Emergency Vehicle Preemption (EVP) Best Practices Study

Project Update

Presented to

MAG ITS Committee

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OZ Engineering

February 4, 2015

Study Scope

This Update

- Task 1: Identify Existing Regional EVP Inventory
- Task 2: Identify Operations Challenges and Limitations

  Tech Memo #1 — January 21, 2015
- Task 3: Research and Review of Current EVP Technologies

  Tech Memo #2 — February 13, 2015
- Task 4: EVP Best Practices

  Tech Memo #3 — March 13, 2015
- Task 5: Recommendations for Improving EVP

  Draft Report — April 10, 2015

  Present to TAG — April 24, 2015

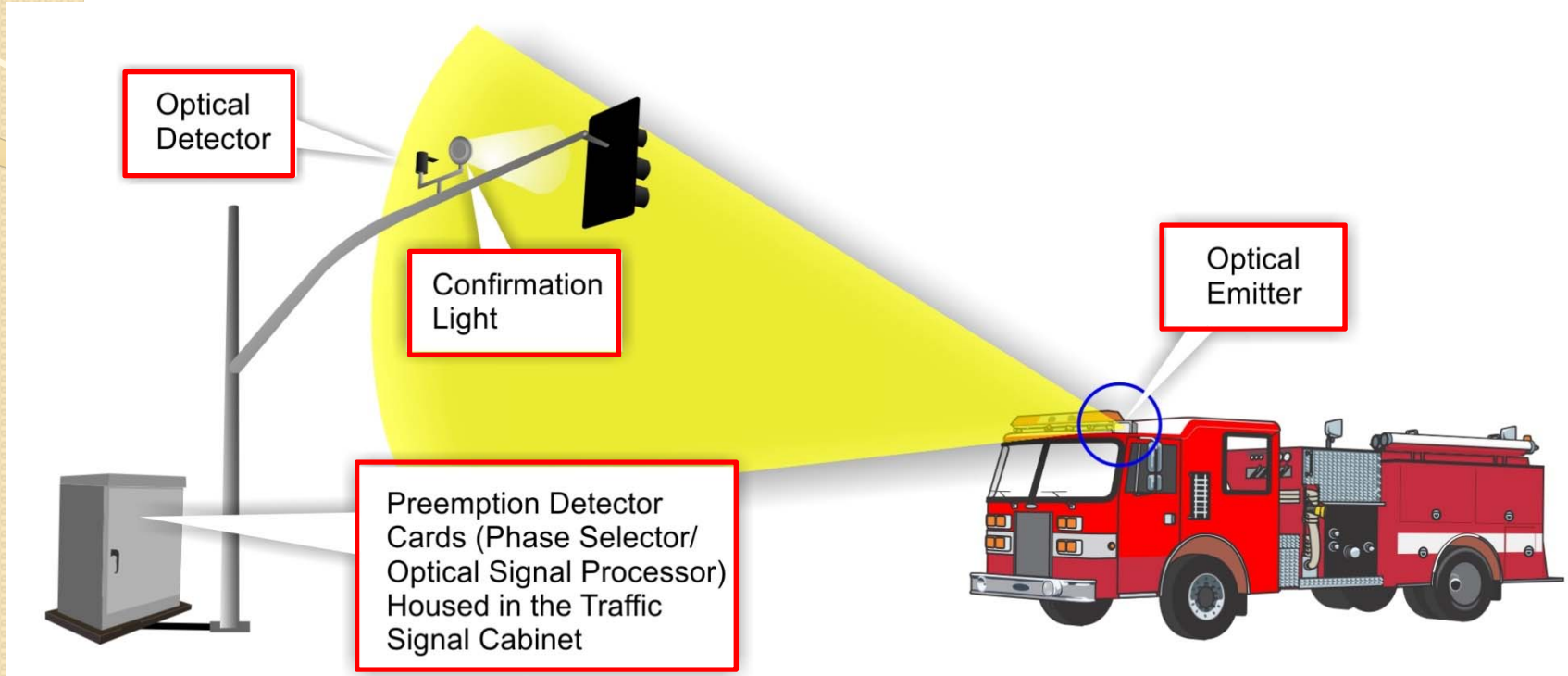
  Present to ITS Cmt — May 6, 2015

  Final Report — May 29, 2015

Tech Memo No. 1 Recap

- Section 1. Overview of EVP technology
  - Major components and functions
- Section 2. Regional EVP inventory
  - Jurisdictions
  - Information collected
- Section 3. Challenges and limitations

