April 30, 2015

TO: Members of the MAG Intelligent Transportation Systems Committee

FROM: Catherine Hollow, City of Tempe, Chair

SUBJECT: MEETING NOTIFICATION AND TRANSMITTAL OF TENTATIVE AGENDA

Wednesday, May 6, 2015- **10:00 a.m.**
MAG Office Building, 2nd Floor, Ironwood Room
302 North First Avenue, Phoenix

The ITS Committee has been scheduled at the time and place noted above. Committee members or their proxies may attend **in person or by video conference or by telephone conference call**. Those attending by telephone conference call please contact MAG offices for conference call instructions.

Please park in the garage under the MAG building, bring your ticket, parking will be validated. For those using transit, Valley Metro/RPTA will provide transit tickets for your trip. For those using bicycles, please lock your bicycle in the bike rack in the garage.

In 1996, the Regional Council approved a simple majority quorum for all MAG advisory committees. If the ITS Committee does not meet the quorum requirement, members who have arrived at the meeting will be instructed a legal meeting cannot occur and subsequently be dismissed. Your attendance at the meeting is strongly encouraged.

Pursuant to Title II of the Americans with Disabilities Act (ADA), MAG does not discriminate on the basis of disability in admissions to or participation in its public meetings. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, by contacting Jason Stephens at the MAG office. Requests should be made as early as possible to allow time to arrange the accommodation.

If you have any questions regarding the meeting, please contact Sarath Joshua at (602) 254-6300.

TENTATIVE AGENDA

	COMMITTEE ACTION REQUESTED
1. Call to Order For the May 6, 2015 meeting, the quorum requirement is 10 committee members.	
2. Approval of the April 1, 2015 ITS Committee Meeting Minutes	2. Review and approve minutes of the meeting held on April 1, 2015.
3. Call to Audience An opportunity will be provided to members of the public to address the ITS Committee on items not scheduled on the agenda that fall under the jurisdiction of MAG, or on items on the agenda for discussion but not for action. Members of the public will be requested not to exceed a three minute time period for their comments. A total of 15 minutes will be provided for the Call to the Audience agenda item, unless the ITS Committee requests an exception to this limit. Please note that those wishing to comment on action agenda items will be given an opportunity when the item is heard.	3. For information and discussion.
4. Program Managers Report The following items will be discussed: • Status of TSOP Projects • FHWA Grant for ICM Deployment Planning for I-10 Corridor • A Simulation Model for Evaluating Active Traffic Management at ASU • Active Transportation Demand Management Workshop • Status Report on the RCN	4. For information and discussion.
5. Emergency Vehicle Pre-emption Study - Best Practices Review The Emergency Vehicle Preemption (EVP) Study is conducting a comprehensive review of the EVP practices to identify best practices and identify potential practices that might be adopted by the MAG region.	5. For information and discussion.

Findings from the study tasks are being documented several technical memoranda. The latest of these is Draft Technical Memorandum No.3 that addresses the best practices in EVP identified through a review of such practices across the nation (See Attachment One).

A brief presentation will be provided on the study findings, followed by a discussion on potential recommendations that may result from study findings for possible adoption by MAG or by MAG member agencies.

6. Request for ITS Project Change

The current MAG TIP includes two projects in the City of Scottsdale in FY2016 and FY2017, each at $678,960 in CMAQ, to upgrade their traffic signal cabinets at a total of 120 locations. The project cannot move forward as currently scoped becasue the traffic signal cabinets would require new foundations, conduits and wiring. For this reason the city is requesting a scope change to purchase and install video detection cameras for 56 intersections, which would result in improved detection and traffic flow along major corridors. The cabinet upgrade will be carried out by the city using local funds.

6. For information, discussion and possible action to recommend approval of the requested change.

7. Status of TIP Arterial ITS Projects Programmed in FY2015 and FY2016

The status of all ITS projects currently programmed in the MAG TIP in FY2015 and FY2016 will be reviewed. Member agencies will be requested to provide brief status reports on each project (See Attachment Two).

7. For information and discussion.

8. Reports by Committee Members

Members will be provided an opportunity to share information related to ongoing ITS activities in their jurisdictions.

8. For information and discussion.

9. Request for Future Agenda Items Topics or issues of interest that members of the committee would like to have considered for discussion at a future meeting will be requested.	9. For information and discussion.
10. Next Meeting Date and Place The next meeting is scheduled to be held at 10:00 a.m. on Wednesday, June 3, 2015. It will be held in the Ironwood Room on the 2nd Floor of the MAG office building. Adjournment	10. For information.

DRAFT MINUTES OF THE
MARICOPA ASSOCIATION OF GOVERNMENTS
INTELLIGENT TRANSPORTATION SYSTEMS COMMITTEE
April 1, 2015
MAG Ironwood Room, 2nd Floor
302 North First Avenue
Phoenix, Arizona

MEMBERS ATTENDING

Farzana Yasmin, for Reza Karimvand, ADOT
* Yingyan Lou, ASU
* Chris Hamilton, City of Avondale
* Chris Lemka, City of Buckeye
Mike Mah, City of Chandler
Captain Burley Copeland, DPS
Bryce Christo, City of El Mirage
Toni Whitfield, FHWA
Leslie Bubke, Town of Gilbert
Allan Galicia for Debbie Albert, City of Glendale
Luke Albert, City of Goodyear
Nicolaas Swart, Maricopa County
Tricia Boyer for Avery Rhodes, City of Mesa
* Ron Amaya, City of Peoria
* Marshall Riegel, City of Phoenix
* Steve Ramsey, City of Scottsdale
Albert Garcia, City of Surprise
Catherine Hollow, City of Tempe
Suresh Shrimavle for Amanda Luecker, Valley Metro

OTHERS PRESENT

David Lucas, City of Tempe
Jeff Jenq, OZ Engineering
Lisa Burgess, Kimley-Horn
Suzy Chambers, Dibble
Paul Porell, RTE
Vinay Vanapalli, Stantec
Jothan Samuelson, Wilson
Don Wiltshire, YSMA
Don Tappendorf, TEC
Don Tappendorf, TEC
Dan Hartig, Ayres
Arnab Gupta, PB
Margaret Boone, MAG
Ryan Gish, MAG
Micah Henry, MAG
Sarath Joshua, MAG
Eric Nava, MAG

* Not present or represented by proxy
# Participated by teleconference
+ Participated by videoconference

1. Call to Order
Chair Catherine Hollow called the meeting to order at 10:00 a.m.

2. Approval of the February 4, 2015 ITS Meeting Minutes
Chair Hollow requested approval of the meeting minutes from the February 4th ITS Committee meeting. **Nicolaas Swart from Maricopa County DOT moved, Luke Albert from City of Goodyear seconded and it was unanimously carried to approve the minutes of the meeting held on February 4, 2015.**

3. Call to Audience
Chair Hollow made a call to the audience providing an opportunity for any members of

the public to address the ITS Committee. No comments were received.

4. Program Manager's Report

Chair Hollow invited Sarath Joshua from MAG to present the Program Manager's Report. Mr. Joshua addressed the following items in his report:

- Current Status of TSOP Projects:

  For Fiscal Year 2014, of a total of 11 TSOP projects at a contracted cost of $338,00, nine have been completed and two projects are on-going. The two ICM projects on I-10 in Phoenix are in the final stages and scheduled to be completed by June 2015. This will conclude the efforts on all 2014 projects. The FY2015 TSOP projects include 11 projects for a total cost of $302,227. Eight projects have been initiated. The Bell Road project is planned to begin in mid-April. The I-10 Integrated Corridor Management (ICM) project has been delayed until the current ICM projects are completed, tentatively scheduled in September 2015. The Synchro training workshop is scheduled for June 9th through June 11th from 8:30 AM to 5:00 PM at the MCDOT Training Facility.

- Letters of Interest for Vice Chair

  Chair Hollow's term concludes at the end of June 2015. Current Vice Chair Marshall Riegel will become Chair, vacating the Vice Chair position. MAG is accepting letters of interest for the Vice Chair position. Letters should be addressed to May Michael LeVault, MAG Chair at MAG Office, 302 N. 1st Avenue, Suite 300, Phoenix, AZ 85003. The appointment will be made by the Regional Council Executive Committee for a 2-year term. Interested parties must submit letters of interest by June 1, 2015. Commitments should be confirmed by corresponding city officials.

- Status Report on the Regional Community Network (RCN)

  Sarath Joshua requested that Ryan Gish from MAG provide an update on the latest RCN developments. The Scottsdale RCN link was down for a few days due to construction activities on Loop 101. The patch was completed the day prior, reestablishing the link to Scottsdale PD and TMC. The Glendale RCN switch processor requires replacement which is expected shortly. Last month, MAG started the on-call network services contract with City of Tempe. MAG staff will be working with City of Surprise and Town of Gilbert to provide additional services. MAG is looking to expand RCN coverage via wireless links possibly to Queen Creek, Avondale, Goodyear, and Salt River Indian Community. This effort will allow interim connectivity to the RCN until a permanent solution becomes available. The video management software pilot project includes about 80% of connected TMCs using the Luxriot software. MAG staff has received positive reviews and will continue provide support to member agencies. Allan Galicia with Glendale thanked Ryan Gish for his efforts to establish the video links, which proved to be valuable during the Super Bowl event.

