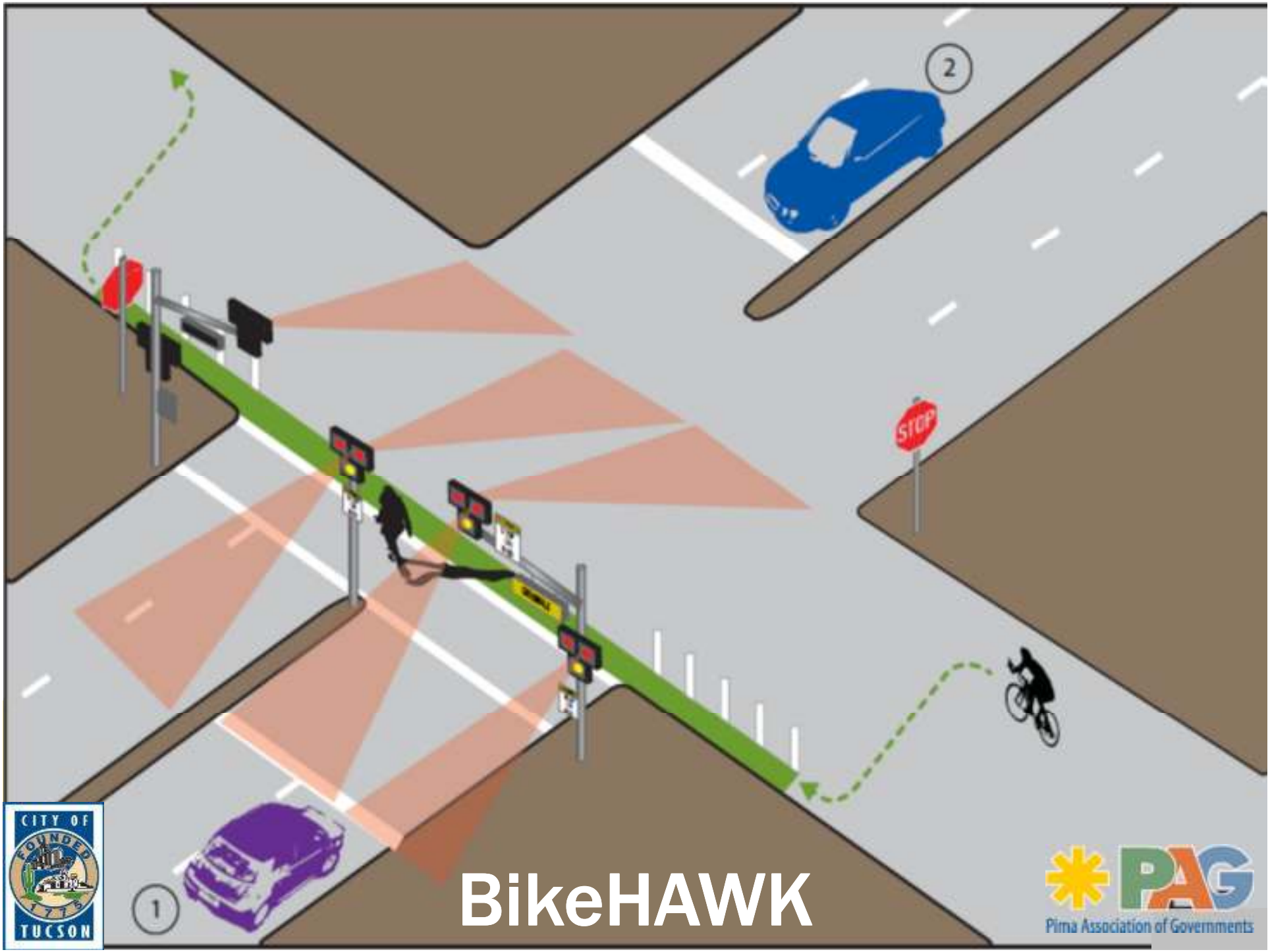


Proven HAWK safety

Meets current Manual on Uniform Traffic Control Devices (Interim Approval for GREEN marking)

Cyclists already using HAWKs, *(BikeHAWK design matched cyclists behavior)*

Safer Bikeway crossings at arterials and collectors



BikeHAWK

CITY OF FOUNDED 1775 TUCSON

PAG Pima Association of Governments

HUMAN BEHAVIOR & DESIGN

Cyclists already had common crossing patterns used by all riders

Design to be in conformance with cyclist's natural behavior

Police and community support

SEPARATED BIKE LANE & CONVENIENT PUSH BUTTON FOR CYCLISTS

DOES THE DESIGN WORK?

Use of the BikeHAWK, from 2012 to 2014:

92%-96% of cyclists use the BikeHAWK as designed

98% -100% of families with children or children alone used the BikeHAWK as designed

COST OF PEDESTRIAN HYBRID BEACON OR HAWK

COST

Infrastructure	Description	Median	Average	Minimum	Maximum	Cost Unit	No. of Observations
Pedestrian Hybrid Beacon	Pedestrian Hybrid Beacon (HAWK)	$51,460	$57,680	$21,440	$128,660	Each	9 (9)

Source: *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*, October 2013

Add $15,000 to $20,000 for BikeHAWK upgrade

The Living Streets Alliance, Tucson's bicycle and pedestrian advocacy organization has indicated that:

"The BikeHAWK helps unite neighborhoods and connect destinations for all modes of safe travel. Already, we've seen families and younger riders, both escorted and unescorted, using the BikeHAWK. This use emphasizes the safe connectivity of all levels of bicyclists across multi-lane, high-speed roadways."

Emily Yetman,
Executive Director

The Tucson Police Department, which participated in the creation of the BikeHAWK has found:

"We have monitored the BikeHAWK and observed that the pedestrians, cyclists and drivers know what to do naturally and the crossing movements are very safe, legal and predictable."

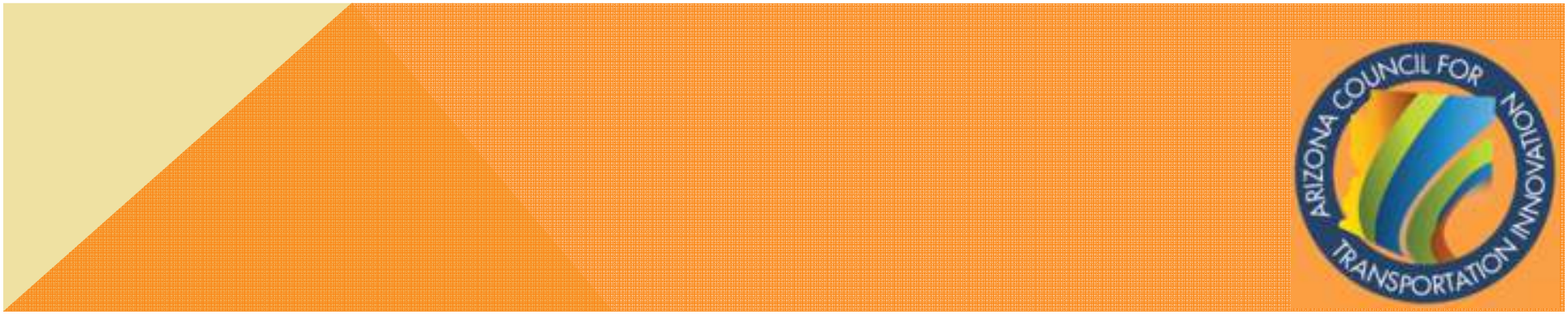
Sergeant Jerry Skeenes,
Tucson Police Department,
Traffic Enforcement Division

MOST IMPORTANT GOAL

Everyone
Gets Home
Safe and
Sound!

BORDER WAITS ANALYSIS

Rudy Perez
Arizona Department of Transportation



BORDER WAITS ANALYSIS AT THE MARIPOSA POE OBJECTIVES

- Install a technology system that accurately measures border wait time for northbound commercial vehicles
- Select one or more appropriate technology for the proposed system
- Implement the system

BORDER WAIT TIMES COMMERCIAL VEHICLES TECHNOLOGY ASSESSMENT

- Automatic Vehicle Identification (AVI)
  - AVI using laser frequency
  - AVI using Radio Frequency Identification (RFID)
  - AVI using infrared frequency
- Automatic License Plate Recognition (ALPR)
- Vehicle matching
- Automatic vehicle location (AVL)
  - GPS
- Mobile phone location
- Inductive loop detectors

BORDER WAIT TIMES COMMERCIAL VEHICLES

RFID TECHNOLOGY ASSESSMENT

Benefits

- RFID technology already in use by CBP for FAST Program, and by ADOT at State Inspection Facilities
- No in-truck equipment installation required
- Continuing costs of operation is relatively low

Concerns

- Data collected is not as precise as GPS
- Agreements must be made with U.S. and Mexican agencies to install RFID readers.
- Information system more complicated than GPS