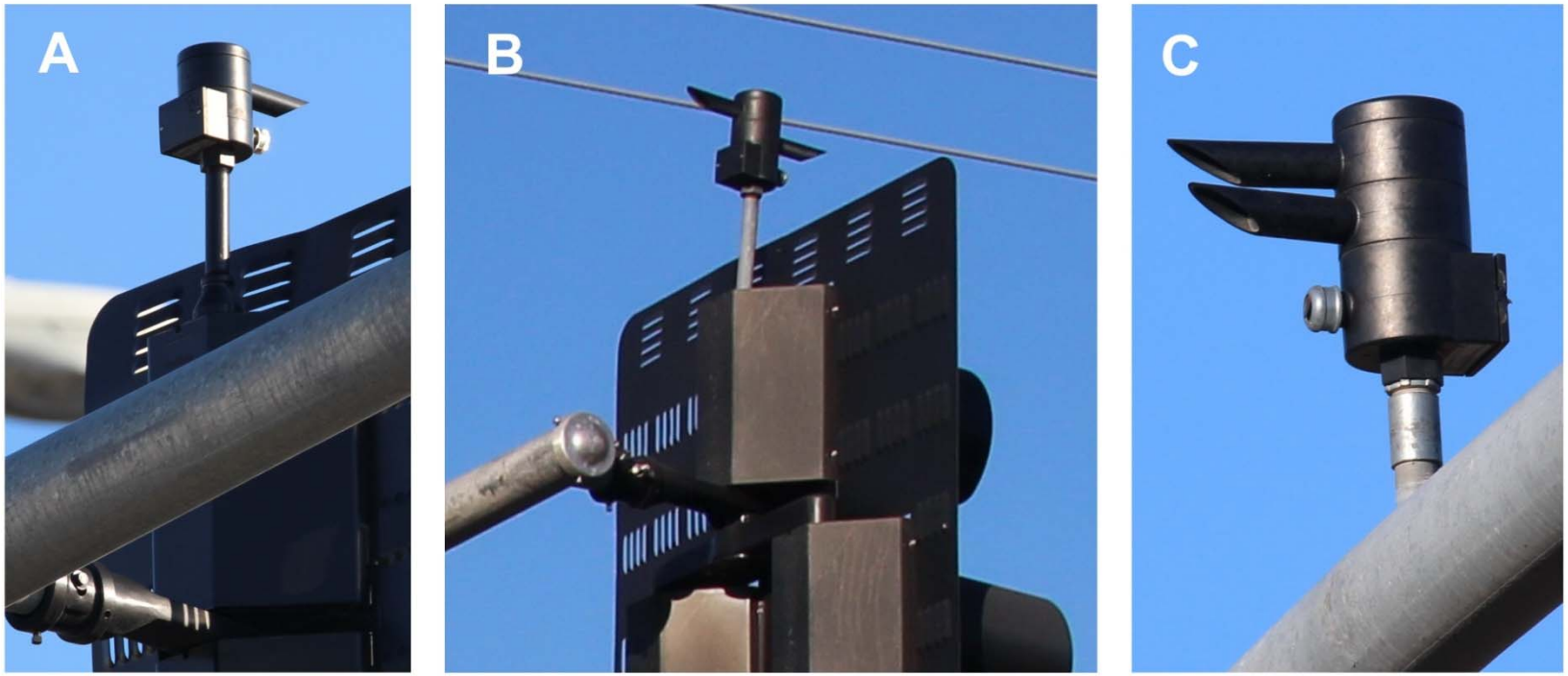
Overview of EVP Technology



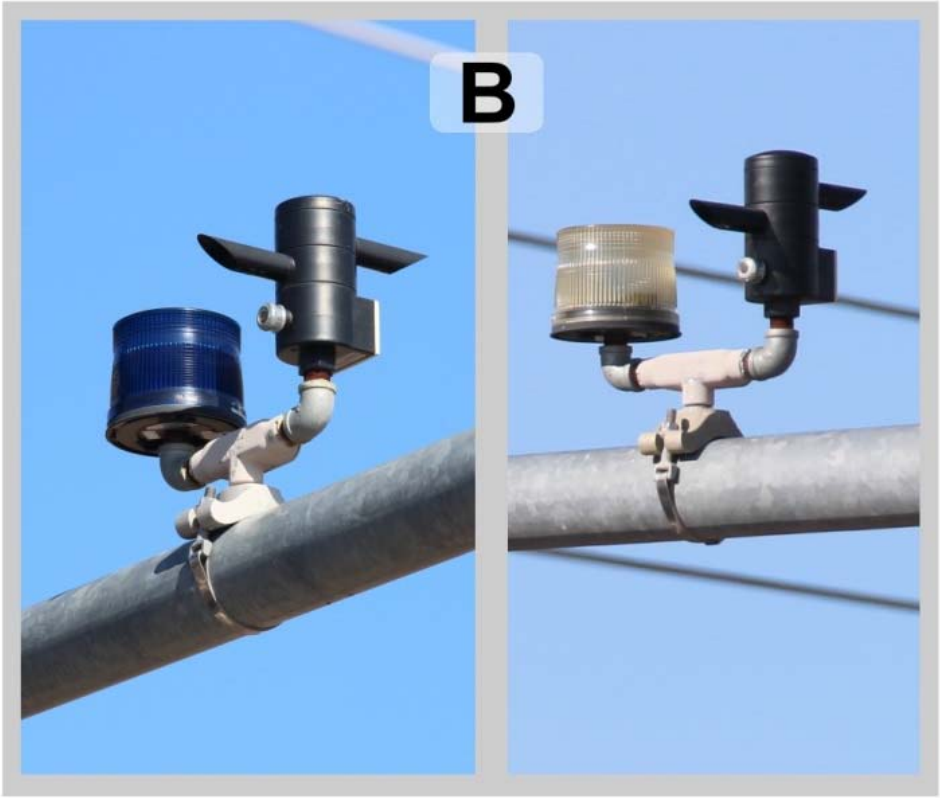
And… traffic signal phase provided during preemption