5. FHWA Grant for ICM Deployment Planning for I-10 Corridor

Chair Hollow invited Sarath Joshua from MAG to present the update on the ITS Deployment Grant for the I-10 Corridor. Several weeks ago MAG staff received notice that the 2013 grant proposal was accepted for the region. The overview of the project is

included in Attachment One, including the study area defining the length of the corridor. Key regional partners include ADOT, DPS, Valley Metro, Maricopa County, Phoenix, Tempe, and Chandler. The next steps include developing the scope of work following the meeting with the FHWA ICM Team. MAG staff is meeting with the FHWA ICM Team on April 21st at 10 AM. All corridor agencies have been invited to this meeting. The intent is to develop initial ICM on I-10 with a vision to expand it to the rest of the freeways in the region. The FHWA-ADOT-MAG Project Agreement is being drafted. MAG FY2015 Work Program will be amended to add the $200,000 grant for ITS on-call Task Orders. This will be presented to the Management Committee next week for recommendation, followed by Regional Council for approval. The schedule for the project is 24 months. The proposal was provided to the ITS Committee.

Sarath Joshua invited Micah Henry and Eric Nava from MAG to provide an overview of the scope. They will be co-managing the project for MAG. MAG staff has identified five primary tasks, including development of the Project Management Plan (PMP), the Systems Engineering Management Plan (SEMP), the Concept of Operations, the ICM System Requirements Specifications (ICMS), and the ICM Analysis, Modeling and Simulation (AMS) Plan.

Sarath Joshua identified the forthcoming TIP process anticipated for Fall of this year to target related projects. Stakeholders are encouraged to incorporate the ICM effort into potential projects in the I-10 corridor. This would aid the future implementation plan identified as a follow-up to this initial effort.

The focus of the project will be on non-recurring congestion, specifically incidents that close freeway operations for a period of 2 hours. Future ICM projects will advance the focus to recurring congestion. The project corridor will include a review of potential arterials parallel to I-10 up to 3 miles from the freeway. As the project is in the initial stages, potential arterial routes will be considered. The project team will be working with partnering agencies on this effort.

6. Systems Management and Operations Plan

Chair Hollow invited Sarath Joshua to present the upcoming Systems Management and Operations Plan. The need for this study to develop a Systems Management and Operations Plan was first identified by the ITS committee during approval of funds for FMS expansion. As the region as a whole has limited capacity improvements, the focus has shifted to operational improvements to increase efficient and effective use of current roadways geometrics. This approach will integrate the desire to increase funding for operations and maintenance of the transportation network. The study has been endorsed by both the Transportation Review Committee and the Management Committee. The scope of the study includes both freeways and arterials. A MAG study to develop this plan is proposed in the Draft FY2016 Work Program for $300,000. It is anticipated that funding will be available July 1, 2015.

A draft scope of work has been prepared and MAG staff is soliciting comments from MAG member agencies. The scope includes best practices, institutional frameworks and business modems for SM&O, a tiered hierarchy of facilities for SM&O investments, reviews of current freeway and arterial infrastructure, management and operations to compare with best practices, a regional concept of SM&O with a target 2038 vision and goal, a defined path forward for the next 20 years to reach the established goal, a process

for data collections and performance measurement, and a framework for interagency oversight and an annual performance review.

The current draft includes sub-regional TMCs, a term for member agencies to collaborate and coordinate operations efforts with neighboring agencies. Regional and local investments will be provided to member agencies for deployment of projects, so input on the SM&O Plan is important particularly at this initial stage. The plan will impact and govern how regional funds are applied to transportation system improvements for the next 20 years, in particular the area of systems management and operations. Toni Whitfield with FHWA identified the agency's efforts to develop several white papers on TSM&O, which should be available in the near future. She suggested that related FHWA and ADOT activities supported by SHRP2 Implementation Assistance Program should be referenced in the MAG SM&O Plan.

7. Next Cycle of TIP Arterial ITS Projects

Chair Hollow invited Sarath Joshua with MAG to present on the upcoming cycle of TIP arterial ITS projects. He explained that arterial ITS funding will be exhausted in 2 years. The next cycle will address the final two years of RTP funds qualified arterial ITS projects in FY2018 and FY2019, with an approximate allocation of $3,500,000 for each year for programming. Beyond FY2019, there is no funding allocated for arterial ITS. The 2012 ITS Strategic Plan currently serves as guidance for programming these funds. The Plan identifies ITS investment priority goals with arterial ITS at 50%, integrated corridor management at 25%, ITS safety improvements at 20%, and local ITS plans at 5%. The MAG Strategic Transportation Safety Plan is nearing the final stages and has established a recommendation to incorporate safety considerations in all future TIP projects. When future ITS projects are evaluated, safety will be considered along with air quality. The weighting of the scoring method will be determined in the future. The use of relevant crash data for the most recent five-years will also be a factor in project applications.

8. Reports by Committee Members

Chair Hollow called on members to report items of interest to the committee. Farzana Yasmin with ADOT stated that the FMS project on I-10 from 83rd Avenue to Litchfield Road will be advertised in June. She also mentioned that ADOT is managing a design project to replace all passive acoustic detectors on freeways in the region with loop detectors. Nicolaas Swart with MCDOT stated that the systems planning branch and project management branch are being grouped with traffic management activities. MCDOT is partnering with University of Arizona and ADOT for a proposal on the next phase for Connected Vehicle implementation program.

9. Request for Future Agenda Items

Chair Hollow called on members to request future agenda items. There were no requests.

10. Next Meeting Date and Place

Next meeting date was announced at 10:00 a.m. on Wednesday, May 6, 2015, in the Ironwood Room (2nd floor) at MAG.

11. Adjournment

Chair Catherine Hollow adjourned the meeting at 11:05 a.m.

Maricopa Association of Governments (MAG)
Task Order No. 536-K.OP14-01

Maricopa Association of Governments (MAG)
Emergency Vehicle Preemption Best Practices Study

Technical Memorandum No. 3

Best Practices

Draft Report

Prepared by:

OZ Engineering
Systems Integrators
Software Consultants

March 30, 2015

Maricopa Association of Governments (MAG)
Emergency Vehicle Preemption Best Practices Study

Technical Memorandum 3:

Best Practices

1. INTRODUCTION

The Maricopa Association of Governments (MAG) is conducting a regional study of the Emergency Vehicle Preemption (EVP) best practices. This technical memorandum is the third in a series of technical documents produced by this project. This report provides a review of the best practices of the EVP operations around the nation. The technical documents expected from this project include:

- Technical Memorandum 1 – Regional Inventory, Challenges and Limitations
- Technical Memorandum 2 – Research and Review of Current EVP Technologies
- Technical Memorandum 3 – Best Practices
- Project Report - Emergency Vehicle Preemption Best Practices Study

The topic of the best practices focuses on the following issues and challenges concerning EVP operations in the MAG region:

- System compatibility - Regional efforts in addressing system compatibility across jurisdictions
- System management – Proactive use of EVP data for troubleshooting and usage monitoring
- Preemption treatment – Coordination on the preemption traffic signal phase and use of confirmation light with the optical-based EVP system

2. Best Practices

This section describes the practices that these other regional agencies follow for EVP operations:

- Regional system compatibility
    - Chittenden County Metropolitan Planning Organization, Vermont
    - FAST, Nevada

    - Harris County, Texas
- EVP system management
    - East Valley EVP Working Group of the greater Phoenix area
- Preemption treatment
    - State of Minnesota

2.1 Regional EVP System Compatibility

Regional system compatibility concerns the ability of an emergency vehicle to request traffic signal preemption in a neighboring jurisdiction that also deploys an EVP system. This need is increasingly important as agencies supporting regional emergency response mutual aid agreements routinely dispatch emergency vehicles beyond their home jurisdictions.

2.1.1 Best Practices: Regional System Compatibility - Chittenden County Metropolitan Planning Organization, Vermont

Synopsis:

Led by the Chittenden County Metropolitan Planning Organization (CCMPO), an evaluation of regional traffic signal preemption/priority standards and practices was conducted in 2006. The study identified the two different optical-based EVP systems deployed in the region and made recommendations to encode the EVP system and migrate to a single compatible technology platform. The best practices described here include the planning process that developed a detailed plan for migrating to a secured and unified regional EVP system.

Description of Practices:

The EVP operations in the Chittenden County area were initially reviewed in a workshop when the region developed the ITS architecture and strategic plan in 2004. A second EVP workshop was held in 2006 as part of the project to evaluate the regional signal preemption/priority standard. The purpose of the second workshop was to develop a regional consensus approach to the future use of traffic signal preemption/priority technology in Chittenden County. The outcome of the workshop was a regional consensus and detailed approaches to develop an encoded EVP system based on a single technology platform.

The motivations for CCMPO to evaluate the regional preemption practices are:

- Concern about possible misuse of “un-encoded” signal preemption infrastructure.