BORDER WAITS ANALYSIS
NOGALES-MARIPOSA PORT OF ENTRY

Reader location – 1

R1 - Mexican Customs

2 lanes with AC power provided by INDAABIN

BORDER WAITS ANALYSIS
NOGALES-MARIPOSA PORT OF ENTRY

Reader location – 2

R2 - End of the queue

BORDER WAITS ANALYSIS
NOGALES-MARIPOSA PORT OF ENTRY

Reader locations – 3 and 4

BORDER CROSSING INFORMATION SYSTEM WEB-BASED TOOL

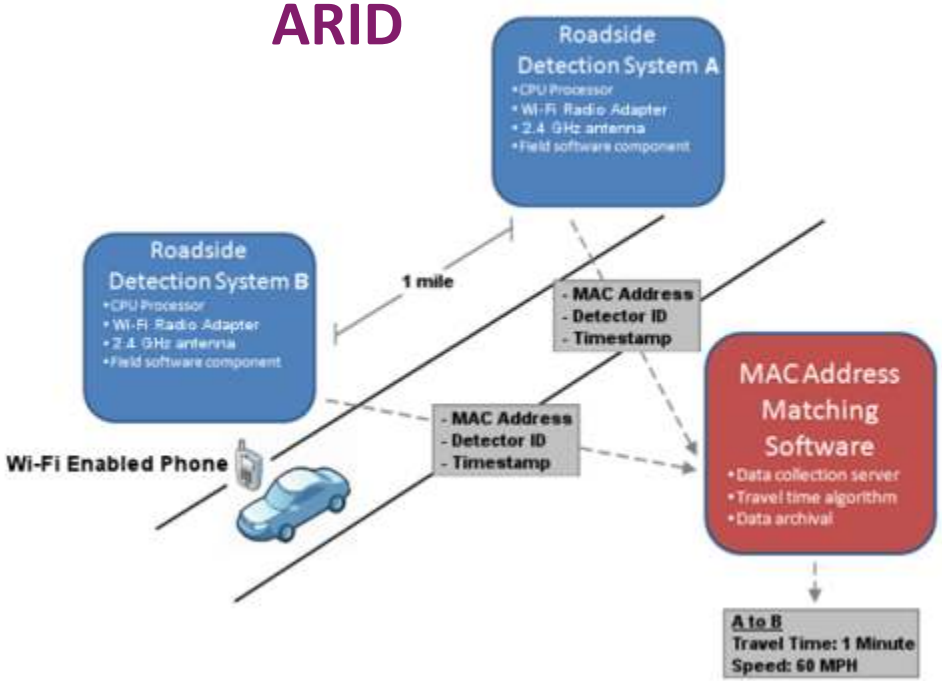
Will display real time and archived border wait time information

BLUETOOTH AND WI-FI TECHNOLOGY

- Will ARID devices collect sufficient sample size to confidently estimate wait time of US and Mexico bound personal vehicles?
- Should ARID devices be installed permanently?
- In what priority order should they be installed?

Anonymous **R**e-**ID**entification

ARID



BLUETOOTH VS. WI-FI TECHNOLOGY

Bluetooth and Wi-Fi Similarities
Travel Time Reporting
Congestion Mapping
Origin-Destination Reports

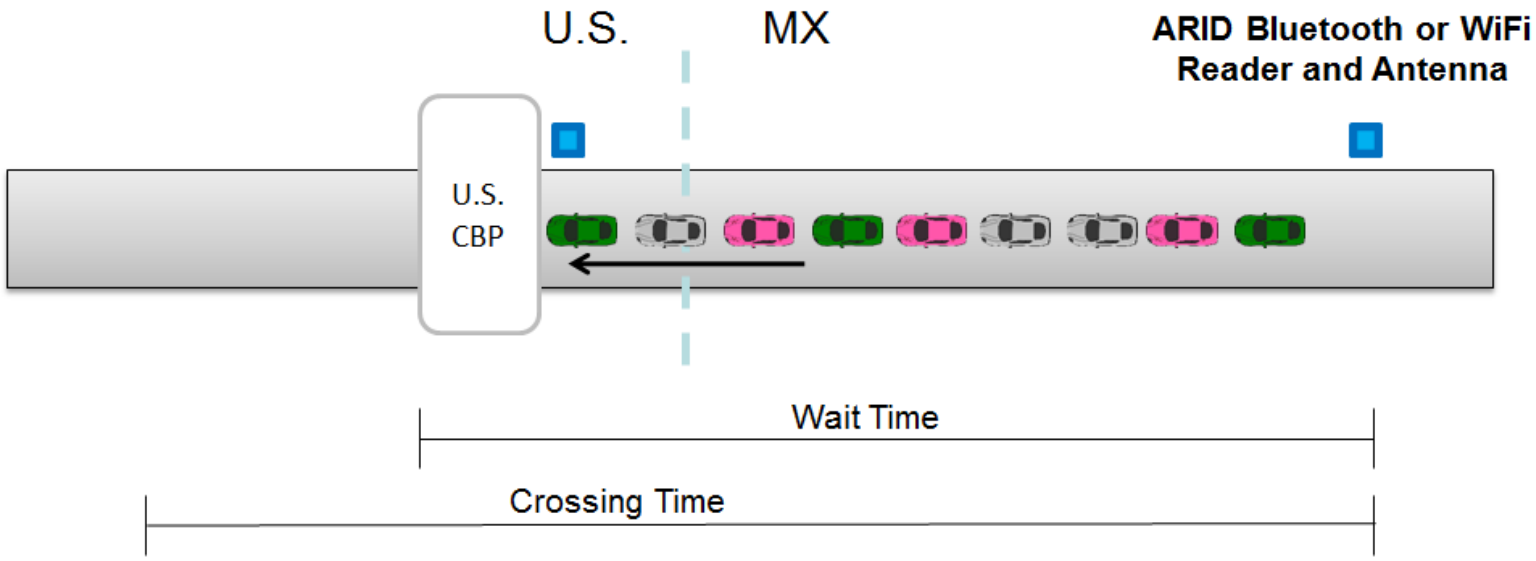
Bluetooth	Differences	Wi-Fi
Continually *"Scans"* (Poll & Response)	**Sensor Detection Method**	Continually *Listens*
Low	**General Detection Rate**	High
High	**Re-Identification Rate**	Low*
In-Vehicle Systems	**Devices Primarily Detected**	Mobile Devices

*Detection & Re-Identification Increase with Slower Travel Speeds

DATA COLLECTION: TEMPORARY ARID DEPLOYMENT

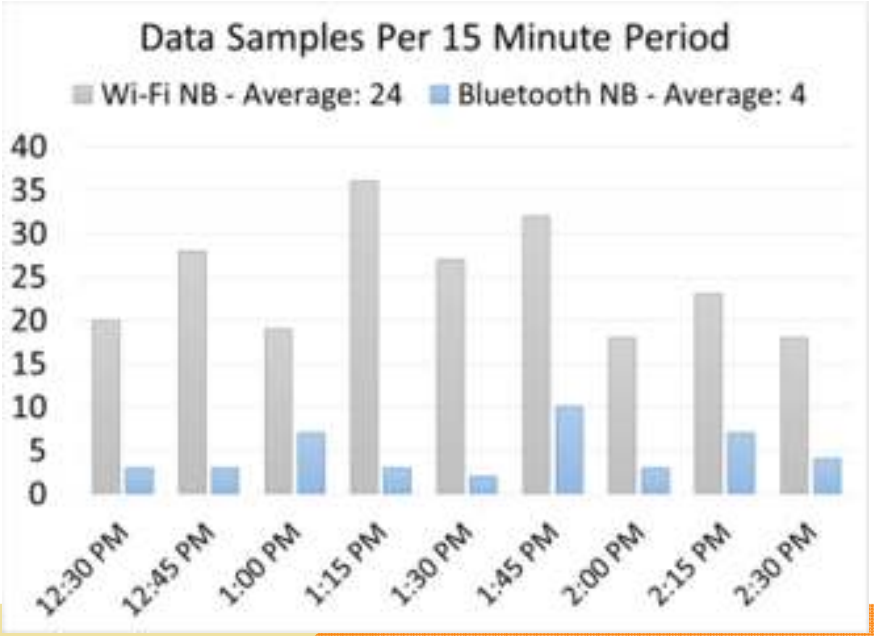
Collected the weeks of
June 15 and June 29