Optical Emitter

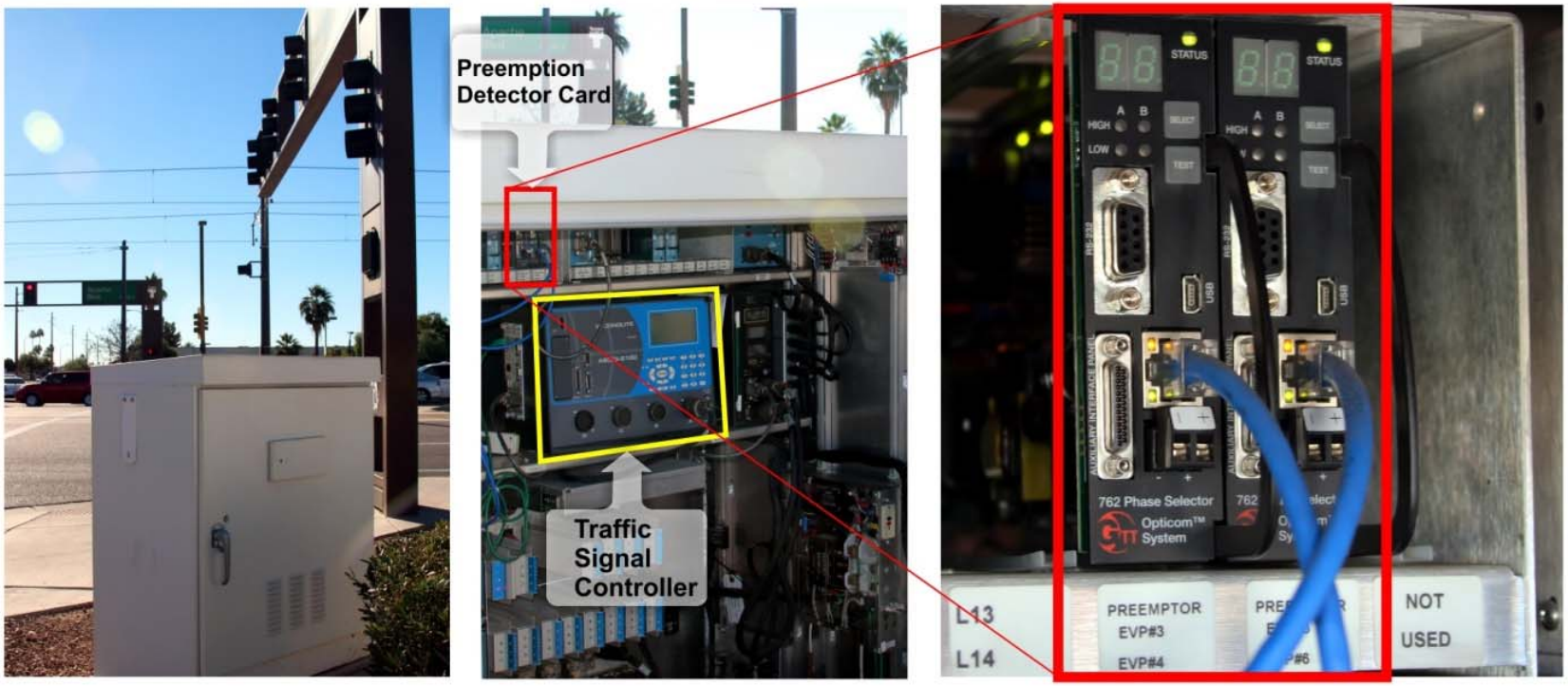
Optical Detector



Confirmation Light



Preemption Detector Card



Regional EVP Inventory

- Method: Survey and (in-person, phone) interviews

- Apache Junction
- Avondale
- Buckeye
- Chandler
- El Mirage
- Fountain Hills
- Gila River Indian Community
- Gilbert
- Glendale
- Goodyear
- Maricopa
- Mesa
- Paradise Valley
- Peoria
- Phoenix
- Scottsdale
- Surprise
- Tempe
- Tolleson
- Queen Creek
- Maricopa County Department of Transportation (MCDOT)
- Pinal County
- Arizona Department of Transportation (ADOT)
- Valley Metro