- Underutilization of available signal preemption/priority features (e.g., encoding features).
- Potential dual use of the EVP infrastructure from the pending implementation of transit signal priority in the County.
- Deployment of traffic signal preemption technologies elsewhere in Vermont that could further complicate the regional inconsistencies, if not coordinated.
- Long-term impact of short-term, project-driven EVP procurement decisions due to lack of regional guidelines.

The 2006 EVP evaluation workshop effectively accomplished the following:

1. Reviewed the current utilization and practices of EVP in Chittenden County;
2. Reviewed the pros and cons of the (existing) un-encoded versus encoded EVP systems;
3. Reviewed, discussed, and voted on three possible options regarding the future regional EVP practices;
4. Developed recommendations for actions.

Each of the above steps is summarized in the following.

Current Utilization and Practices in Chittenden County

- Equipment from two major vendors, 3M/GTT (Opticom) and Tomar (Strobecom) are utilized in mixed proportions in various municipalities in the region, with the majority of installations using Tomar technology.
- The signal preemption equipment in Chittenden County is operated in an un-encoded mode, whereby the emitters and field detectors utilize the industry standard of a 14MHz frequency for emergency signal preemption and 10MHz for transit signal priority. This open standard, used by both 3M/GTT and Tomar, provides interoperability between equipment provided by the two vendors.
- The signal preemption inventory in the County is in a state of constant evolution. The determination of which EVP technology to deploy is often left to the project contractor. If competed on a price basis, Tomar has historically proven to be the lower cost option, and therefore is the technology most often deployed.
- The Chittenden County Transportation Authority (CCTA) was in the midst of planning for Transit Signal Priority (TSP) which could potentially share the EVP infrastructure.
- The Fletcher-Allen Health Care Medical Center Campus in Burlington is a major medical and trauma center serving a large portion of northern Vermont beyond the boundaries of Chittenden County. The EMS responders from rural communities

currently benefit from an un-encoded signal preemption system when they travel to the medical center.

Comparison of Un-encoded and Encoded EVP Systems

- **Un-encoded Systems:** Un-encoded systems provide signal preemption to any vehicle emitting an optical signal at the correct frequency. This is a de facto standard within the industry that allows interoperability of un-encoded equipment from multiple manufacturers. Because un-encoded systems use a relatively simple technology, such systems are susceptible to unauthorized use.
- **Encoded Systems:** An encoded system is capable of logging the vehicle class code and unique vehicle ID that are useful for troubleshooting and managing usage. Encoding also prevents unauthorized use of the system by requiring confirmation of a special encrypted code in order to activate preemption functions. The drawbacks of moving toward an encoded system are:
    - Lack of a national "open" standard – region must choose one equipment manufacture's proprietary standard.
    - Require central administration of vehicle emitter ID codes when multiple agencies are involved.
    - Current capability for emergency responders, en-route to the County medical facilities from other jurisdictions might be interrupted by the required encoding.

Comparison of Available Options

Three options regarding future EVP practices were developed for review by the regional partners.

Option #1: Stay un-encoded: The benefits are that all equipment will remain interoperable and there is no immediate investment aside from routine hardware replacement or system expansion.

Option #2: Gradual migration toward an encoded preemption standard: Upon adopting a preferred standard, the County would gradually move toward an encoded system by upgrading non-compliant or obsolete field and onboard equipment as it reaches the end of its service life. There is no cost to this approach since all new equipment purchased can operate in an encoded mode. It was estimated that an encoded system can be achieved with this approach within 5 to 10 years. The major drawbacks of this approach are the inability of un-encoded vehicle emitters to preempt an encoded intersection during the long migration period.

Option #3: One-time implementation of an encoded preemption standard: Upon adopting a preferred standard, the County would implement an encoded system through a one-time replacement of non-compliant or obsolete field and onboard equipment. The stakeholder would immediately realize the benefits of an encoded system. However, this is the largest up-front cost option to accomplish the switchover, and some onboard and cabinet equipment would need to be replaced before the end of its useful life.

After extensive discussion of the three options, the stakeholders voted to recommend Option #2: Gradual migration toward an encoded preemption standard.

Recommendations for Actions

The recommendations for implementing a regional encoded EVP system contain the following components.

- Recommendation #1: Selection of Encoded Technological Standard
- Recommendation #2: Near-term Technology Recommendations
- Recommendation #3: Requirements for Implementation of Encoded Operation
- Recommendation #4: Phasing in an Encoded Regional Standard
- Recommendation #5: Roles and Responsibilities
- Recommendation #6: Institutional Agreements

Recommendation #1: Selection of Encoded Technological Standard

Given the decision to migrate toward an encoded system, recommendation #1 provided a check list of items to be considered in selecting a vendor system, including:

- Factors in selecting a preferred technology
    - Suitability of technology to future needs
    - Transit requirements
    - Equipment condition and life cycle cost
    - Local technical support
- Information needed to support decision-making
    - A detailed articulation of the requirements of all potential system users
    - Identification of the quantity and location of existing and planned traffic signal preemption projects
    - Transit functional requirements and deployment details
    - A detailed equipment inventory of existing preemption and traffic controller hardware in the field.
- Procurement and cost competitiveness considerations
    - Cost of all roadside and in-vehicle components

- Cost of replacement parts, including multi-year price guarantee
- Maintenance agreement and warranty
- Manufacture's incentives (e.g., trade-in credits)
- Opportunities for joint procurement or negotiated price agreements through a regional entity.

Recommendation #2: Near-term Technology Recommendations

Based on the criteria described in recommendation #1, the region selected Tomar Opticom II as the standard for the future encoded EVP system. Specific models of Tomar discriminator (i.e., detection card), detector, and vehicle emitter were recommended for any near-term EVP implementation.

Recommendation #3: Requirements for implementation of Encoded Operation

Three prerequisites were identified for the transition to a regional encoded system:

- Conversion of all roadside equipment to the selected encoded standard
- Upgrading and programming of all vehicle emitters to be capable of transmitting an encoded signal to the encoded roadside equipment.
- Development of institutional agreements in support of system configuration and maintenance, including:
  - Procurement of new equipment
  - Initial system configuration and testing
  - Development of the regional coding scheme
  - System maintenance and troubleshooting
  - Collection and archiving of system use data log files

Recommendation #4: Phasing in an Encoded Regional Standard

- Phase 1: Implementation of near-term standard
- Phase 2: Develop technical specification and standardize future deployment of encoded equipment
- Phase 3: Deploy encoded transit signal priority (while EVP remains un-encoded)
- Phase 4: Define switchover schedule to encode the emergency vehicle preemption system

Recommendation #5: Roles and Responsibilities

The key point in this recommendation is to designate a lead implementation agency, other than the Chittenden County Metropolitan Planning Organization (CCMPO), whose role is to serve as

regional facilitator. To transition from planning toward engineering design, implementation, day-to-day operations, and maintenance, it is desirable to involve one or more traffic signal operating agencies as a lead agency for the implementation of the regional encoded system. It was recommended that the Vermont Agency of Transportation (VTrans) lead the deployment of traffic signal preemption, and that the Chittenden County Transportation Authority (CCTA) lead the traffic signal priority deployment.

Recommendation #6: Institutional Agreements

This recommendation outlines the necessary institutional agreements in support of implementing the regional encoded system, including:

- Garnish endorsement of the regional consensus from regional decision-makers. An example of such endorsement is the Policy Statement signed by the CCMPO Board of Directors to endorse the gradual migration to the regional encoded EVP system based on the technology developed by Tomar (Appendix A).
- Development of Interagency Agreements (IGAs) and or Memorandum of Understanding to memorialize the agreed upon technical standard, technology, configuration, operating procedure, and funding decision.

2.1.2 Best Practices: FAST, Nevada

Synopsis:

The Freeway and Arterial System of Transportation (FAST) is an integrated Intelligent Transportation System (ITS) in the region that encompasses the greater Las Vegas metropolitan area. In 2009, under the leadership of the Regional Transportation Commission of Southern Nevada (RTC), FAST successfully implemented a solution to resolve the compatibility issues between the different EVP systems deployed in the region. The effort has led to the development of a regional encoding scheme based on the unified technology platform. The best practices include the standardization of the system specification and the implementation of the regional encoding scheme for all agencies, including the low priority traffic signal application for transit operations.

Description of Practices:

The RTC planning region has been one of the nation's fastest growing areas in the past decade. On average, FAST logs more than 3,000 high priority preemptions each day on the centralized traffic management system. The RTC estimated that the actual number of preemption events

to be much larger because not all EVP-equipped intersections are connected to the central system.

FAST cited the following EVP operational concerns in the RTC region:

- Degradation of traffic flow and increased congestion, with possible safety implications for the traveling public, resulting from the large number of preemptions.
- The unauthorized preemptions by illegally purchased optical preemption emitters and unauthorized users driving an EVP equipped public vehicle. Member agencies observed taxi drivers using the illegally purchased emitters in the field.
- Potential false calls and false preemption service caused by unusual lighting conditions, such as emitter signals or background light reflecting off signs or windows. This problem can be avoided by encoding the EVP system which enables the verification of emitter ID before granting the preemption.
- Anticipated significant increase in the EVP equipped fleet from the Las Vegas Metropolitan Police Department to more than 1,000 police cruisers, in addition to the fire and ambulance vehicles.