BORDER WAIT AND CROSSING TIME DEFINITIONS

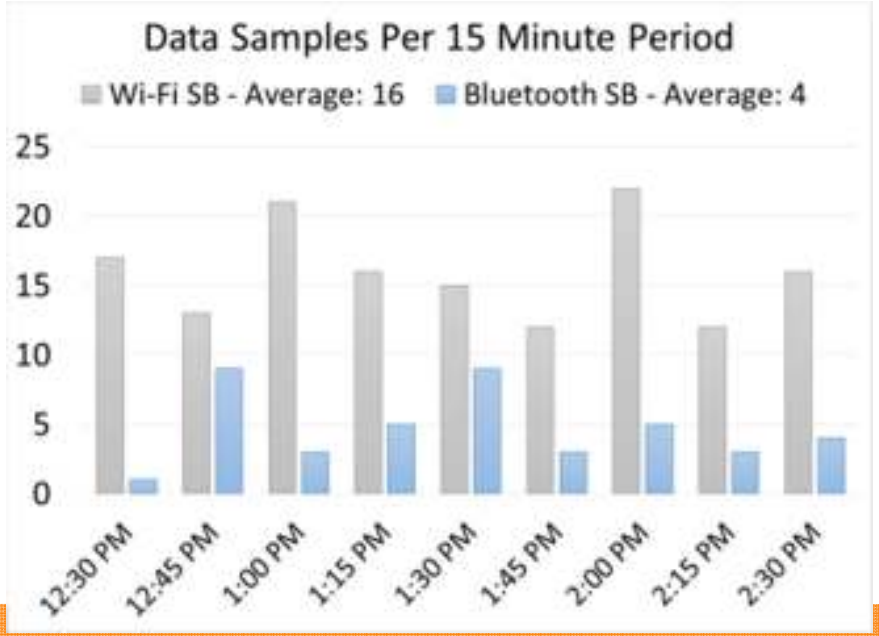


DATA COLLECTION: WI-FI VS. BLUETOOTH

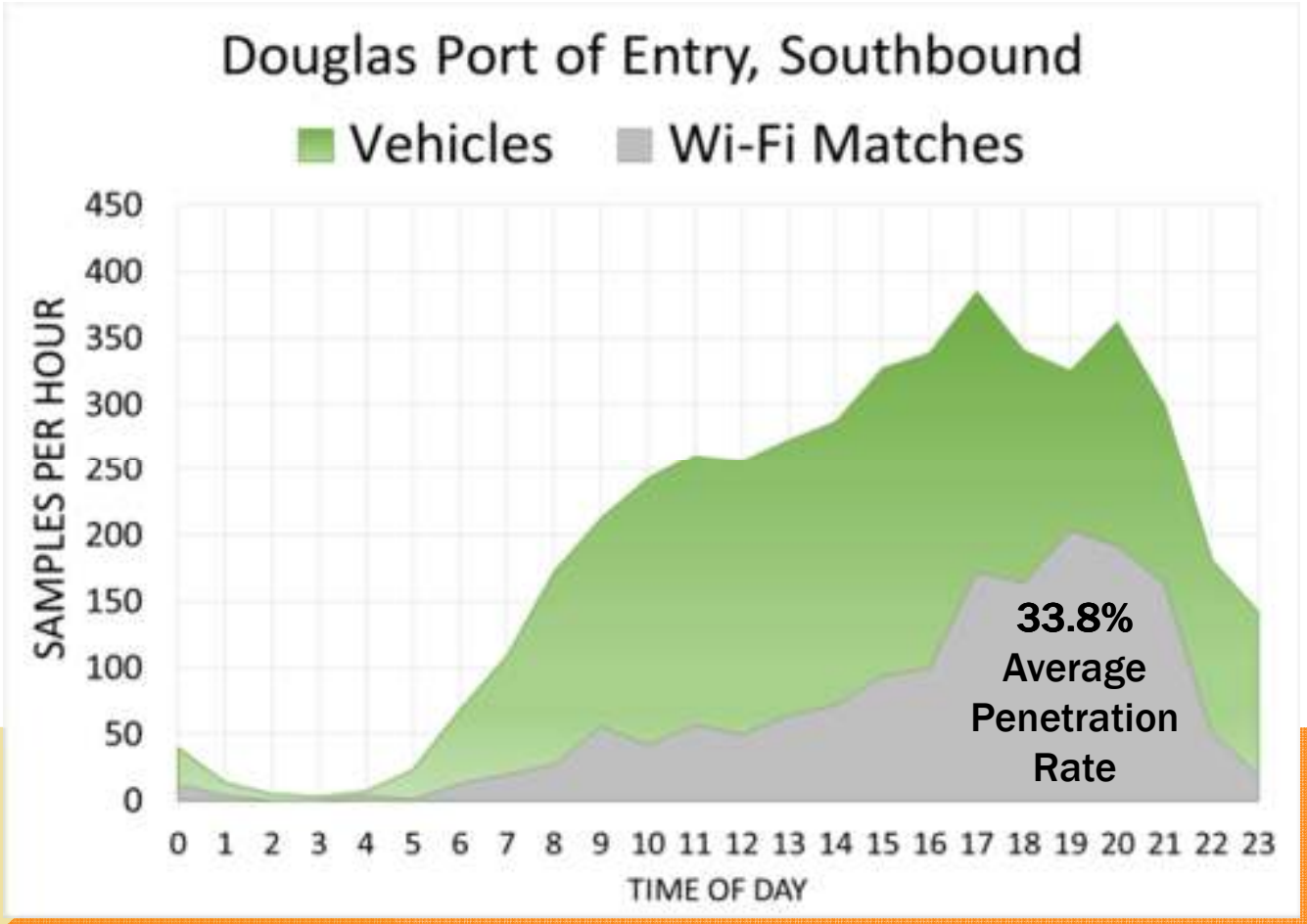
Northbound



Southbound



DATA COLLECTION: PENETRATION RATE



ACTIVE TRAFFIC MANAGEMENT
(Variable Speed Limits)

Reza Karimvand, P.E.
Arizona Department of Transportation

WHAT ARE VARIABLE SPEED LIMITS?

SPEED LIMITS THAT CHANGE based on road, traffic, and weather conditions

IMPROVE SAFETY by restricting speeds during adverse conditions

MINIMIZE THE BREAKDOWN of traffic on the freeway

(***Photo credit: Patch file***)

NUMEROUS VSL DEPLOYMENTS ACROSS THE UNITED STATES

Source:
Beverly T. Kuhn, Ph.D., P.E.
Texas A&M Transportation Institute

HOW DO VARIABLE SPEED LIMITS WORK? DEVELOPMENT CONSIDERATIONS

1. Regulatory versus Advisory
   - Regulatory is enforceable
   - Advisory is not

2. State Law
   - Who can change speed limits in Arizona?

Regulatory

Advisory

28-702. State highway speed limits

A. If the ***director determines on the basis of an engineering and traffic investigation*** *that any maximum speed limit is greater or less than is reasonable or safe under the conditions found to exist on any part of a state highway,* ***the director may determine and declare a reasonable and safe maximum speed limit or varying speed limits*** *for the location.*

HOW DO VARIABLE SPEED LIMITS WORK? PLACEMENT OPTIONS

1. Over the Road
   - Individual Lane Speed Limits
   - Individual Speed Limits on HOV and General Purpose Lanes

(*Photo credit:* Parsons Brinckerhoff)

2. Side of the Road
   - Individual Speed Limits on Road Segments Only

(*Photo credit: udot.Utah.gov*

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HOW DO VARIABLE SPEED LIMITS WORK? MODES OF OPERATION

1. Time-of-day Mode.
   - Will Only Operate During Specific Time Periods (Peak Periods)
   - Based on Speed Detection
2. Harmonization or Automated Mode.
   - Completely Automated.
   - Based on Speed Detection
3. Override Mode
   - Initiated by Operator
   - Weather Events
   - Construction Activities

(***Photo credit imsasafety.org***)

EXAMPLE: WSDOT SEATTLE

OVER THE ROAD, LANE BY LANE REGULATORY VSL

Challenges

1. Speed Limit Debate – Minimum Speed Changed from 40 to 30 MPH
2. Required Staff Reorganization to Staff Off-Hours and Weekends
3. Gantry Maintenance and Sign Failures
4. Setting Expectations – Decision Makers wanted Results Quickly
5. Detailed and Thorough Communications Plan
6. WSDOT Built Own Algorithm

EXAMPLE: GEORGIA DOT, ATLANTA AREA

I-285, 36 CENTERLINE MILES, SIDE OF THE ROAD

Challenges…

1. Enforcement
2. The Media was Relentless
3. Lack of Results

(*Photo credit: Google Earth*

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EXAMPLE: MISSOURI DOT, ST.LOUIS

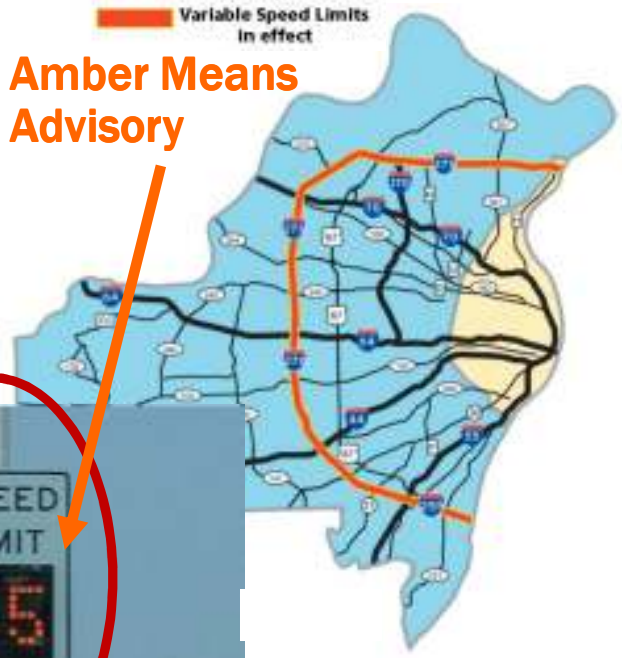
I-270, 35 CENTERLINE MILES, SIDE OF THE ROAD

Regulatory Initially

Changed to Advisory

Challenges

1. Many Enforcement Challenges
2. Lack of Compliance
3. Never Convinced Public
4. Eventually Removed



(*Photo credit: MoDOT*)

KEYS TO SUCCESS

1. Need accurate detection to be able to display appropriate speeds.

2. Need to gain public trust that speeds are appropriate.

3. Need clear messaging to explain the benefit of VSL. Get media on board early.

4. Need maintenance plan to quickly replace broken signs.

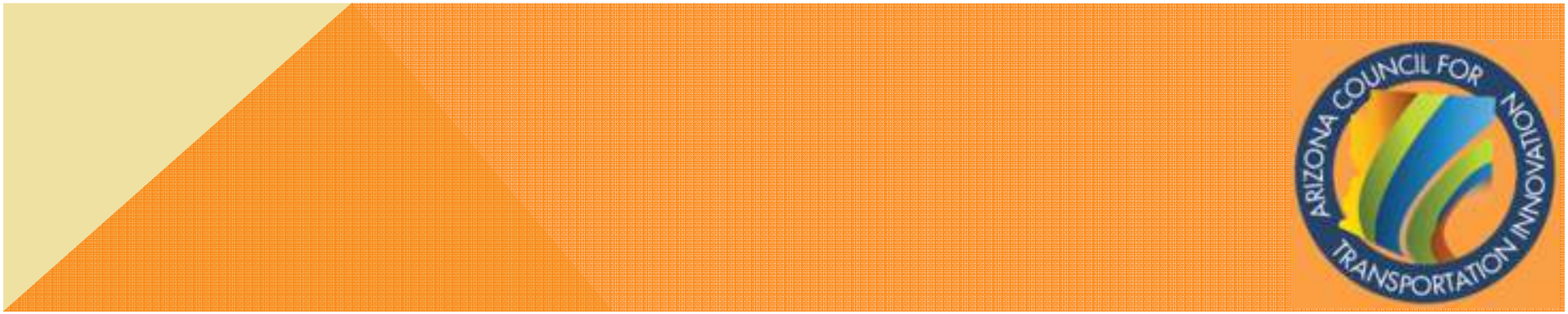
EXPECTED BENEFITS

- Reduces Stop-and-Go Conditions.
- Alerts Drivers when Traffic Congestion is Imminent or Unexpected Situations like Bad Weather.
- Reduces the Number Crashes.
- Increases Throughput.
- Improves Travel Time Reliability.

INTELLEGENT TRANSPORTATION SYSTEM TRENDS AND ADVANCES

Faisal Saleem

Maricopa County Department of Transportation



The Problems Today

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CHALLENGES—HOW ARE WE GOING TO GET MORE OUT OF OUR INFRASTRUCTURE?