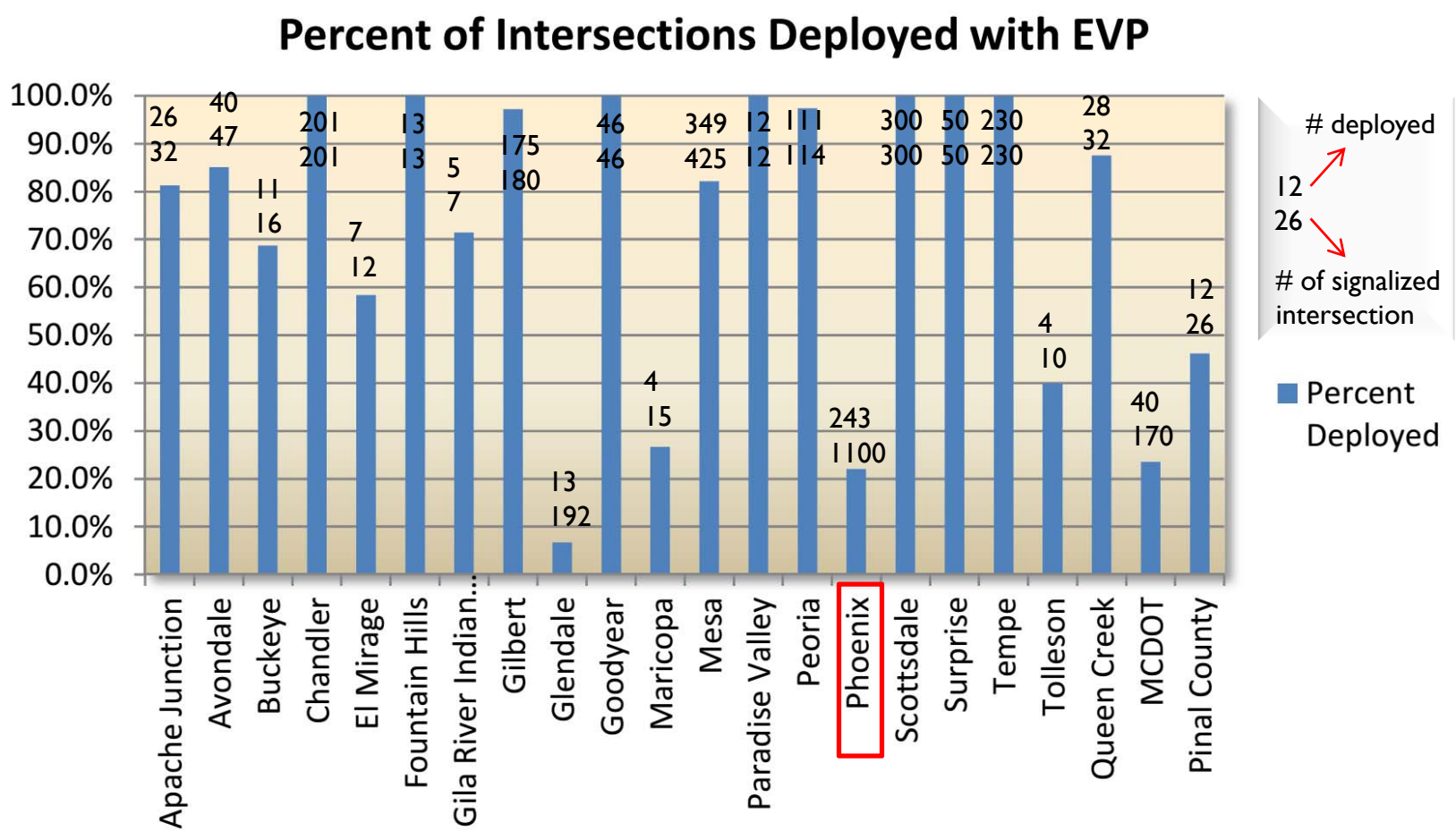
Key Information Collected

- Number of EVP equipped intersections
- Brand of EVP system
- Signal phase provided during preemption
- Confirmation light
- Use of encoding
- Detection range settings
- Maintenance
- Users (fire, ambulance, police)
- Central Management Software
- Usage data review
- Shared use with transit