The regional encoding requirement of the EVP systems was initially established in 2004. FAST has been the manager of this encoding scheme. As the managing agency of FAST, the RTC developed the following guidelines to implement the regional preemption encoding scheme:

- Standard Specifications: The 3M (later became GTT) Opticom was specified as the standard for the region. The guidelines required the model 700 (i.e., 700 series) equipment (phase selector) for all future purchase…. citing "since using encoding requires that all equipment are of the same manufacture"
- Standard Panel: Develop a standard panel for terminating preemption wiring in the traffic signal cabinet that can be used by all agencies to facilitate troubleshooting and retrofitting of the existing cabinets.
- Green Monitoring: Provide communication to the Opticom phase selectors (in the traffic signal cabinet) to enable remote monitoring and access to the EVP system logs.
- Addresses: Programming the phase selectors with the same intersection ID used in the central traffic signal management system. This simplifies the management of the field EVP system as it uses the same ID as the signalized intersections.
- Vehicle Maintenance List: All agencies responsible for maintaining and coding their emitters are required to maintain a list of vehicles, associated vehicle ID, and assigned EVP code. The purpose is to allow monitoring EVP usage and "verify that the user is a valid vehicle". Traffic agencies are supplied with the vehicle

maintenance list to ensure these codes are programmed as valid in the preemption equipment.

Preemption Encoding Scheme:

To facilitate the migration to an encoded EVP system, FAST developed a common classification and encoding scheme for all agencies to avoid duplicate vehicle class and ID from being used by different agencies. Using the encoding convention provided by the Opticom EVP system, a table depicting the encoding scheme was developed. The key data fields in the table include:

- Vehicle Class (0-9)
- Vehicle ID (0-999)
- Relative Priority (0-9)[1]
- Description of Agency[2]

Since Opticom supports separate coding for high and low priorities, two encoding tables were developed, one for the high priority emergency vehicle preemption, and the other for the low priority transit Traffic Signal Priority (TSP).

The high priority (emergency vehicle preemption) encoding table is developed based on the following guidelines:

- Dedicated vehicle class 0 for maintenance (e.g., Clark County, Henderson County, Las Vegas, and North Las Vegas Department of Transportation).
- Each fire department is assigned with its own vehicle class (e.g., Clark County Fire Department, Henderson Fire Department, Las Vegas Fire Department, and North Las Vegas Fire Department).
- Each police department is assigned with its own vehicle class with the exception of the Las Vegas Metropolitan Police which is expected to exceed 1,000 vehicles, the maximum number of ID allowed for a vehicle class. Two vehicle classes were designated for the Las Vegas Metropolitan Police.
- The relative priority for all maintenance vehicles (vehicle class 0) is set to be 1.
- The relative priority for all fire and paramedic agencies is 9, the highest priority allowed. Priority 7 to 9 is allocated to fire and ambulance for future determination of relative priorities among the agencies.
- The relative priority for police agencies is given a 6 across the entire region. Priority 2 to 6 is assigned to police for future determination of relative priorities among the

[1] Relative priority feature is only available in newer Opticom 700 series phase selector cards. This feature is not currently used in the encoded EVP systems in the MAG region.
[2] Description of agency is not encoded in the emitter and needs to be maintained in the vehicle maintenance list.

agencies. The police vehicles always have lower priority than the fire and ambulance vehicles, in the case of concurrent preemption requests to the same intersection.

The low priority (transit signal priority) encoding scheme is less complicated because RTC is the only anticipated user. The guidelines for the low priority encoding table include:

- Dedicated vehicle class 0 for maintenance (Clark County, Henderson County, Las Vegas, and North Las Vegas Department of Transportation).
- Vehicle Class 1 is assigned for the Bus Rapid Transit (BRT) service.
- Vehicle Class 2 is assigned to the CAT buses.
- The remaining Vehicle Classes 3 to 9 are unassigned and reserved for future transit applications.
- The relative priority for all maintenance vehicles (vehicle class 0) is set to be 1.
- The relative priority of the BRT (vehicle class 1) is 7 which is higher than the 6 designation for the regular CAT buses (vehicle class 2).

Issues Associated with Encoding:

RTC identified the following issues associated with the changeover to encoding.

- There are costs associated with the changeover to encoding. Preemption equipment deployed in the Las Vegas area is not all from the same manufacturer. Using encoding requires that all equipment be from the same manufacturer. Using encoding requires replacement of numerous vehicle emitters and some intersection hardware. This requires specifying a single manufacturer for all new installations (i.e., GTT Opticom).
- A significant number of older model 3M (GTT) preemption equipment on the street would need to be upgraded to 700 series equipment (phase selector).
- There is added work for the vehicle maintenance technicians in each agency that are responsible for installing the vehicle emitters. A list of vehicle ID numbers and associated Opticom (emitter) ID numbers needs to be maintained and shared with traffic signal maintenance staff.
- During changeover, there may be a short time period when not all agencies' emergency vehicle emitters will work in different jurisdictions. If one agency upgrades to encoding, and another agency does not program the emitters, the vehicles may not be able to place preemption calls across agency boundaries.

Role of RTC:

The role of RTC in implementing the regional encoding scheme includes:

- Maintaining the regional EVP encoding tables.
- Providing updates to the encoding tables based on member agencies' input.
- Facilitating all EVP operations related discussions in the region.
- Developing guidelines regarding EVP implementation and operations for adoption by the member agencies. Such guidelines may be of a policy and/or technical nature. Examples of the technical guidelines include the standard specifications (e.g., specifying Opticom 700 series phase selectors) and development of standard panel (i.e., standard EVP wiring terminations in the traffic signal cabinet) in support of troubleshooting and retrofitting of traffic signal cabinets by different agencies.

2.1.3 Best Practices: Harris County, Texas

Synopsis:

As the nation's third largest county, Harris County encompasses the greater Houston metropolitan area. In 2008, a pilot study was carried out to evaluate the new EVP technologies which aim to address the shortcomings of the optical-based system. The best practices include the systematic approach of evaluating alternative technologies and the institutional process to adopt the recommendations for regional deployment.

Description of Practices:

Harris County manages the traffic signal systems for several jurisdictions through an Inter-Governmental Agreement (IGA). Over the past decades, Harris County cited several shortcomings associated with the optical-based EVP system that was widely deployed in the region, including:

- High maintenance requirements – cleaning and calibration of the detectors on the mast arm due to the line-of-sight nature;
- Traffic impeding during maintenance;
- Cannot coordinate preemption request with the adjacent intersections;
- Not integrated with the central traffic signal management system.

Based on the aforementioned concerns, Harris County explored the alternative EVP technologies and identified the GPS-based system from E-Views. A multi-year pilot deployment

and evaluation were conducted along Louetta Road in north Harris County. The pilot deployment tested E-Views' GPS-based EVP system with the following objectives:

- Providing remote management capabilities of the system from Houston TranStar;
- Enhanced situational awareness for participating emergency responders;
- Enhanced advance notification of the need for emergency vehicle preemption treatment;
- Minimal disruption to existing coordinated signal timing;
- Implementation of national data sharing standards between response vehicles, traffic management systems, and emergency dispatch systems;
- A migration plan to allow for long term data communications and routing capabilities of emergency vehicles.

The evaluation of the pilot deployment was completed in 2008 with favorable findings in support of the deployment of the GPS-based system in the region. The following efforts were made to advance the decision:

- Harris County revised its policy to disallow the further deployment of the optical-based EVP system.
- The evaluation recommendations for adopting the E-Views EVP system were approved by Emergency Services District (ESD) in the Harris County area. An example of the endorsement letter to the Harris County Commissioner's Court is provided in Appendix B.
- With court approval, the recommendations to deploy the E-Views GPS-based EVP system were adopted by the individual cities through the IGAs with Harris County.

An agreement between Harris County and Emergency Service District (ESD) 11 was approved by the Harris County Commissioner's Court in July 2008, allowing Harris County to work cooperatively with ESD 11 in Northwest Harris County to install and operate an emergency vehicle preemption system on traffic signals maintained by Harris County.

The EVP system users are limited to first responders, large fire apparatuses and ambulances responding to emergency situations within the confines of ESD 11. The agreement enabled ESD 11 to purchase the necessary equipment to allow emergency vehicles to communicate vehicle information to traffic signals and provide incident data from ESD 11 dispatch centers to Houston TranStar.

To facilitate the installation of the GPS-based EVP system in different jurisdictions, Harris County developed several documents in support of the technical implementation and institutional process:

- **Harris County Emergency Vehicle Priority System Requirements – Local Controller Firmware:** Defined how the traffic signal controller interacts with the GPS-based EVP messages, including check-in, check-out, and policy for terminating signal phase, etc. (see Appendix C)
- **Harris County Emergency Vehicle Priority System Requirements – GPS System:** Defines the behavior of the GPS-based onboard unit (see Appendix D)
- **Court order for executing Inter Governmental Agreement for deploying the EVP:** A boiler plate for adoption by different local jurisdictions (see Appendix E)

The controller and GPS requirements document (Appendix C and D) highlighted several advantages of the GPS-based system over the optical-based system, including:

- Use travel time to intersection (estimated time to arrive) as opposed to fixed distance (pre-determined light sensitivity level) for requesting preemption
- Minimum of 80 seconds of advanced notice (cannot be specified with the optical-based system)
- Vehicle ID is visible from traffic signal controller front panel and in the controller logs
- Left turn request can be passed from the onboard GPS to the intersection to determine if the green left turn arrow (if available) needs to be served as part of the preemption phase
- Left turn request can be forwarded to the next intersection
- All messages are passed from the field EVP device to the controller via Ethernet

The standardization of system functions and specifications has been instrumental in the success of Harris County's EVP deployment involving multiple local jurisdictions.