- Reduced Budgets
- Rising Populations
- System Expansion Limits
- More with less

The Problems Today

+

- Reduced Budgets
- Rising Populations
- System Expansion Limits
- More with less

=

- Economic (Efficiency & Reliability)
- Social
- Environmental (Emissions)

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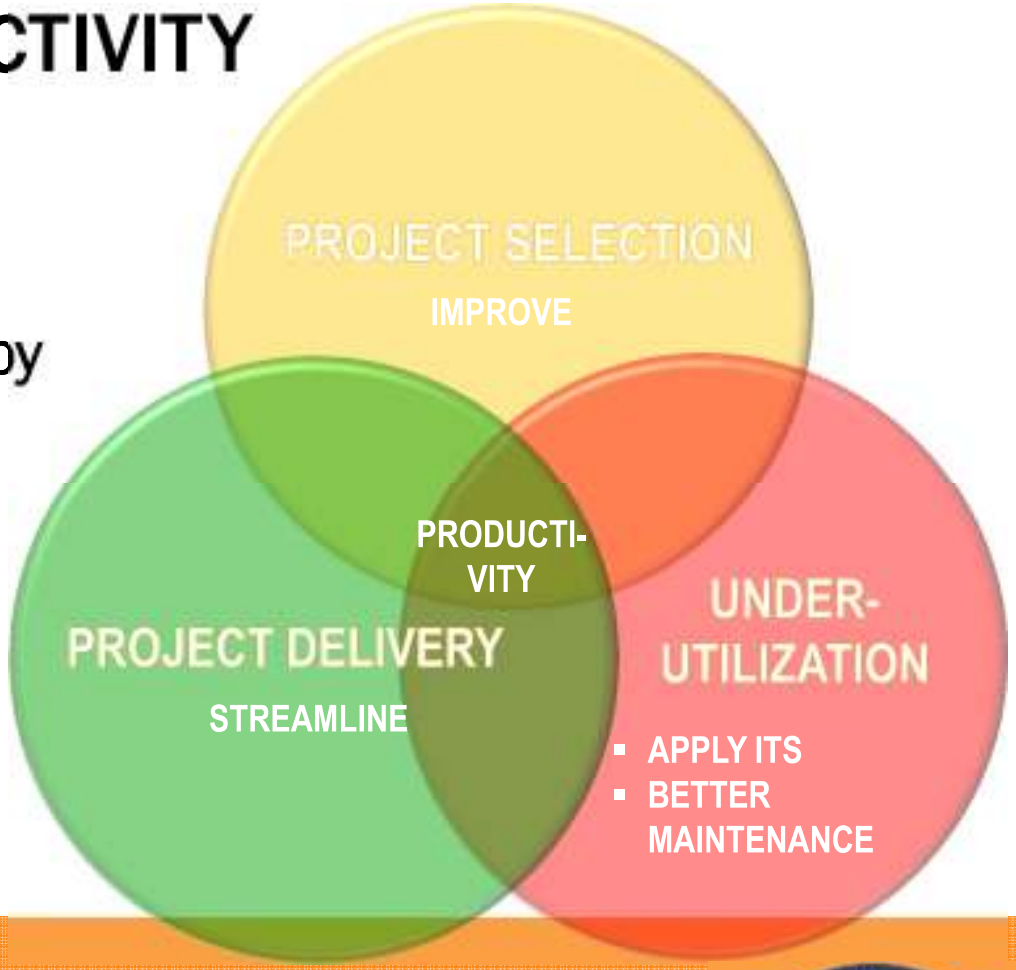
INFRASTRUCTURE CONUNDRUM: IMPROVING PRODUCTIVITY

Research shows
"Governments could boost infrastructure productivity by $ 1 trillion/year (globally)"

Application of Intelligent Transportation Systems addresses the underutilization issue



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MCDOT WORK FLOW CHART

ITS EVOLUTION

1996-2003

AZTech MDI: Technology Development

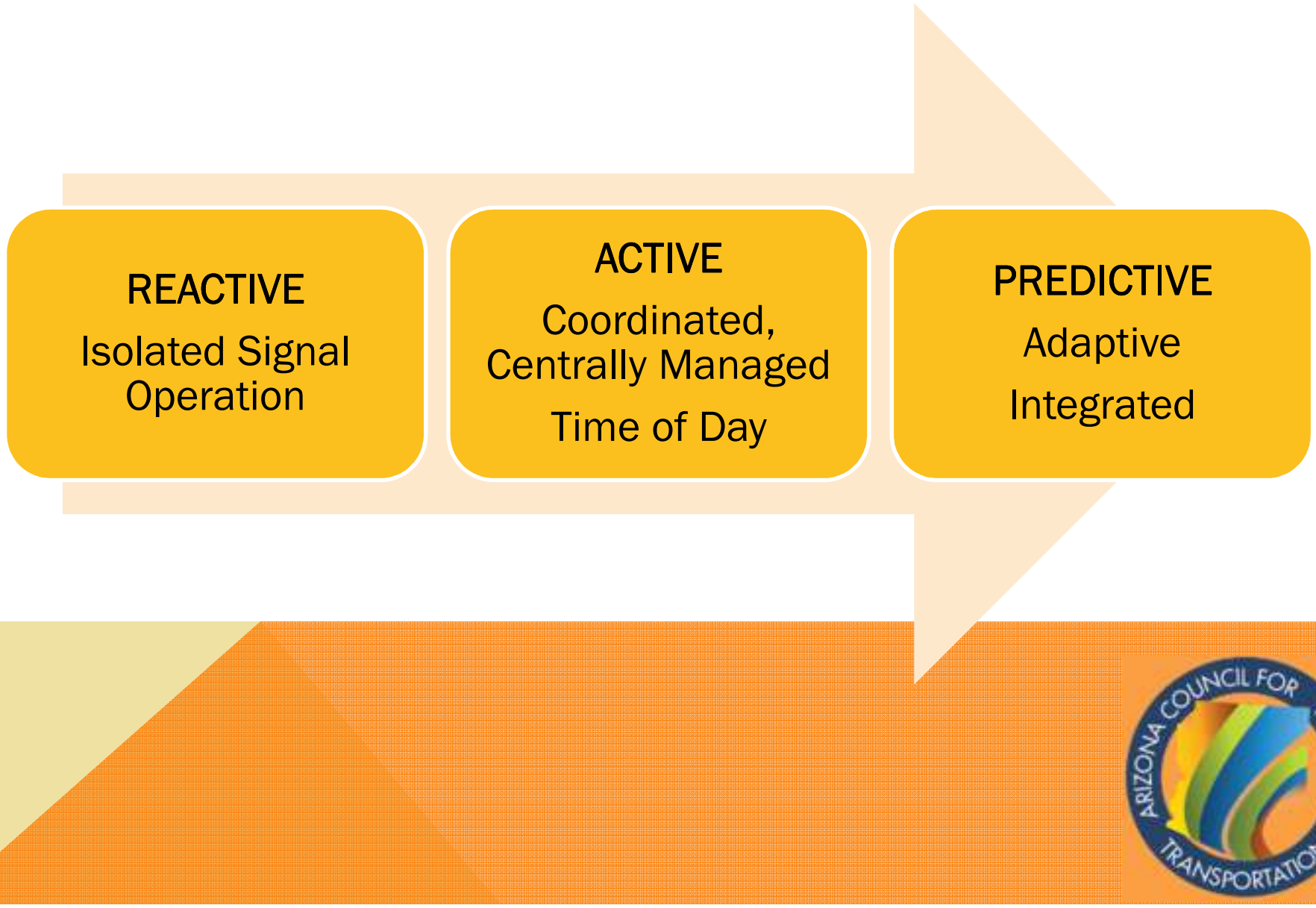
2003-2014

Infrastructure Deployment

2014 -

System Management & Operations

CORRIDOR MANAGEMENT ADVANCEMENT



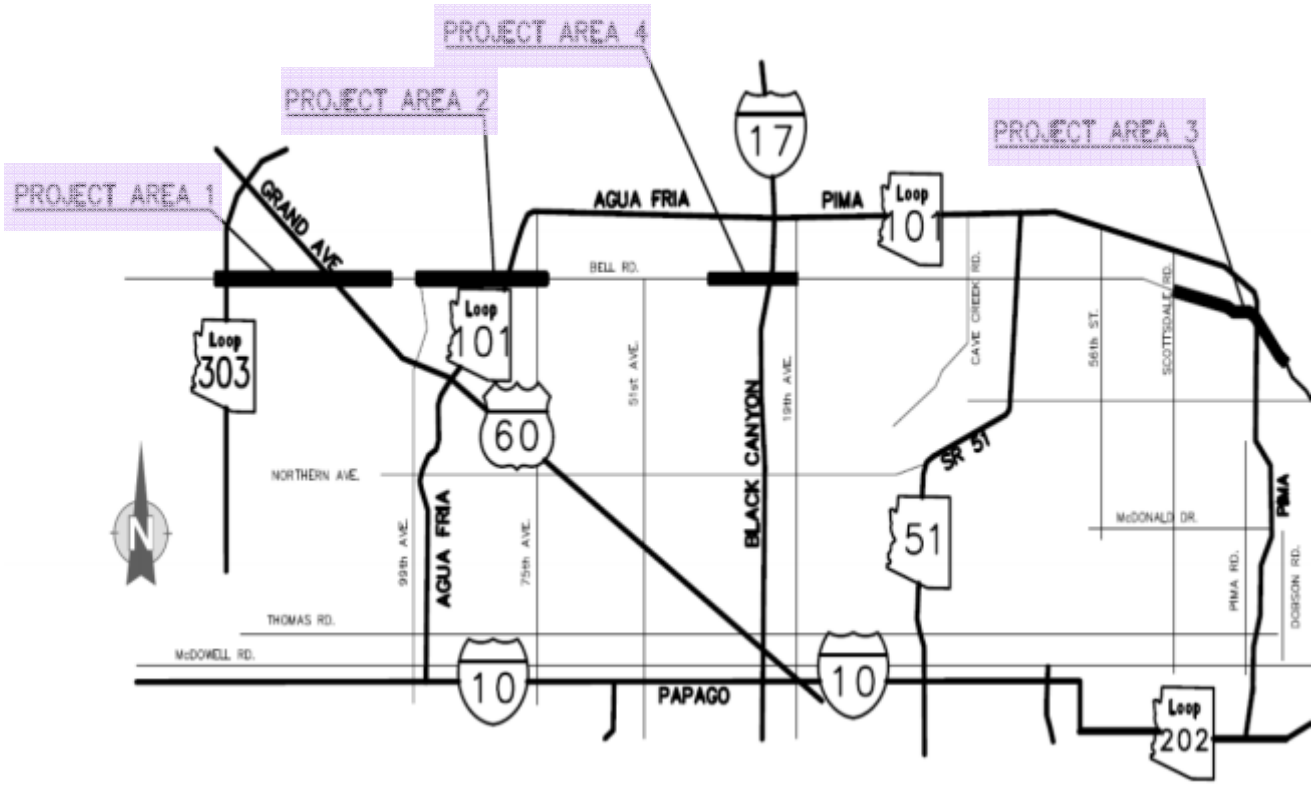
CORRIDOR MANAGEMENT: BELL ROAD

- Bell Road Plan (2000)
  - Seven partnering agencies
- Shared Deployment
  - ITS infrastructure
- Integrated Operations
  - Signal Timing
  - Traveler Information
  - Incident Management
- Performance Monitoring