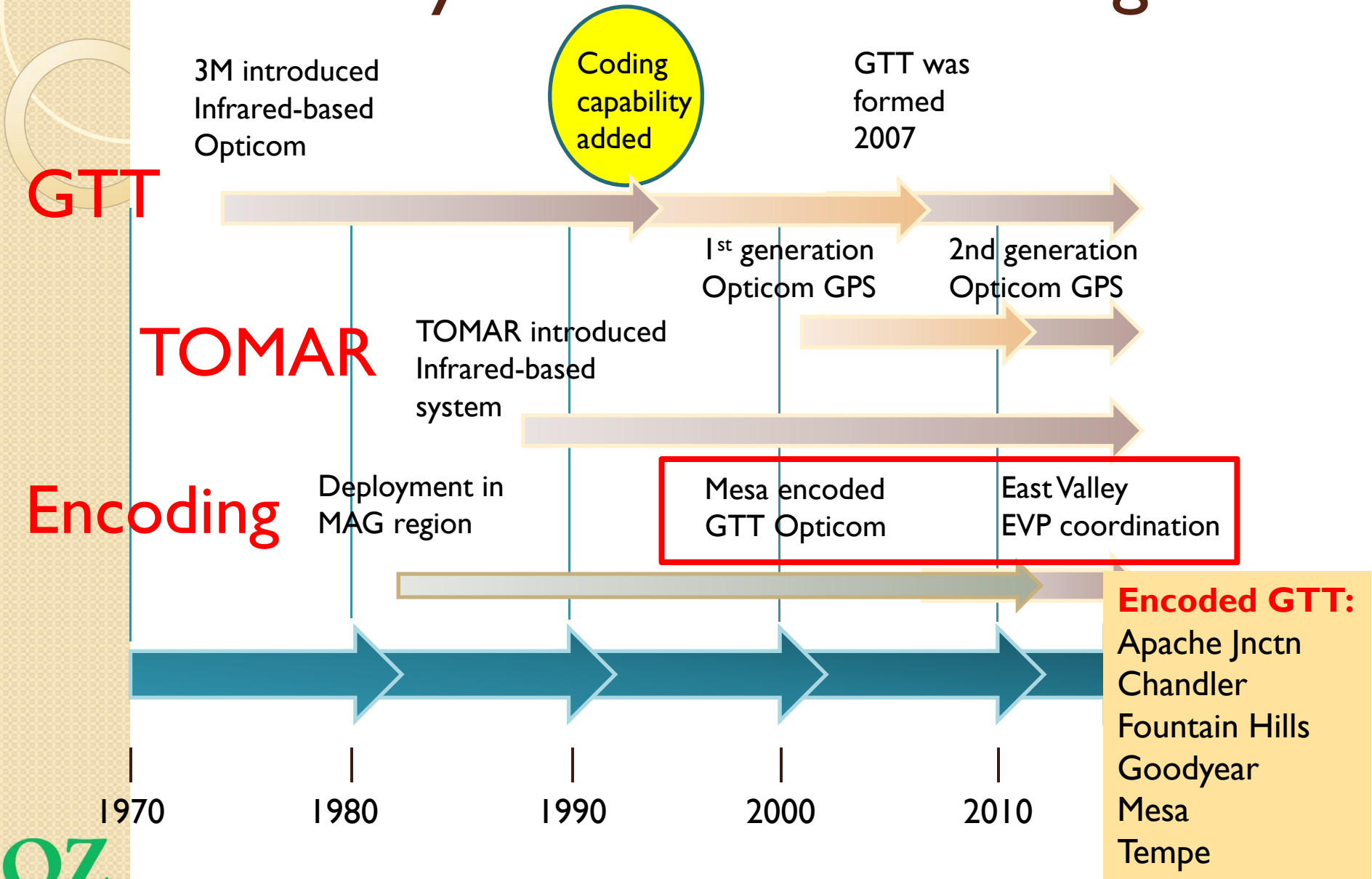
Summary of Findings

Jurisdictions (Traffic Signal Contracted to)	# of EVP Intersections (Total Signalized)	Brand (GTT, TOMAR)	Encoding (Y/N)	Signal Phase Provided (B, B+A)	Confirmation Light (2, 4-way)	Detection Range (Feet)	Maintenance Period	Users (Fire, Ambulance, Police)	Review Usage Data	Transit (Y/N)
Apache Junction	26 (32)	G	Y	B+A	2-way	2500	3 mo	F, A	Reactive	N
Avondale	40 (47)	T	N	B+A	4-way	1000	3 mo	F, A	Reactive	N
Buckeye	11 (16)	G	N	B+A	N/A	2600	Annual	F, A, P	Reactive	N
Chandler	201 (201)	G	Y	B	N/A	2600	Annual	F, A	Reactive, TransSuite	N
El Mirage	7 (12)	G, T	N	B	2-way	200	Annual	F, A	Reactive	N
Fountain Hills	13 (13)	G	Y	B+A	N/A	Max	6 mo	F, A	Reactive	N
Gila River Indian Community (MCDOT)	5 (7)	G, T	N	B+A	N/A	250	6 mo	F	Reactive	N
Gilbert	175 (180)	T	N	B+A	N/A	1000	2 mo	F, A, P	Centracs	Y
Glendale	13 (192)	T	N	B+A	N/A	200-2500	Annual	F	CMS, KITS	N
Goodyear	46 (46)	G	Y	B+A	N/A	790-1180	Annual, 2 mo	F, A, P	Reactive	N
Maricopa	4 (15)	?	?	?	N/A	N/A	N/A	N/A	N/A	N
Mesa	349 (425)	G	Y	B, B+A	N/A	1800	Annual	F, P	CMS, Centracs	Y
Paradise Valley (City of Phoenix)	12 (12)	T	N	B	4-way	1500	Annual	F, P	N	N
Peoria	111 (114)	G	N	B	N/A	1500	3 mo	F	CMS, Intelight MaxView	N
Phoenix	243 (1100)	T	N	B	4-way	2500	Annual	F	Reactive	N
Scottsdale	300 (300)	G	N	B	N/A	1500	Annual	F, A	TransSuite	N
Surprise	50 (50)	T	N	B+A	2-way	500-1000	Reactive	F, A, P	Reactive	N
Tempe	230 (230)	G	Y	B	N/A	1000	Biannual	F, A	CMS, TransSuite	N
Tolleson (Avondale)	4 (10)	T	N	B+A	4-way	500	3 mo	F, A	Reactive	N
Queen Creek	28 (32)	T	N	B	N/A	2500	Routine	F	Reactive	N
ADOT	-	-	-	-	-	-	-	-	-	
MCDOT	40 (170)	T	N	B+A	Vary	150	Annual	F	Reactive	N
Pinal County	12 (26)	G	N	B	4-way	N/A	N/A	N/A	N/A	N
Valley Metro	40	G	Y	-	-	800	-	-	-	Y