2.2 EVP System Management

2.2.1 Best Practices of EVP System Management: East Valley EVP Working Group of Phoenix Area, Arizona

Synopsis:

The East Valley EVP Working Group originally started in 2008 to coordinate EVP operations in the Cities of Chandler, Mesa, Tempe, and Town of Gilbert in 2008. The Working Group collaboratively developed an encoding scheme for encoding their EVP systems and coordinated details about the traffic signal phase provided during the preemption. The encoding scheme

was later expanded to include all emergency agencies in the greater Phoenix metropolitan area. Over the years, the Working Group has expanded to include more East Valley jurisdictions that share common borders. The best practices include the development of the regional encoding scheme and EVP data management in support of troubleshooting, performance monitoring, and policy decision making.

Description of Practices:

Currently, the East Valley EVP Working Group is comprised of the fire departments and traffic operations personnel of the Cities and Towns of Apache Junction, Guadalupe, Scottsdale, Chandler, Mesa, Sun Lakes, Gilbert, Queen Creek, and Tempe. The goals of the East Valley EVP Working Group are to:

- Standardize the way traffic signals operate in the East Valley;
- Allow use of encoded traffic preemption systems to eliminate unauthorized users;
- Allow use by ambulance companies with oversight by the appropriate fire department;
- Improve response times for automatic aid calls;
- Reduce liability to the cities.

Based on the common technology platform[3] (GTT Opticom), the East Valley EVP Working Group collaboratively encoded their EVP systems with the following objectives:

- Prevent the activation of EVP by elicit emitters
- Enable the EVP usage data logging in support of:
    - Troubleshooting (resolve complaints of EVP not working)
    - Detecting unauthorized use of EVP equipment
    - Assessing traffic network impact
- Coordinate emitter encoding allocations so each agency uses a unique block of ID's to prevent duplication.
- Coordinate the preemption signal phasing to improve consistency across jurisdictions

Based on the encoding scheme created by City of Mesa in 1994, the East Valley Working Group now maintains an expanded encoding scheme for high priority preemption including ambulance, fire, and police departments in the greater Phoenix area. In 2010, with the debut of Bus Rapid Transit (BRT) service in the East Valley, a low priority coding scheme was developed to facilitate the Transit Signal Priority (TSP) that share the use of the EVP

[3] The Town of Gilbert deployed the Tomar optical-based EVP system that is not compatible with the encoded GTT Opticom system deployed by the rest of the East Valley EVP consortium member agencies.

infrastructure along the BRT route. Instead of preempting the traffic signal, the low priority TSP request is served by either providing an early green or extending the existing green phase to facilitate the passage of the transit vehicle. The low priority request does not affect the emergency vehicle preemption because the high priority preemption request automatically overrides the low priority calls should there be concurrent requests.

Based on the GTT Opticom, there are two components to the EVP code, namely, Vehicle Class (0-9) and IDs (0-999) per Vehicle Class. That is, the Opticom system can be programmed to support up to 10,000 unique IDs using the combination of Vehicle Class and ID fields. In addition, the newer hardware (e.g., 700 series phase selectors) can also support the relative priority that can be assigned to each encoded emitter.

The East Valley Working Group divided up the 10 vehicle classes by type of operation.

- Vehicle class 0-1: Ambulance
- Vehicle class 2: Reserved for future applications
- Vehicle class 3-7: Fire
- Vehicle class 8-9: Police

A Code Assignment List was developed based on the following:

- Class 0 code 0 is left unassigned. This locks out the illegally purchased emitters, un-encoded GTT emitters, and Tomar emitters. The Working Group allows the individual cities to decide if they want un-encoded emitters to activate their signals. Class 0 and code 1 is also unassigned because this is the default value used for GTT Opticom emitters.
- To accommodate the large number of older 500 series phase selectors still deployed in the field, the coding method is compatible with the 500 series while allowing the flexibility to use the additional features of the 700 series (e.g., allowing setting the relative priority (0-9) and setting valid codes individually[4]).
- The Code Assignment List allocates blocks for each emergency agency based on the assumption that larger cities would have more emitter equipped apparatus. For smaller jurisdictions, a minimum of 100 vehicle ID codes is assigned per agency.
- Classes 0 and 1 are reserved for ambulances due to the potentially large number of service providers, vehicles, and communities involved. The ambulance classes require further definition to assign codes to the individual ambulance companies. The assignment should be done in a manner that permits individual cities to decide which ambulance companies to allow access within their jurisdictions. Having

[4] For 500 series phase selectors, the valid codes were assigned as a single block with a low (starting) and high (ending) code number. The 700 series allows any combination of codes to be made valid.

ambulances in their own class also allows cities to apply "relative priority" should they choose to.

- Two dedicated vehicle classes are assigned to police. With the 700 series phase selector's ability to assign relative priority, this allows an individual city to decide if a police vehicle should be of lower priority than fire apparatus, in the case of concurrent requests at an intersection.
- When interpreting event logs from the phase selectors, there needs to be a way to correlate the Opticom emitter codes (vehicle class, vehicle ID) with the vehicle numbers (e.g., those assigned using the "Valley Fire Chiefs Mutual Aid Numbering System"). That is, there is a need to maintain a regional database which relates vehicle IDs to emitter codes. GTT's Opticom Central Management Software (CMS), used by several East Valley jurisdictions, includes built-in management of vehicle IDs and accommodates regional operations involving multiple agencies.

The key to the successful implementation of this Code Assignment List is that each agency (vehicle maintenance) programs the emitters using unique IDs within the assigned block. This unique ID makes it possible to examine system logs to verify that a specific ID (vehicle) was present at an intersection on a given date and time. The ability to capture positive ID is very useful in troubleshooting signal problems.

As the lead agency of the East Valley EVP Working Group, the City of Mesa routinely utilizes the EVP event logs for various system monitoring and analysis, including:

- In response to trouble calls from the fire department, Opticom Central Management Software is used to retrieve and analyze the EVP event logs. City of Mesa's centralized traffic signal management system, Centracs, is used in conjunction for troubleshooting. A reported failed actuation can be investigated in two aspects: 1) if the Opticom system received the preemption request (through EVP event logs), and 2) if the controller actually received the preemption call from the phase selector (through Centracs traffic signal controller logs). In addition, the Opticom Central Software can be used to review or set the phase selector configuration parameters in support of maintenance and troubleshooting.
- The Opticom Central Management Software has been configured to automatically generate EVP actuation reports and e-mail them to the fire department every week. The reports contain the detailed EVP events summarized by location and time of day.
- In conjunction with Valley Metro, provided assistance in configuration and logging of the low priority transit Traffic Signal Priority (TSP) event logs in support of system monitoring and assessment;

2.3 Preemption Treatment

2.3.1 Best Practices of Preemption Treatment and Confirmatory Light: State of Minnesota

Synopsis:

The State of Minnesota is one of the nation's EVP system early adopters. The Twin Cities area began implementing optical-based EVP systems in the mid 1960's. They included use of four-way confirmatory lights as part of EVP operation in the early 1970's. Their best practices include the inclusion of EVP preemption phase and confirmatory indicator light standards in the Minnesota Manual on Uniform Traffic Control Devices (MMUTCD). The EVP implementation in St. Paul is provided to exemplify the conformity brought along by the MMUTCD.

Description of Practices:

As a supplement to the Federal Manual on Uniform Traffic Control Devices (MUTCD), the Minnesota Manual on Uniform Traffic Control Devices (MMUTCD)[5] (January 2014) includes sections dedicated for emergency vehicle preemption operation.

- 4D.27 Preemption and Priority Control of Traffic Control Signals (amended by Minnesota)
- 4D.27.1 Operation of Preemption (new sub-section added by Minnesota)

Section 4D.27 defines the standard of strobe actuated preemption and priority detection as "*the system shall respond to emitter frequencies*":

- Preemption - 14.035 Hz ± 0.05 Hz
- Priority - 9.639 Hz ± 0.03 Hz

These frequencies are the common standard used by GTT (Opticom), Tomar (Strobecom) and other compatible optical-based EVP systems.

Section 4D.27.1, Operation of Preemption, contains the following standards:

- Traffic signal phase transition into and out of preemption control;
- Requirements that all newly constructed signals be wired for Emergency Vehicle Preemption (EVP), including confirmatory indicator lights;

[5] Minnesota Manual on Uniform Traffic Control Devices (MUTCD)
http://www.dot.state.mn.us/trafficeng/publ/mutcd/

- Preemption signal phase for two-phase, protected/permissive, freeway interchange, and protected operations.