BELL ROAD PERFORMANCE RESULTS

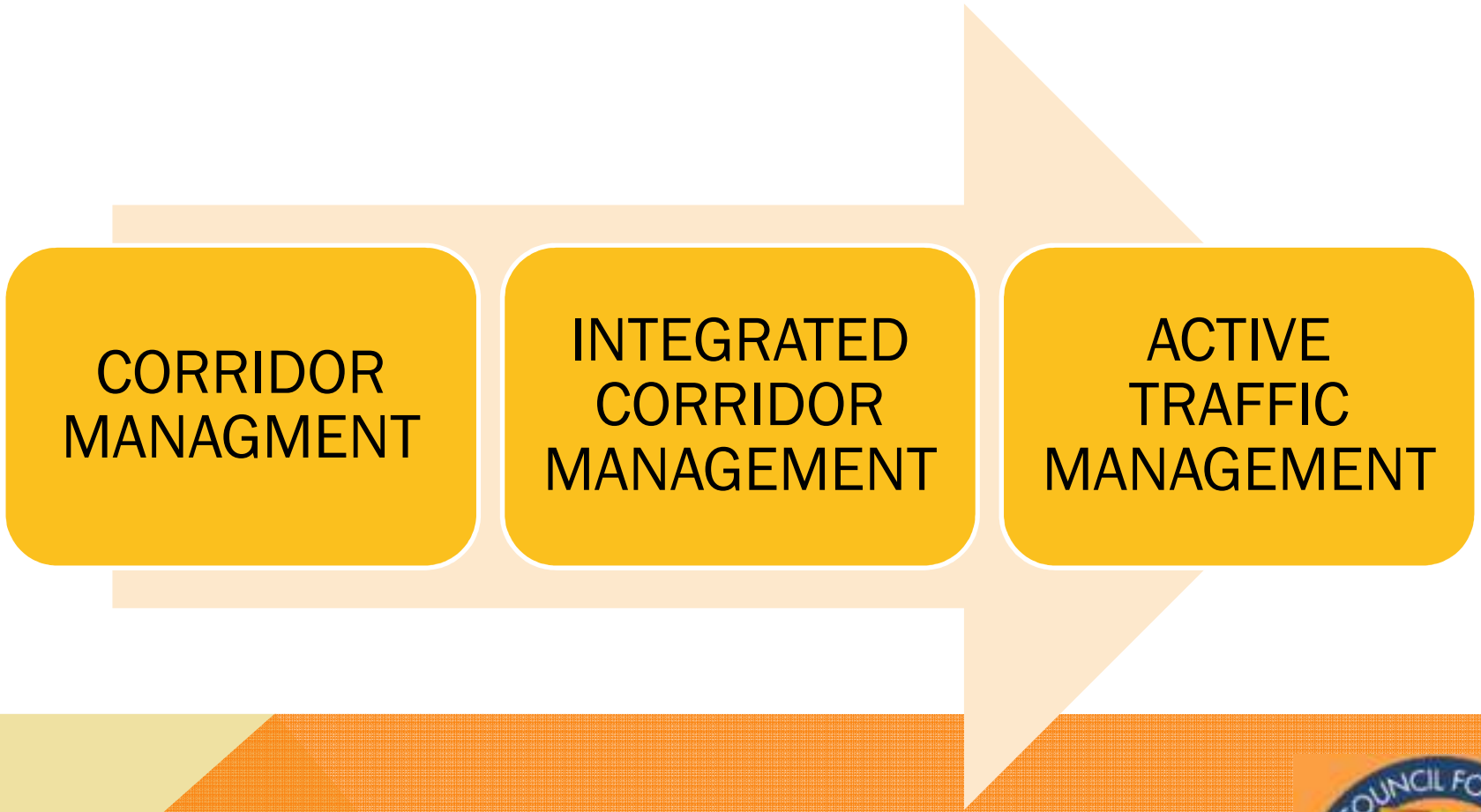
% TRAVEL TIME CHANGE							
PEAK HR – DIRECTION	2007	2008	2009	2010	2011	2012	2013
AM - East Bound		-7.3	0.0	-6.2	0.0	0.0	0.0
PM - West Bound		-3.5	0.0	-24.8	0.0	0.0	-9.7
Combined EB & WB		-5.0	0.0	-17.4	0.0	0.0	-5.3
Cumulative Change	0	-5.0	-5.0	-22.5	-22.5	-22.5	-27.8

BELL ROAD ADAPTIVE SIGNAL PROJECT



- Seven agency partners
- 51 Signals
- Four sections
- Design Completed
- Operations plan in progress

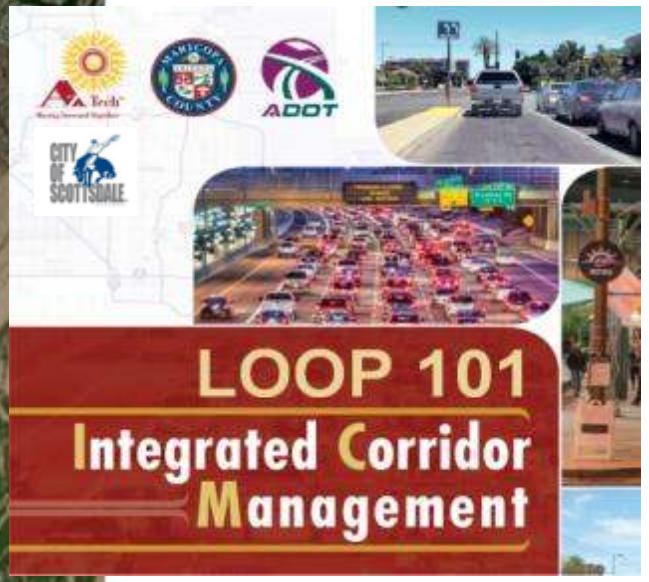
SYSTEM MANAGEMENT AND OPERATIONS



INTEGRATED CORRIDOR MANAGEMENT

MCDOT TMC	
Identification	Notify Scottsdale TMC if a freeway closure will occur Confirm with Scottsdale TMC that REACT assistance is needed
Dispatch	Dispatch REACT to scene if support is needed for freeway closure
Coordination	Confirm with Scottsdale TMC detour route picked Notify REACT of detour route picked
Implementation	
Notification	Send email to distribution list alerting of closure and follow up emails for status
Contact Information	Scottsdale TMC: 480-312-7777
	REACT: 602-201-1452
	ADOT TOC: 602-257-1563

- Loop 101 closure zone—traffic interchange area including ramps OR freeway mainline between traffic interchanges
- Forced detour route in Scottsdale—Preferred
- Forced detour route in Scottsdale—Alternate
- Upstream detour route in Scottsdale—Preferred
- Upstream detour route in Scottsdale—Alternate
- Identification of detour route—Person, Truck, DMS
- Prioritized traffic signal timing plan movement
- Arterial road closure recommendation
- Freeway DMS location to support detour routing