Percentage of Signalized Intersection Instrumented with EVP



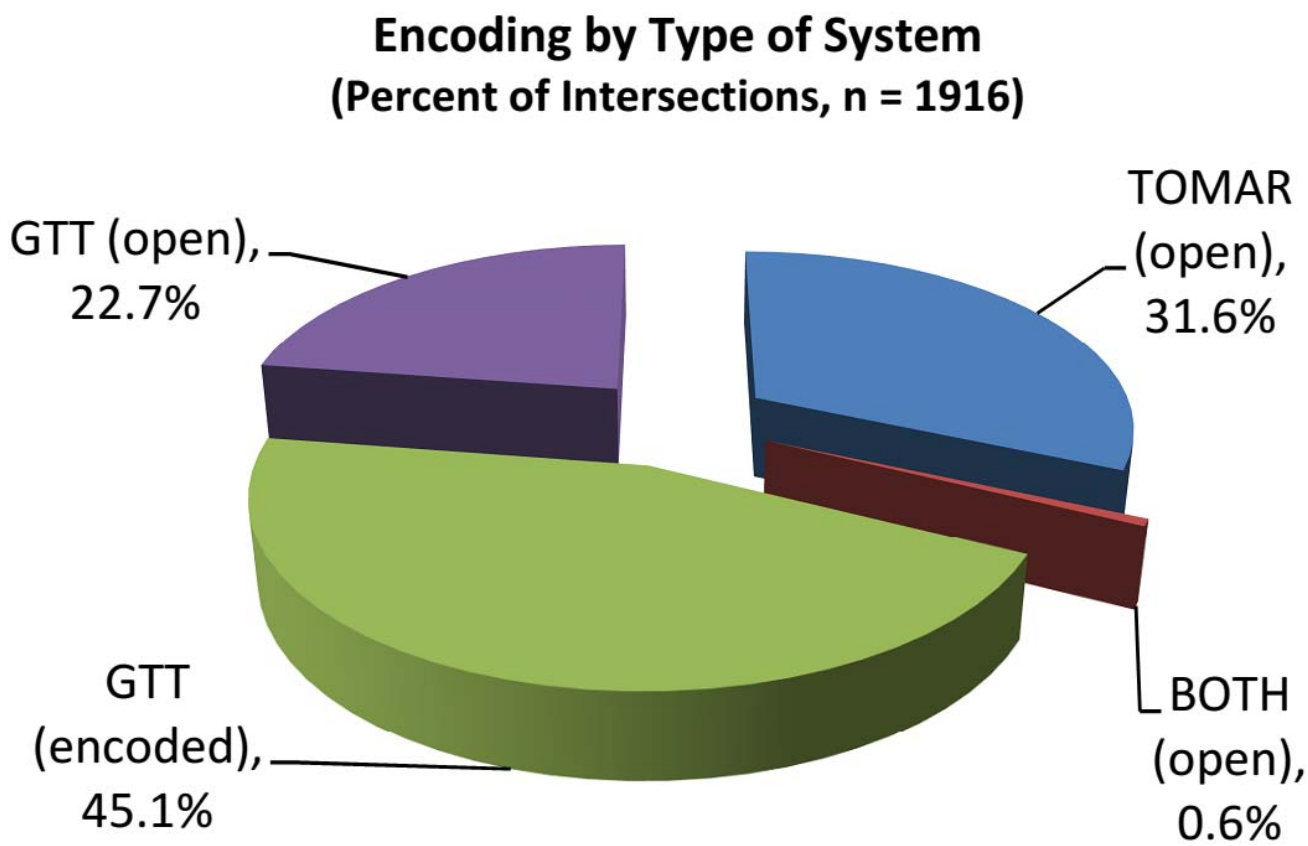
History of EVP in MAG Region



Compatibility Explained

	Intersection GTT Encoded	Intersection GTT Open	Intersection TOMAR Open
GTT Emitter (Vehicle) Encoded	Will Preempt Signal	Will Preempt Signal	Will Preempt Signal
GTT Emitter (Vehicle) Open	Will NOT Preempt Signal	Will Preempt Signal	Will Preempt Signal
TOMAR Emitter Open	Will NOT Preempt Signal	Will Preempt Signal	Will Preempt Signal