The requirement for newly constructed signal stated "*All newly constructed signals shall be wired for Emergency Vehicle Preemption (EVP). This includes running the necessary electrical conductors to the base of each pole or terminating in the mast arm as appropriate.*"

The standard further defined the type and operations of the confirmatory indicator light as follows.

Traffic signals with EVP shall use confirmatory white/clear indicator lights. The confirmatory lights shall only be used during signal preemption.

- A steady confirmatory indicator light facing an approach shall mean that the authorized emergency vehicle preemption has been received by the signal controller for that approach.
- A flashing confirmatory indicator light facing an approach shall mean that the signal controller has received a conflicting preemption call and cannot respond to the preemption from the authorized emergency vehicle on the approach.

The Minnesota MUTCD explained that the purpose of the confirmatory indicator light is *"to verify to the authorized emergency vehicle driver that <u>the controller has received the preemption call</u>, to indicate which approach will be served under the preemption…*" and "*The confirmatory indicator light <u>does not assign any right of way at the intersection</u>. The driver of the emergency vehicle is required to respond to the traffic control signal indications in accordance with applicable statutes and ordinances.*"

MMUTCD provides the standards of the preemption signal phase for two-phase (Figure 1, protected/permissive (Figure 2), and protected only (Figure 3) locations.

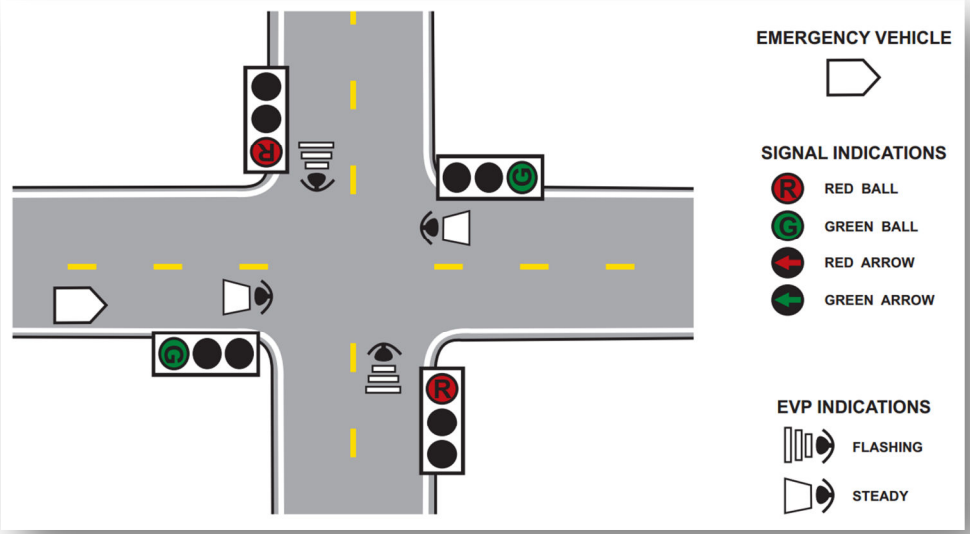

Figure 1. MMUTCD EVP - Two Phase Operation

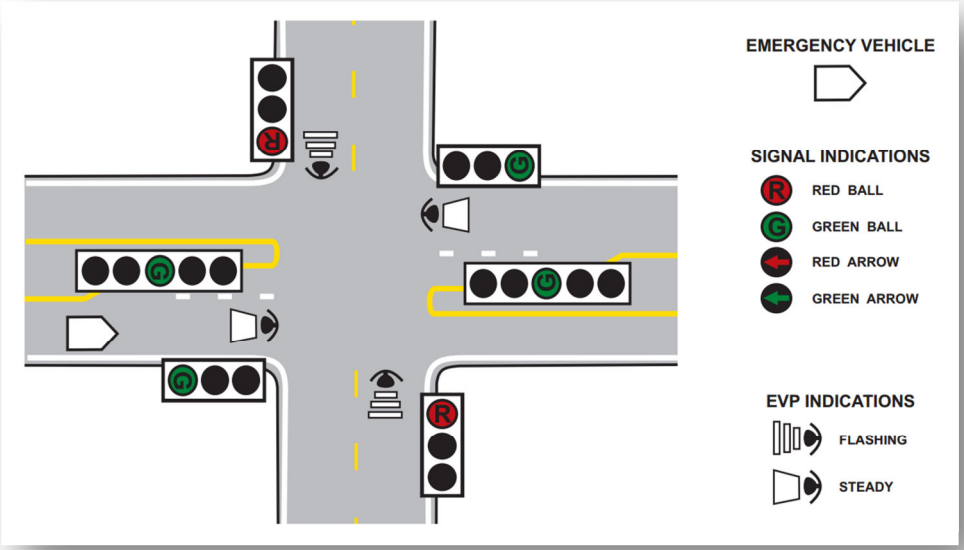

Figure 2. MMUTCD EVP - Protected/Permissive Operation

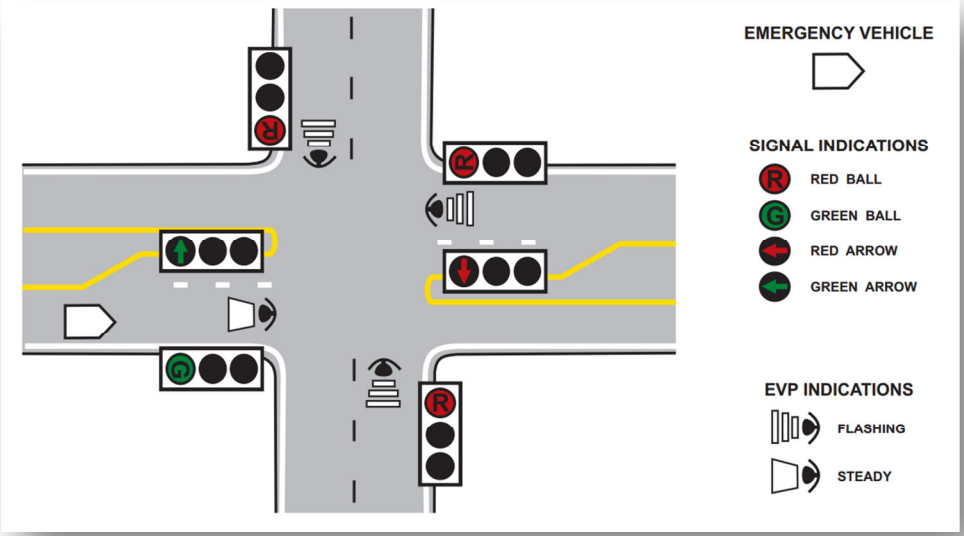

Figure 3. MMUTCD EVP – Protected Operation

For two-phase (permissive left turn only) intersections (Figure 1), the authorized emergency vehicle's approach shall receive a steady confirmatory light along with the opposing approach. The controller shall cycle through to bring up the circular green indications. The conflicting approaches shall receive flashing confirmatory lights and circular red indications.

The rationale of protected/permissive operations (Figure 2) is explained as follows. The authorized emergency vehicle's approach shall receive a steady confirmatory indication light along with the opposing approach. The controller shall cycle through to bring up the circular green signal indication. The left turn green arrow is not given on the preempted approach since a permissive green ball for the opposing flow would have to be terminated first. An opposing left turner, seeing the signal go to yellow, might mistakenly assume that the preempted approach was also yellow, and turn into the oncoming traffic proceeding on a green. This is referred to as a "left turn trap." To avoid this, the left turn green arrow is not given to any approach. The operation of this intersection, under preemption, is similar to that of a two-phase intersection. Conflicting approaches shall receive flashing confirmatory indication lights and circular red signal indications. The “left turn trap” (also known as “yellow trap”) is observed by the jurisdictions in Arizona.

An option for handling a protected/permissive location was provided in the MMUTCD. The authorized emergency vehicle's approach may receive a steady confirmatory indicator light, a protected left turn green arrow, and a circular green, with opposing and conflicting approaches

receiving flashing confirmatory indicator lights and red indications, if the traffic signal first transitions to an all red indication for all approaches. The drawback of this option is that "transitioning to an all red indication for all approaches" will incur additional delay before the green indication can be provided to the emergency vehicle. This option may be considered for low speed locations where it takes longer for an emergency vehicle to arrive at the preempted intersection. In Arizona, no jurisdiction has adopted this option due to the overall higher operating speed.

For protected intersections (Figure 3), the authorized emergency vehicle's approach shall receive a steady confirmatory indicator light, a protected left turn green arrow, and a circular green. The opposing and conflicting approaches shall receive flashing confirmatory indicator lights and red indications.

In the MAG region, 12 out of the 21 jurisdictions that responded to the survey operate EVP at protected location similar to those described in Figure 3 (without use of the confirmatory indicator light). The remaining jurisdictions operate the protected locations like the protected/permissive operation described in the MMUTCD (i.e., green through indication for preempted and opposing directions).

The operation of the confirmatory indicator light in the MMUTCD is similar to but different than the City of Phoenix's implementation which also deployed the 4-way white/clear flood light. The difference is that MMUTCD requires that the confirmatory indicator lights for all non-preempted approaches be flashing, and the preempted approach to receive a solid indication; whereas, in the case of Phoenix, the lights of non-preempted approaches will stay off (dark) and only flash if there is a concurrent request from the non-preempted approach. Flashing indicates to an emergency vehicle operator that the right-of-way has been denied due to an earlier preemption request.