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SMARTER WORK ZONES

Minnesota
IWZ Toolbox

Guideline for
Intelligent Work Zone
System Selection

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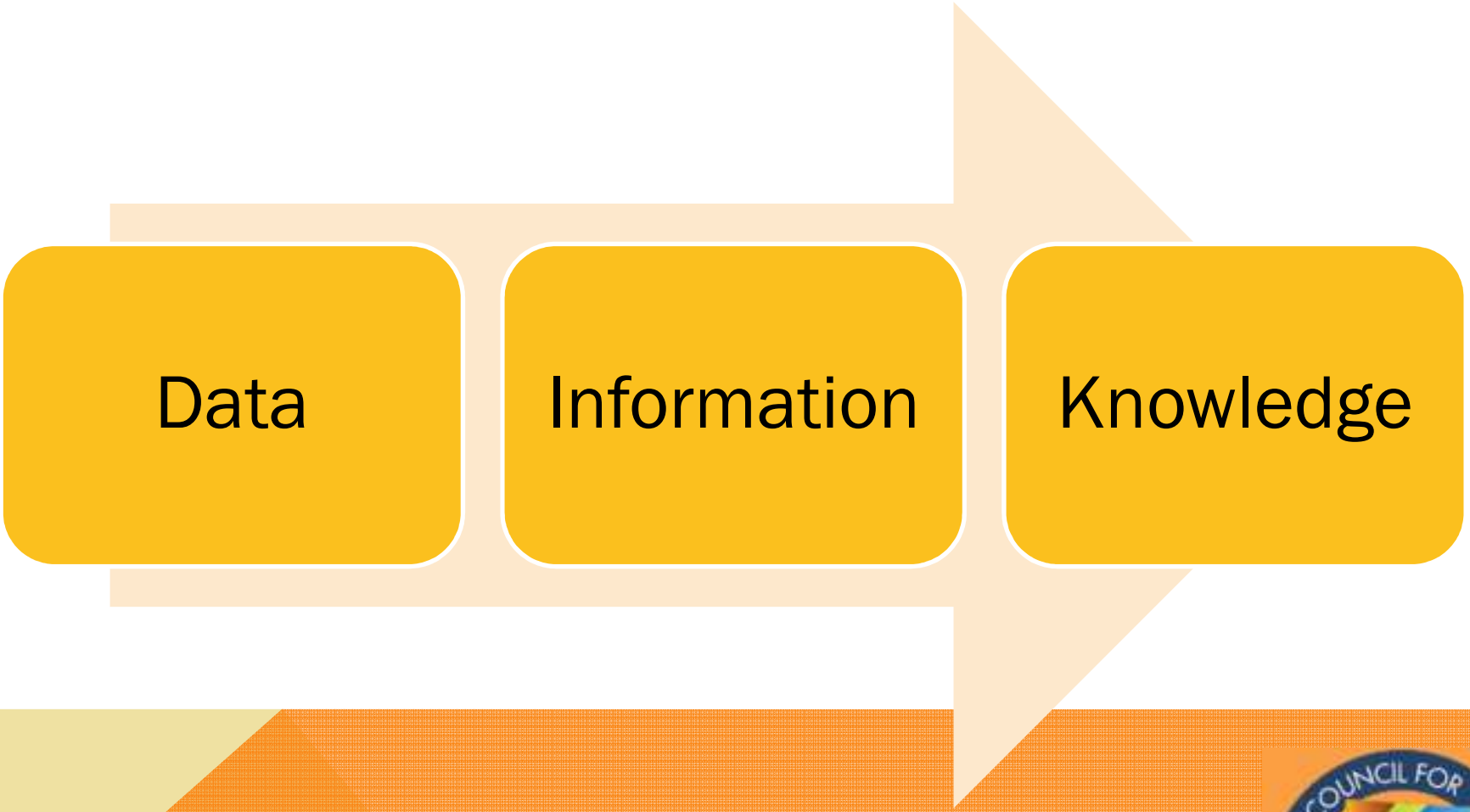
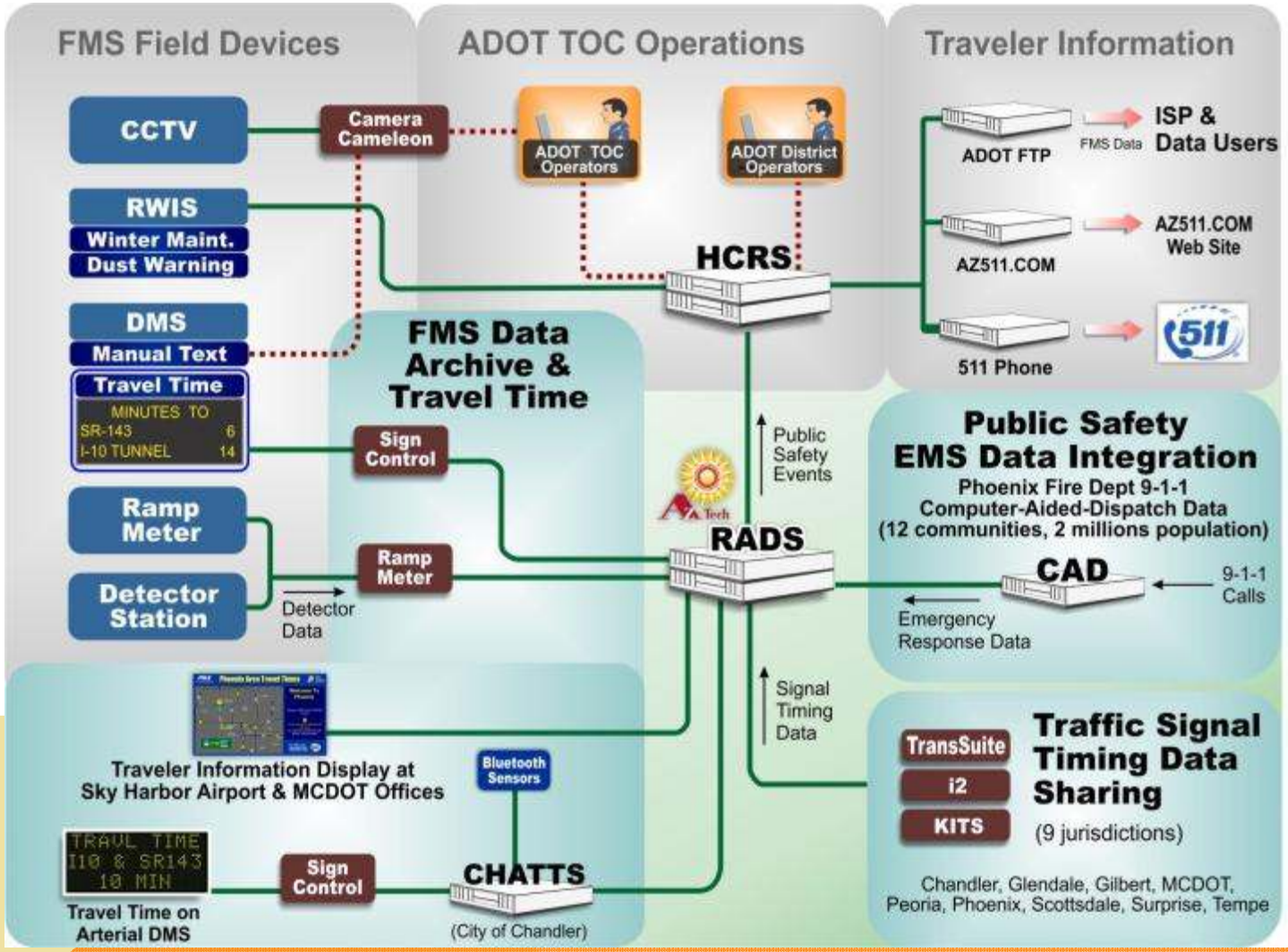
MORE DATA, MORE INFORMATION



DATA BACKBONE: REGIONAL ARCHIVED DATA SYSTEM



ARIS
AZTech Regional Information System

REGISTRATION FORM & ZONE

ARIS
AZTech Regional Information System

NOTIFICATION SUBSCRIPTION FORM

Notification Destination:

Subscriber Name: _____ Organization: _____

Notification Preference:

☐ Email Email Address: _____

☐ Cell Phone Cell Phone Service Provider: _____

Geographic Zones (Check all ARIS monitoring zones preferred. Please refer to the "*ARIS Monitoring Zones*" document to view maps of the pre-defined zone parameters):

☐ Arizona	☐ Chandler	☐ Glendale	☐ Mesa	☐ Scottsdale
☐ Apache Junction	☐ El Mirage	☐ Goodyear	☐ Paradise Valley	☐ Surprise
☐ Avondale	☐ Fountain Hills	☐ Guadalupe	☐ Peoria	☐ Tempe
☐ Buckeye	☐ Gila Bend	☐ Litchfield Park	☐ Phoenix	☐ Tolleson
☐ Cave Creek	☐ Gilbert	☐ Maricopa County	☐ Queen Creek	☐ Youngtown
☐ DOM Scottsdale	☐ MCDOT ITS	☐ PWY PHX		

ITIS Categories (Check up to 3 impact levels for only the preferred ITIS categories):

	ITIS CATEGORY	RED (High Impact)	YELLOW (Medium Impact)	GREEN (Low Impact)
1	Level of Service	☐	☐	☐
2	Incidents/Accidents	☐	☐	☐
3	Closures	☐	☐	☐
4	Lane Restrictions	☐	☐	☐
5	Road Maintenance	☐	☐	☐
6	Obstruction Hazards	☐	☐	☐
7	Road Conditions	☐	☐	☐
8	Weather	☐	☐	☐
9	Winds	☐	☐	☐
10	Environment	☐	☐	☐
12	Activities	☐	☐	☐
15	Delays/Cancellations	☐	☐	☐
16	Traffic Equipment Status	☐	☐	☐
19	Travel Times	☐	☐	☐
20	Parking	☐	☐	☐
21	Information	☐	☐	☐
22	Floodgate	☐	☐	☐
99	Winter Storm Codes	☐	☐	☐

Types of Event Notifications (Check up to 3 preferred notification types):

☐ New Events ☐ Updates ☐ Deleted Events

Notification Schedule (Enter start and end times for only the days preferred or check "24-hours"):

TIME OF DAY	SUN	MON	TUE	WED	THU	FRI	SAT
Starts	Military time?						
Ends							
			OR				
24-Hours	☐	☐	☐	☐	☐	☐	☐