EVP Brand and Encoding Status



System Compatibility

Intersections

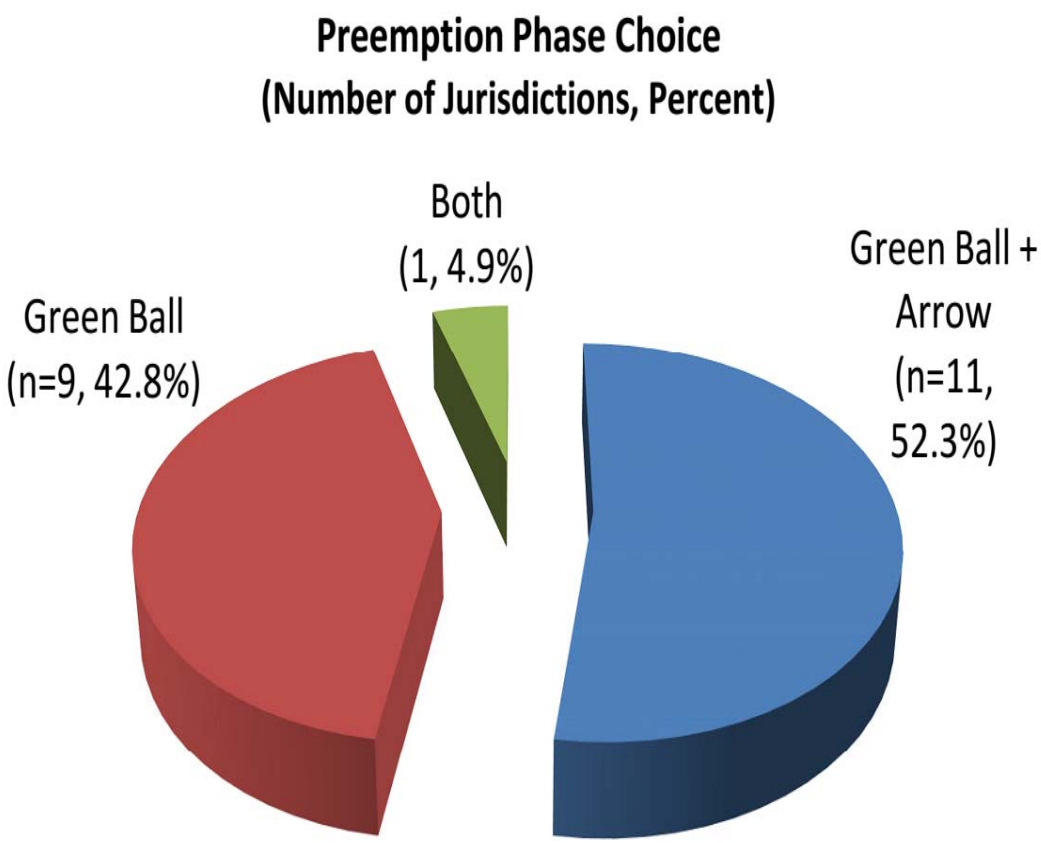
Vehicle Emitter

	EVP Brand (Encoding Y/N)	Apache Junction	Avondale	Buckeye	Chandler	El Mirage	Fountain Hills	Gila River Indian C.	Gilbert	Glendale	Goodyear	Maricopa	Mesa	Paradise Valley	Peoria	Phoenix	Scottsdale	Surprise	Tempe	Tolleson	Queen Creek	MCDOT	Pinal County
		G (Y)	T (N)	G (N)	G (Y)	G, T (N)	G (Y)	G, T (N)	T (N)	T (N)	G (Y)	?	G (Y)	T (N)	G (N)	T (N)	G (N)	T (N)	G (Y)	T (N)	T (N)	T (N)	G (N)
		Operating in the above jurisdictions																					
Apache Junction	G (Y)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Avondale	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Buckeye	G (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
Chandler	G (Y)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
El Mirage	G, T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
Fountain Hills	G (Y)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Gila River I C.	G, T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
Gilbert	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Glendale	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Goodyear	G (Y)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Maricopa	?	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-
Mesa	G (Y)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Paradise Valley	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Peoria	G (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
Phoenix	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Scottsdale	G (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
Surprise	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Tempe	G (Y)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Tolleson	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Queen Creek	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
MCDOT	T (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Pinal County	G (N)	N	Y	Y	N	Y	N	Y	Y	Y	N	-	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y

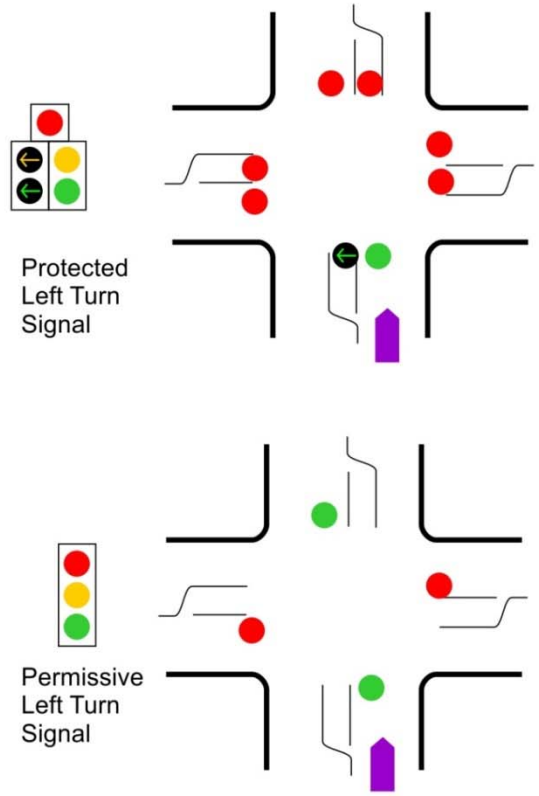
Emergency Vehicles from the jurisdictions on the left

Preemption Traffic Signal Phase

A Green ball for both through movements for protected and permissive left turn locations



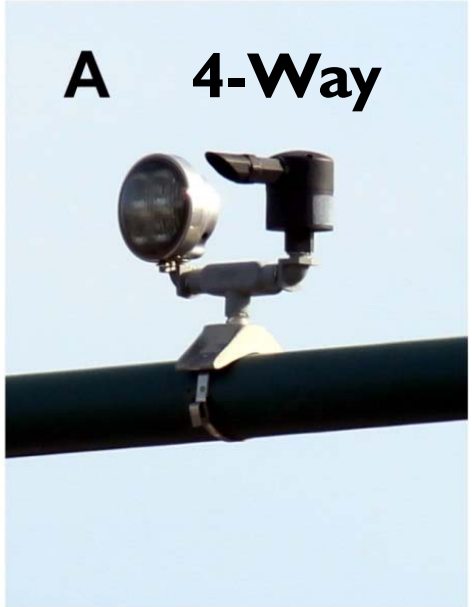
B Green ball + arrow for protected left turn locations
Green ball for permissive left turn locations



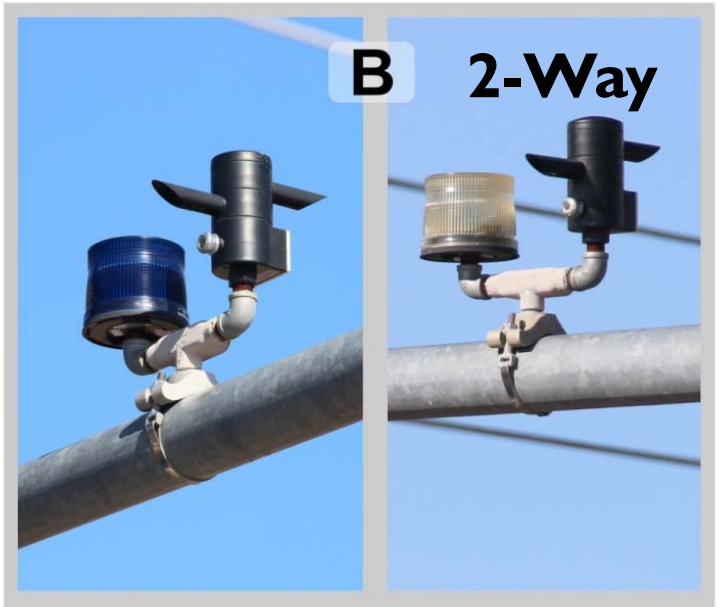
Confirmation Light

Not Deployed

Buckeye
Chandler
Fountain Hills
Gila River I C
Gilbert
Glendale
Goodyear
Maricopa
Mesa
Peoria
Scottsdale
Tempe
Queen Creek