Table 1 (next page) compares the EVP standards (Section 4D.27 Preemption and Priority Control of Traffic Control Signals) between the Minnesota, Arizona, and Federal versions of the MUTCD.

Table 1. MMUTCD EVP Standards Compared

Section 4D.27 of MUTCD	Minnesota (2014)	Arizona (2009)	FHWA (2009)
Signal indication sequence during the transition into preemption control	Yes	Yes	Yes
Signal indication light sequence during preemption control and during the transition out of preemption control	Yes	Yes	Yes
Requirement of EVP wiring for new signal construction	Yes	No	No
EVP emitter frequency standard	Yes	No	No
Specification of confirmatory indicator light	Yes	No	No
Operation of preemption signal phase and confirmatory indicator light	Yes	No	No

Example of City of St Paul's (Minnesota) EVP Implementation

The Twin Cities of St. Paul and Minneapolis make up the largest metropolitan area in the state of Minnesota. City of St. Paul is one of the nation's earliest adopters of the optical-based EVP system. In 1969, optical-based EVP system technology was installed at 28 intersections in St. Paul as part of their efforts to reduce emergency vehicle-related crashes. By 1976, over 90% of its 308 intersections were equipped with the EVP system. In 1972, the 4-way clear/white flood light type of the confirmatory indicator lights were deployed and became part of the standard EVP operation. Currently, all 375 signalized intersections in St. Paul are equipped with the optical-based EVP and confirmatory indicator lights. The users of the EVP system include fire department, ambulance service, and police. St. Paul is one of only a few jurisdictions in the country that provides preemption access to all police vehicles.

Figure 4. EVP Detector and Confirmatory Indicator Light (City of St. Paul)

The majority of the traffic signal controllers are Type 170 along with some ASC-3 RM controllers in Type 332 and 332D cabinets. St. Paul is currently using the Centracs centralized traffic signal management system for managing its traffic signals in the field.

The implementation of the EVP system in St. Paul has closely followed the MMUTCD standards. In St. Paul, the confirmatory indicator lights are implemented by the traffic signal controller, as opposed to the preemption detection cards. The rationale of using the traffic signal controller to control the confirmatory indicator light was explained in the MMUTCD that "the purpose of the confirmatory indicator light is to verify to the authorized emergency vehicle driver that the controller has received the preemption call". The possible issue of letting the preemption detector card control the confirmatory indicator light is that if the controller failed to receive the request from the preemption detection card, the confirmatory indicator lights will still be working without the intersection being preempted. This creates a confusion that could endanger public safety.

For signals with protected only left turn phasing, the Minnesota Manual on Uniform Traffic Control Devices (MMUTCD) requires the left turn green phase to come up with the through phase green during an EVP call; in this case the solid confirmatory light is on for this approach, and all other approaches would flash.

On an intersection with protected/permissive left turn phasing or permissive only intersections, an EVP call can request the through phase and the opposing phase (e.g., phases 2 & 6); in this case the confirmatory light would be solid for phases 2 & 6, and EVP confirmatory lights for

phases 4 & 8 (i.e., through phases for the cross street) would flash. This second case (i.e., green indication for both through phases) would be the more common type of operation in St. Paul and is accepted by the Emergency Responders. A vast majority of the intersections in St. Paul are low speed (30 mph) and have 2 lanes of approach and occasionally left turn lanes. Engineering judgment was applied to each site in light of the geometry and speed of the intersection. In recent years, the original incandescent flood lights were replaced with the LED Flood (PAR 38, 7.3W), which dramatically improved the reliability and reduced power consumption.

Appendix A

CCMPO Policy Statement

CCMPO POLICY STATEMENT OF IMPLEMENTING A REGIONAL TRAFFIC SIGNAL PRE-EMPTION STANDARD

Regional coordination is necessary to ensure the effectiveness, security, and interoperability of traffic signal pre-emption systems in Chittenden County, in light of evolving needs and technologies.

Traffic signal pre-emption systems are currently used in several Chittenden County communities to expedite the movement of emergency vehicles through signalized intersections on the region's arterial roadways. These systems allow authorized emergency vehicles to override traffic signals using an optical emitter device mounted on the vehicle. Nationally, signal pre-emption equipment has been proven to reduce emergency response times, which in turn reduces fatalities and property destruction. In addition, these systems reduce the risk of collisions involving emergency vehicles at signalized intersections.

Existing traffic signal pre-emption systems in the County were installed by individual municipalities or the Vermont Agency of Transportation. This equipment uses an open industry standard that is increasingly obsolete and is subject to misuse by unauthorized individuals using illicit emitters to activate traffic signals.

Implementation of a regional, code-capable standard that is adopted and implemented by all affected parties will preserve the existing benefits of the existing, un-encodable system while providing numerous additional benefits:

- Greatly reduce the potential for misuse of the signal pre-emption system by unauthorized users;
- Allow for better tracking of system usage and performance; and
- Provide for future usage monitoring, data logging, and system maintenance.

Future signal preemption equipment installed in the region shall utilize the Strobecom II 2140 system, manufactured by Tomar Electronics Inc., or its comparable equivalent.

Implementation of a standardized code-capable system can occur in a phased manner, as existing traffic signal equipment reaches the end of its useful life, to minimize the cost of transitioning to an encoded system, or until an agreed-upon switchover deadline is reached.

The CCMPO recommends implementation of a near-term regional traffic signal pre-emption standard in Chittenden County to promote migration to a common technology platform. The regional standard should be endorsed by municipalities, emergency services, health care providers, the Chittenden County Transportation Authority, the Vermont Agency of Transportation, and other affected stakeholders in the region.

Adopted this 20th day of September, 2006 by the CCMPO Board of Directors.

Robert H. Penniman, Chair

Appendix B

Letter of Endorsement

HARRIS COUNTY EMERGENCY SERVICES DISTRICT NO. 11
c/o 820 Gessner, Suite 1710
Houston, Texas 77024

October 31, 2012
Lynn LeBouef, President

The Honorable R. Jack Cagle
Commissioner, Harris County Precinct 4
1001 Preston, Suite 950
Houston, Texas 77002

Dear Commissioner Cagle:

This letter is written on behalf of Harris County Emergency Services District No. 11 ("Harris County ESD 11").

As you may know, Harris County ESD 11 provides EMS to an area consisting of 250 square miles in the northwest/Spring area of Harris County. Harris County ESD 11 provides this EMS service through its service agreement with Cypress Creek EMS. (This service area overlaps the areas served by Ponderosa VFD, Spring VFD, Cypress Creek VFD, Champions FD, and Klein VFD, among others, who are first responders with Cypress Creek EMS.) To be sure our residents expect expeditious and professional emergency care which is what Harris County ESD 11, Cypress Creek EMS, and our fire departments are known for. However, as the population continues to grow our service area, new challenges arise which can hamper 911 emergency responses.

One daily challenge is the safe and rapid response in the ever increasing vehicle congestion along our roads and highways. Harris County ESD 11 supports the expansion of the EViEWS Emergency Vehicle Priority (EVP) System in Harris County. Harris County ESD 11 has worked with Harris County TranStar, Cypress Creek EMS, and our local fire departments on a multi-year evaluation of the EViEWS EVP System along the Louettta Road corridor. Travel time of the ambulances along this corridor has been significantly reduced following the implementation of the EViEWS EVP system, cutting lifesaving seconds. The program has proven so successful Harris County ESD 11 and our local fire departments were able to expand the project to TEXDOT/State roadways along FM 1960, FM 2920, and SH 249.

Faster response is not the only benefit of the EViEWS EVP System. Reduction of accidents involving emergency vehicles at Intersections as well as the rapid recovery of normal traffic patterns are highly sought benefits of the fire/EMS community as well as Harris County TranStar. Harris County ESD 11 therefore requests the Harris County Commissioner's Court to approve the EViEWS EVP System final report and allow further expansion of this system along Harris County roadways. Harris County ESD 11 is ready to continue its part of the funding of this project along with the area fire ESDs under an Interlocal Agreement similar to the current program that has worked so well.