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EVENT MONITORING

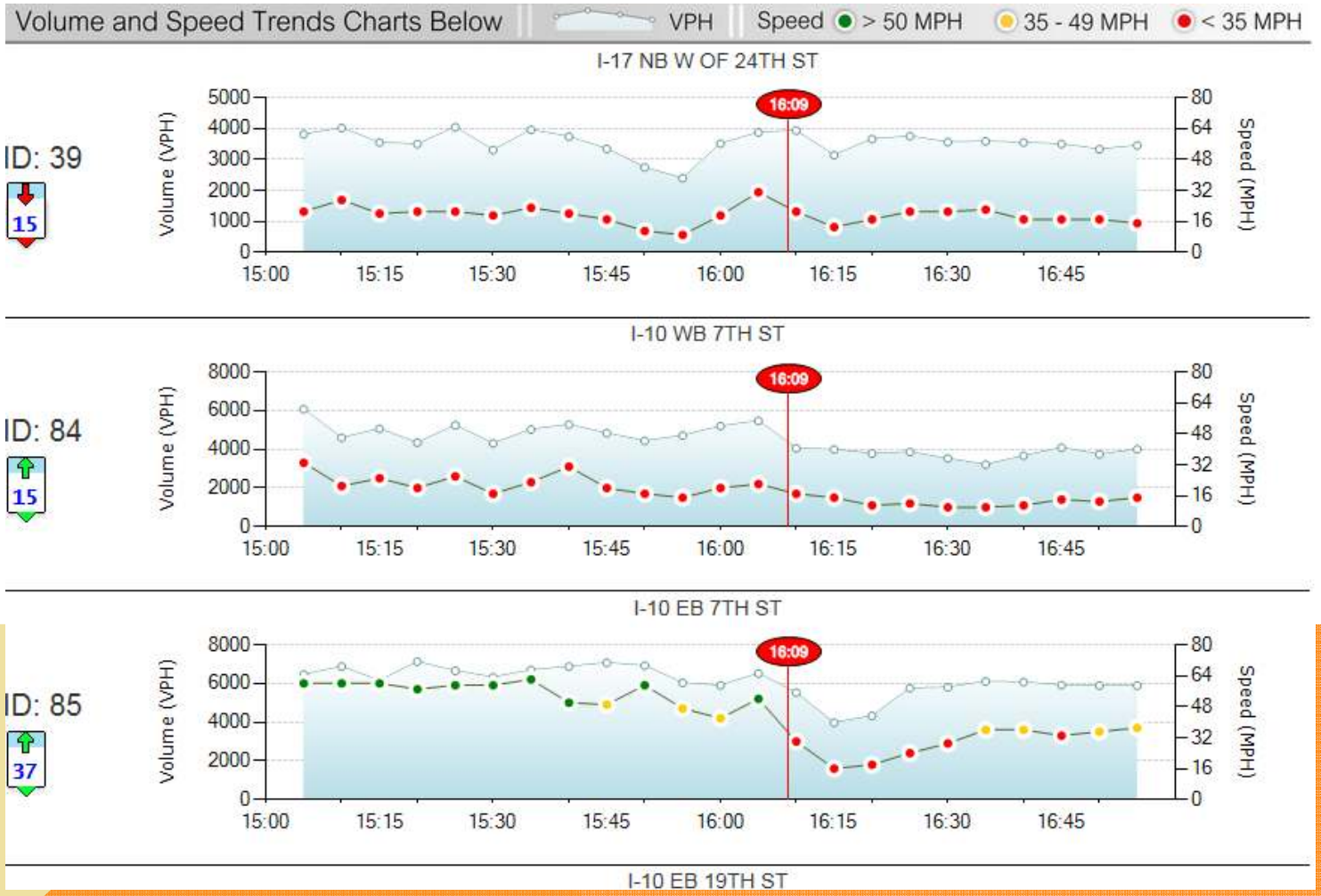
ARIS
AZTech Regional Information System

TACTICAL SCREEN

ARIZONA COUNCIL FOR TRANSPORTATION INNOVATION

ARIS
AZTech Regional Information System

TACTICAL SCREEN



ARIS
AZTech Regional Information System

AGENCIES CURRENTLY SUBSCRIBING

- ADOT, MCDOT, Phoenix, Tempe, Scottsdale, Chandler, Mesa, Gilbert, Glendale, Peoria, Surprise
- Notifications (Typical Daily – 960 notifications)
- Events (Typical Daily – 18 closures, 200 lane restrictions, 60 maintenance events, 22 others)
- Feedback is very positive (general comment is that it provides too many notifications)

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ARIS
AZTech Regional Information System

Institute of Transportation Engineers (ITE) 2015 Transportation Management Systems and Operations Council Project Achievement Award

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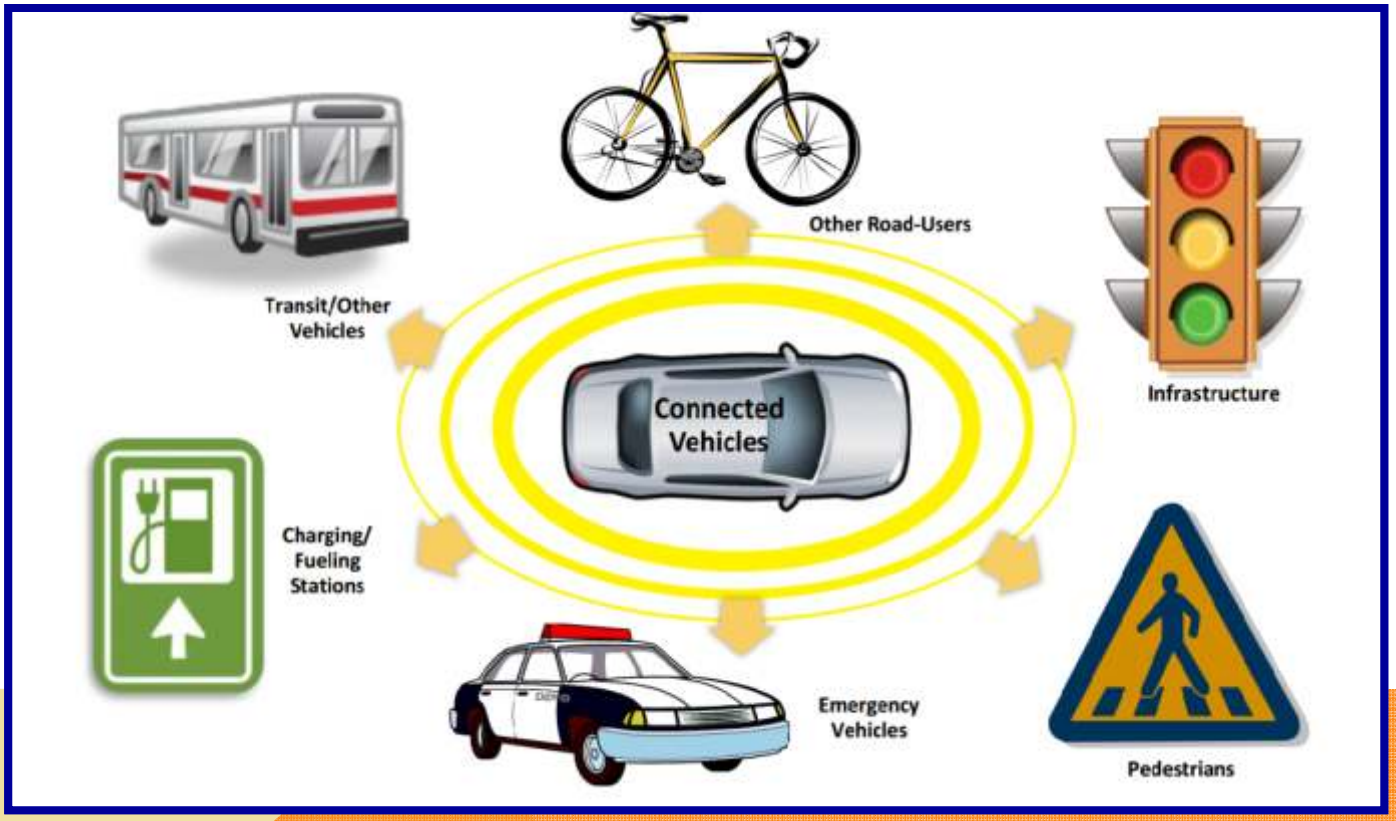
21ST CENTURY TRANSPORTATION LANDSCAPE IS CHANGING: EARLY 21ST CENTURY INNOVATIONS



- Multi-modal
- Connected
- Informed
- On-Demand
- Shared
- Smart Parking

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DEVELOPING FUTURE TECHNOLOGIES

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WHAT'S ON THE HORIZON

Larry Head, University of Arizona

INNOVATIVE TECHNOLOGIES

Connected Vehicles

Automated Driving Vehicles

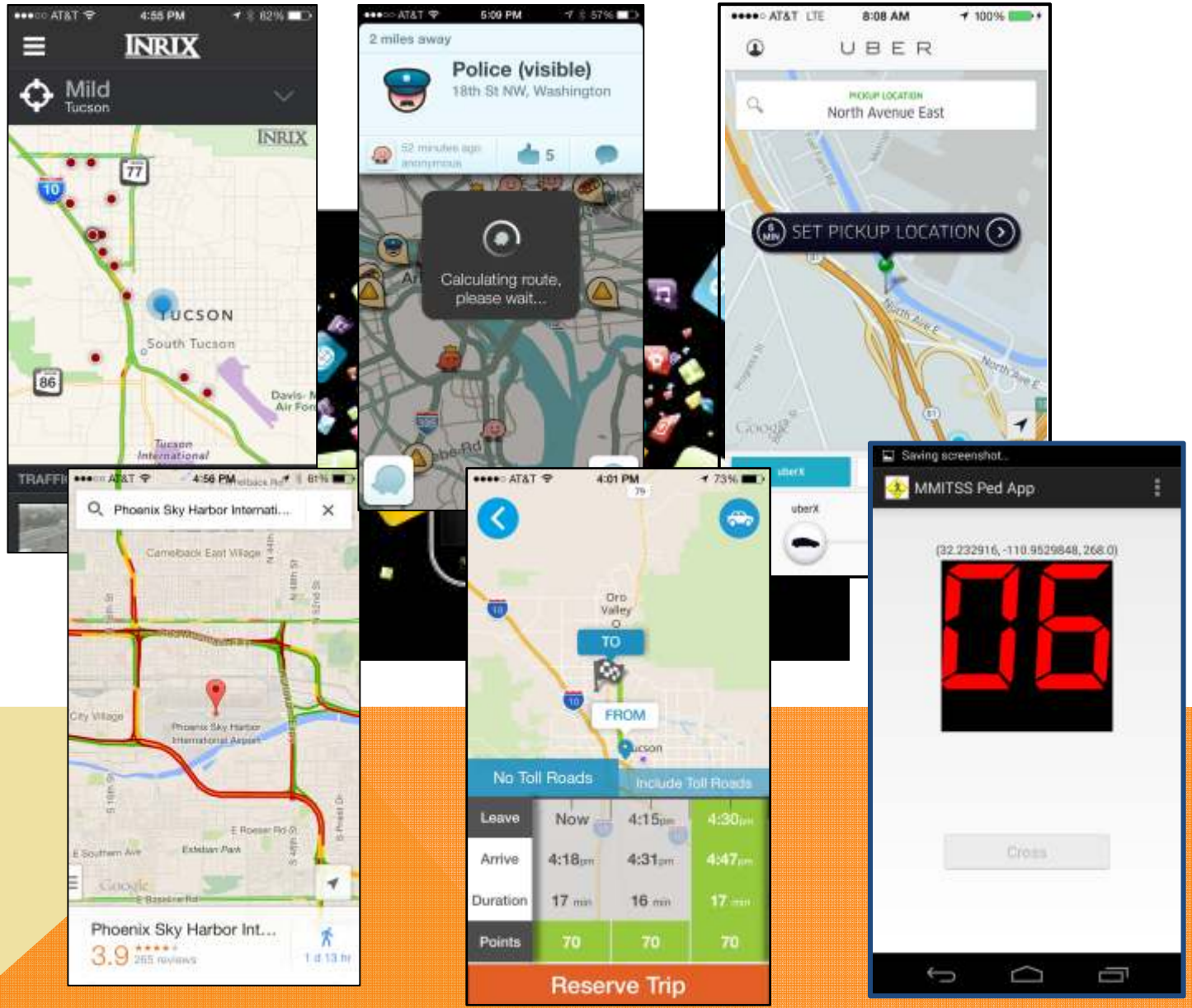
Connected Travelers

Connected Infrastructure

Photo Source: http://www.its.dot.gov

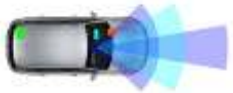
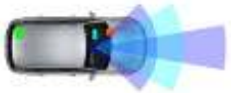
ARIZONA COUNCIL FOR TRANSPORTATION INNOVATION