Avondale
Paradise Valley
Phoenix
Tolleson
Pinal County



Apache Junction
El Mirage
Surprise
MCDOT

Benefits of Confirmation Light

Remedy to Green Ball for both through movements

- Provide confirmation to emergency vehicle
- 4 – way
  - Steady light indicates direction of preemption
  - Flashing light indicates denial of ROW due to competing preemption request
- 2 – way
  - Blue strobe indicates E-W direction
  - White strobe indicates N-S direction
  - Can be seen from all approaches
  - Unable to indicate actual preemption approach

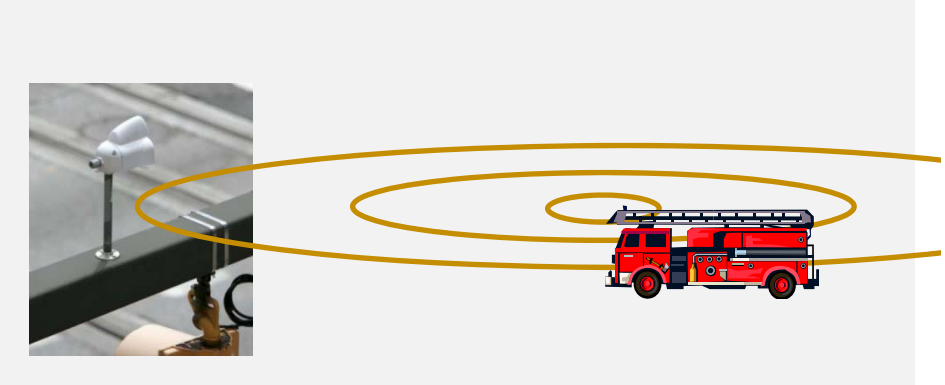
Challenges & Limitations

- System incompatibility exists
- Two different preemption traffic signal phase scenarios employed
- Confirmation light
  - Not deployed in most jurisdictions
  - Two variants
- Usage data under utilized
- Maintenance is a challenge to large jurisdictions

Tech Memo No. 2 Preview: Review of Current EVP Technologies

• Optical-based system • Radio-based system	Existed since1970'
• GPS/Radio-based system	Latest offer
• Central/AVL-based system	System-specific
• Connected Vehicle	Evolving

Optical and GPS/Radio Compared

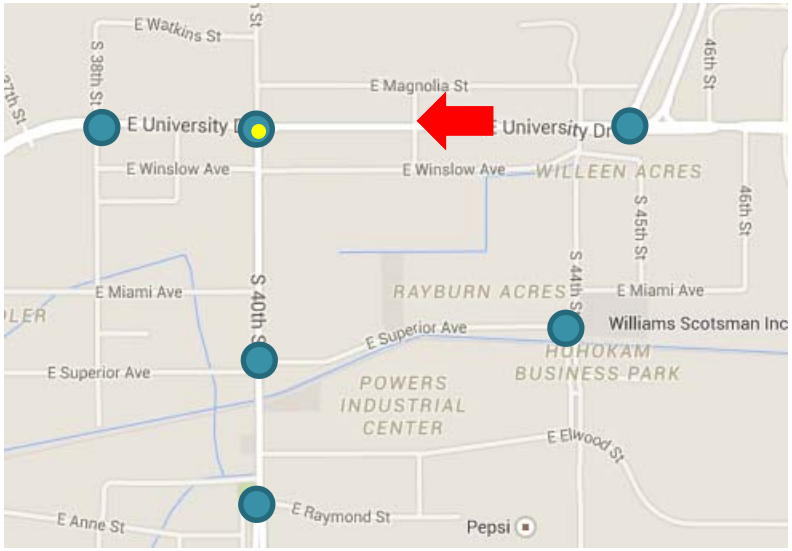


Optical	GPS / Radio
• Infrared light	• Radio (2.4 Ghz)
• Line of sight needed	• Line of sight not needed
• No onboard feedback (confirmation)	• Onboard feed back
• Actuates at fixed distance	• Continuously transmit ETA based on GPS
• First-come, first serve	• Allows different priority levels
• ID requires encoding	• Unique radio ID
• More demanding installation and maintenance	• Simplified installation and maintenance
	• GPS coverage

Central / AVL-based EVP

System-Specific

- No field installation
- Vehicle reports location to <u>central computer</u> using Automatic Vehicle Location (AVL)
- <u>Central computer</u> maps vehicle location and direction to identify the approaching intersection
- Use centralized traffic signal management system to directly control the intersection and preempt the signal



Connected Vehicle

- ADOT/MCDOT/University of Arizona V2I application: A priority System for Multi-modal Traffic Signal Control
  - Core technology: 5.9 Ghz Dedicated Short Range Communication (DSRC) radio

Point of Contact

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