CONNECTED TRAVELERS



AUTOMATED DRIVING VEHICLES

NHTSA automated driving levels

	Level 0	Level 1	Level 2	Level 3	Level 4
	Driver only	Assisted	Partial	Conditional	Full
Feature		Active high beam Collision imminent braking Cruise control	Traffic jam assist Adaptive cruise & lane keeping Self-parking (with driver)	Collision avoidance Automated highway Automated urban	Valet self-parking Highway point-to-point Urban point-to-point
					
Technology		Radar Forward sensors	Radar Forward sensors Multi-domain controller Driver state sensor V2X	High accuracy GPS Multi-domain controller Forward, HD & IR cameras V2X Internal moment unit	High accuracy GPS Multi-domain controller Forward, HD & IR cameras V2X Internal moment unit
		Today		2020	2025+

DELPHI

Source: Michael Pozsar, AVS 2015, July 21, 2015

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AUTOMATED DRIVING VEHICLES (SAE LEVELS)

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

CONNECTED VEHICLES

Basic Safety Message (SAE J2735 BSM) Broadcast 10 times/second (10 HZ)

Purpose

- Safety
- Mobility
- Environment

Basic Safety Message (BSM)

- Temporary ID (ensure privacy)
- Position (GPS)
- Motion
  - ✧Speed
  - ✧Heading
  - ✧Steering Wheel Angle
  - ✧Acceleration
- Brakes
- Vehicle Size
- Mode (vehicle, transit, truck, EV,…)

CONNECTED VEHICLES AND INFRASTRUCTURE SYSTEMS

Vehicle(s)…

+

Connected Vehicle Equipment

On Board Equipment (OBE)
After Market Safety Device (ASD)

DSRC 5.9 GHz Radio

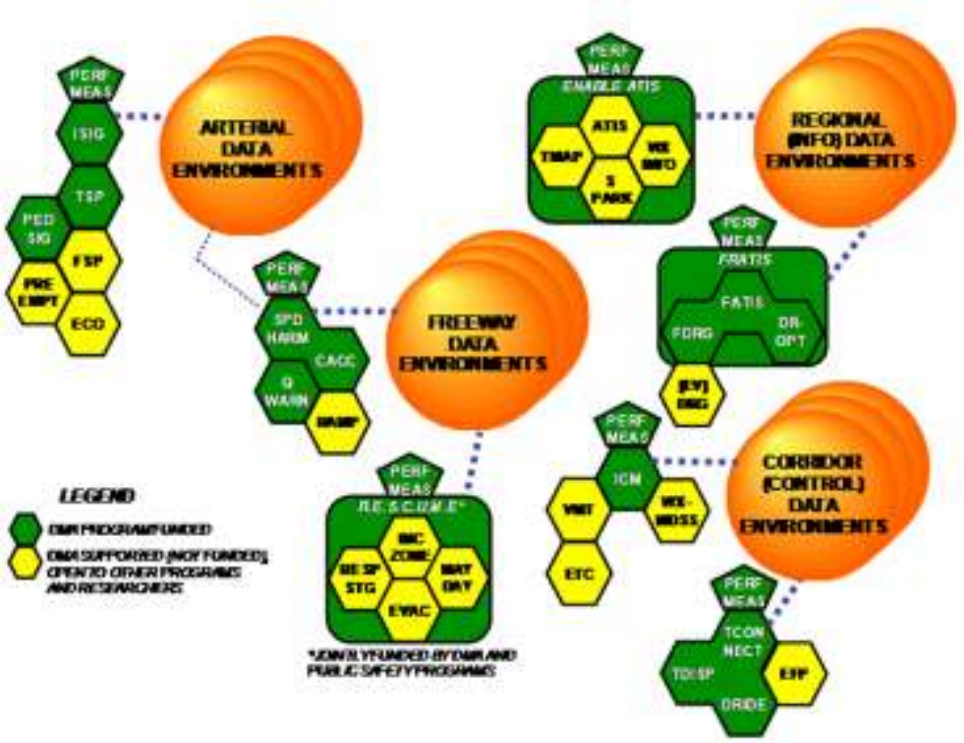
Cooperative Applications:
Transit Priority
Truck Priority
Emergency Vehicle Priority

Connected Vehicle Infrastructure Equipment
Road Side Equipment (RSE)

MAP Data
Digital Description of Roadway
(D. Kelley, 2012)

DYNAMIC MOBILITY APPLICATIONS (DMA)—USDOT

ATIS - Multi-Modal Real-Time Traveler Information
CACC - Cooperative Adaptive Cruise Control
DRG - Dynamic Routing of Vehicles
D-RIDE - Dynamic Ridesharing
DR-OPT - Drayage Optimization
ECO - Connected Eco Driving
EFP - Multimodal Integrated Payment System
ETC - Electronic Toll Collection System
EVAC - Emergency Communications & Evacuation
F-ATIS - Freight Real-Time Traveler Information with Performance Monitoring
F-DRG - Freight Dynamic Route Guidance
FSP - Freight Signal Priority
ICM - NxGen Integrated Corridor Management
INC-ZONE - Incident Scene Workzone Alerts for Drivers and Workers
I-SIG - Intelligent Traffic Signal System
MAYDAY - Mayday Relay
PED-SIG - Mobile Accessible Pedestrian Signal System
PREEMPT - Emergency Vehicle Preemption with Proximity Warning
Q-WARN - Queue Warning
RAMP - NxGen Ramp Metering System
RESP-STG - Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
S-PARK - Smart Park and Ride
SPD-HARM - Dynamic Speed Harmonization
T-CONNECT - Connection Protection
T-DISP - Dynamic Transit Operations
T-MAP - Universal Map Application
TSP - Transit Signal Priority
VMT - Mileage Based User Fees
WX-INFO - Real-Time Route Specific Weather Information for Motorized and Non-Motorized Modes
WX-MDSS - Enhanced MDSS



http://www.its.dot.gov/press/2011/mobility_app.htm

ARIZONA CONNECTED VEHICLE RESEARCH

Multi Modal Intelligent Traffic Signal System (MMITSS)

I-SIG - Intelligent Traffic Signal System

PREEMPT - Emergency Vehicle Preemption with Proximity Warning

TSP - Transit Signal Priority

FSP - Freight Signal Priority

PED-SIG - Mobile Accessible Pedestrian Signal System

RAMP - NxGen Ramp Metering System

ARIZONA®

Sponsored by Connected Vehicle Pooled Fund
(USDOT, MCDOT, Caltrans, ADOT, MNDOT, FDOT, TxDOT, VDOT…)

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MMITSS PEDESTRIAN SMARTPHONE APP

Allows Pedestrian to receive auditory and haptic feedback

- Align with Crosswalk
- Send Call for Service
- Be given WALK
- PedCLEAR Countdown
- Alignment Assistance

Connected Vehicle TEST BED

MARICOPA COUNTY + ARIZONA + ADOT

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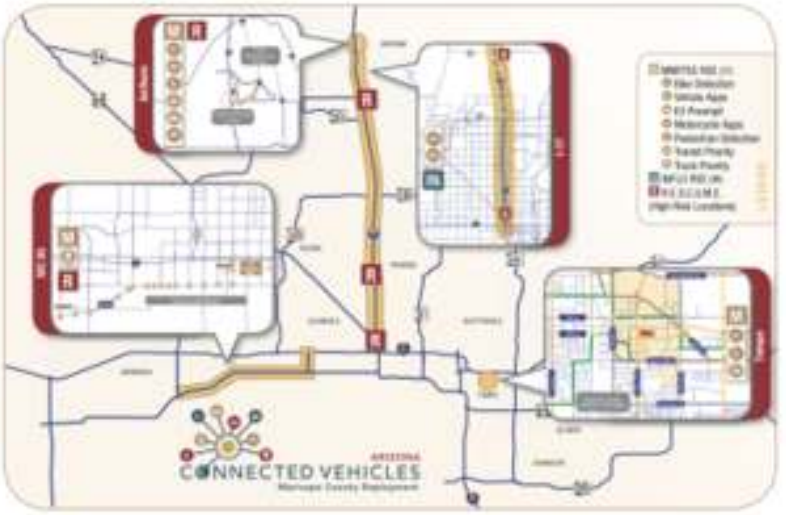
ARIZONA CONNECTED VEHICLE TEST NETWORK

ARIZONA
CONNECTED VEHICLES
Maricopa County Deployment



INFLO integrated with Metropia (Concept)

INFLO

- Speed Harmonization
- Queue Warning

MMITSS

- Intelligent Traffic Signals
- Priority Signal Control
- Pedestrian Accessibility
- Performance Observation

R.E.S.C.U.M.E.

- Incident Alert
- Staging Assistance

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WWW.AZDOT.GOV/ACTI

2015 INNOVATION EXCHANGE CAMPAIGN

QUESTIONS AND DISCUSSION