Sincerely,

Lynn LeBouef
President

Appendix C

Harris County Emergency Vehicle Priority System Requirements - Local Controller Firmware

Harris County Emergency Vehicle Priority System Requirements

Local Controller Firmware

Objective: To serve emergency vehicle(s) with minimal disruption to vehicular traffic

Traffic Signal Firmware Requirements:

- The natural controller sequence shall be preserved at all times. By default no phases are skipped and left-turn signals operate as normal unless requested by the emergency vehicle
- No phase with demand shall be shortened to less than the alternate minimum green and the priority shall proportionally truncate all conflicting phases subject to this constraint
- In the instance where phase truncation is necessary (with full vehicular demand on the conflicting movements), the controller shall not arrive on the service phase earlier than the specified travel time for that approach
- The firmware shall have at least 4 emergency vehicle priority modules (one per direction)
- Each module should consist of the following programming items:
    - Primary service phase (thru phase) – activated by GPS advance message(s)
    - Secondary service phase (left-turn phase) – activated by GPS left-turn message
    - Flags with the ability to omit phases or pedestrian movements as necessary for each of the priority modules (no omits by default)
    - Travel time parameter for the primary service phase (thru-phase) where the specified movement shall be green by the time the vehicle is that distance away
        - Any conflicting walk rest shall be terminated once a conflicting emergency vehicle request is recognized by the controller
        - On a coordinated street the opposing direction walk rest shall be terminated only if a conflicting secondary service phase is programmed
        - Any walk rest parallel to the emergency vehicle shall rest as normal
    - Travel time parameter for the secondary service phase (left-turn-phase) where the specified movement shall be green by the time the vehicle is that distance away
    - Check out input – activated by GPS check-out message
    - Maximum presence timer where the priority is ignored until the call is dropped
- A conflicting emergency vehicle priority request on the cross street shall be able to force-off the coordinated phases early in order to serve the green by the specified travel time
- The controller firmware shall have mechanism in place to prevent acceptance of increasing travel times from the GPS unit if the emergency vehicle were to encounter reduced speeds
- All phases shall have an alternate priority minimum green (typically greater than the normal minimum green) that will apply if there is demand for a particular phase. This prevents the short timing of phases if short-way transition is required
- Upon check-out the controller shall immediately move onto the next phase if the priority is timing beyond the normal force-off point, subject to the alternate minimum green
- All priority requests and left-turn requests, including Vehicle ID shall be logged by the controller and be brought back to the ATMS (central system) for further analysis

Appendix D

Harris County Emergency Vehicle Priority System Requirements - GPS System

Harris County Emergency Vehicle Priority System Requirements
GPS System

Objective: To serve emergency vehicle(s) with minimal disruption to vehicular traffic

GPS System Requirements:

GPS shall report the following to the traffic signal controller for <u>each</u> approach (4 minimum):

- Travel Time away from the intersection (in seconds)
- Minimum 80 seconds advance notice is required
- Travel time must be passed directly to the controller via Ethernet (using a crossover cable if no Ethernet switch is present) and pass the Vehicle ID directly to the controller
- Vehicle ID shall visible from the controller front panel and in the controller logs
    - In no instance shall raw inputs in the detector racks be used
    - A minimum of 4 messages <u>per direction</u> via Ethernet (16 total) are required
        - 2 advance messages (4 preferred)
        - 1 left-turn message (latched)
        - 1 check-out message (active when vehicle is at the stop-bar)
    - Each of the advance messages shall not activate until the specified travel time away from the intersection is reached
- GPS unit shall pass along left-turn requests (default is no left-turn)
    - Left-turn request is provided via Ethernet and must be logged
        - This message is passed along on an intersection by intersection basis
        - The left-turn request is only valid for the next intersection after passing the previous intersection
    - Left-turn inputs are a “latched” call linked to the vehicle left-turn signal
        - Left-turn signal shall only need to be on for a second to latch
        - Left-turn must not latch to more than one intersection at a time
        - Left-turn request shall be remembered after passing the previous intersection but have the ability not to pass the call to the controller until the emergency vehicle is the specified travel time away from the intersection
- GPS unit shall have mechanism in place to prevent sending increasing travel times to the local intersection controller
- GPS unit shall send a check-out request to all downstream intersections (provided there are no other active emergency vehicles on that approach) if the vehicle is in park or there is a communication loss between the vehicle and the controller (in seconds)
    - A vehicle in park shall immediately send the check-out request to the controller pending no other active priority requests on that approach
    - GPS shall have a separate time-out value (in seconds) for communication loss configurable on a per approach basis

Appendix E

Court order for executing Inter Governmental Agreement for deploying the EVP

ORDER OF COMMISSIONERS COURT
Authorizing an Interlocal Agreement for the Deployment of an
Emergency Vehicle Priority System

The Commissioners Court of Harris County, Texas, met in regular session at its regular term at the Harris County Administration Building in the City of Houston, Texas, on _____, with all members present except _____.

A quorum was present. Among other business, the following was transacted:

ORDER AUTHORIZING EXECUTION OF AN INTERLOCAL AGREEMENT BETWEEN HARRIS COUNTY AND THE CITY OF WEBSTER IN REGARDS TO DEPLOYMENT OF AN EMERGENCY VEHICLE PRIORITY SYSTEM ON COUNTY ROADS WITHIN THE CITY OF WEBSTER FIRE DEPARTMENT'S SERVICE AREA

Commissioner _____ introduced an order and moved that Commissioners Court adopt the order. Commissioner _____ seconded the motion for adoption of the order. The motion, carrying with it the adoption of the order, prevailed by the following vote:

	Yes	No	Abstain
Judge Ed Emmett	☐	☐	☐
Comm. El Franco Lee	☐	☐	☐
Comm. Jack Morman	☐	☐	☐
Comm. Steve Radack	☐	☐	☐
Comm. R. Jack Cagle	☐	☐	☐

The County Judge thereupon announced that the motion had duly and lawfully carried and that the order had been duly and lawfully adopted. The order thus adopted follows:

IT IS ORDERED THAT:

1. The Harris County Judge is authorized to execute on behalf of Harris County an Interlocal Agreement between Harris County and the City of Webster in regards to deployment of an emergency vehicle priority system on County roads within the City of Webster Fire Department's service area. The County is not obligated to expend any funds pursuant to the Interlocal Agreement. The Interlocal Agreement is incorporated by reference and made a part of this order for all intents and purposes as though fully set forth word for word.

2. All Harris County officials and employees are authorized to do any and all things necessary or convenient to accomplish the purposes of this order.

ATTACHMENT TWO

ITS Projects Currently Programmed in FY2015

Project	Lead Agency	Partner Agencies	Project Description	CMAQ
DOT15-461C	ADOT	Avondale, Goodyear, MAG	ADOT FMS Phase 11A project is currently planned to extend fiber communications backbone along I-10 up to Dysart Road. This project will expand the FMS Phase 11A scope to include the RCN expansion to City of Avondale (Section 1) and City of Goodyear (Section 2).	$51,045
APJ15-461	Apache Junction		This project will develop an ITS Strategic Plan for the City of Apache Junction.	$141,450
AVN15-461	Avondale		Provide and install fiber communications backbone on Dysart Road north of I-10. This project will allow City of Avondale to view ADOT CCTV Cameras and respond to traffic incidents that occur on I-10. as well as on the surrounding arterial system by adjusting signal timing from the Avondale interim TOC.	$508,579
CHN15-461	Chandler		The city has about 201 traffic signal controllers operating in field. The existing signal controllers have many limitations. Currently, the city is in the process of upgrading controller firmware. This project will install new compatible traffic signal controller hardware.	$511,766
GDY15-461	Goodyear		Expand Traffic Management Center (TMC) traffic surveillance and mornitoring capability by connecting to existing CCTV cameras at Indian School Road and Camelback Road traffic signals at SR 303L; Facilitate the adjustment of traffic signal timing adjustments at these locations in response to real-time traffic conditions.	$219,876
MMA15-461	Maricopa County	ADOT, Peoria, Glendale, Scottsdale, Phoenix, Surprise	This project will add adaptive signal control capabilities to the existing signal system and enable coordination between agencies. Adaptive capability will be provided for all the signals within the Bell Road corridor for four areas operated by Surprise, ADOT, Maricopa County, Peoria, Glendale, Scottsdale, and Phoenix.	$2,315,065
MES15-461	Mesa		This project will install four access points per radio tower on 12 existing radio towers for a total of 48 access points. Purchase 40 remotes to support field device communications back to the radio towers.	$233,864
PHX15-461	Phoenix		Procure, install 8 Dynamic Message Signs that will display messages such as real-time travel times, traffic incident information, downtown event information, and advise on alternate routes along 7th street and 7th Avenue. Messages will be generated either automatically by field devices or posted by TMC staff.	$854,811

PHX15-463	Phoenix		Install CCTV traffic monitoring cameras at approximately 65 locations along six major corridors, 7th Avenue and 7th Street for North-South movements and on Bell Road, Greenway Road, Northern Road and Glendale Ave. for East-West movements.	$730,891	
SCT15-463	Scottsdale		This project will install 4 Highway Advisory Radio (HAR) transmission units plus approximately 60 flashing advisory signs with a message such as [TUNE TO 610AM FOR VITAL INFORMATION WHEN FLASHING]. The transmission sites will receive data from the Scottsdale TMC, and the flashing signs will be activated through the City's interconnected Signal System.	$380,040	Deleted - but appears to have used FY13 fed$ for design & may have to pay it back
TMP15-461	Tempe		This project will install a fiber connection from ADOT's node 12 building to the signals at Broadway and Ramp K and Broadway and 48th St, and 48th St and Ramp C. The project will also install wireless radios, high speed DSL communications and 22 CCTV cameras at several intersections in Tempe.	$287,752	

Additional Projects Moved to 2015:

		Original Pgm Yr		
ELM14-101	El Mirage	2014	Construct arterial traffic signal enhancements	451,122
GLB13-904	Gilbert	2013	Fiber Installation and ITS Components	137,690
GDY14-101	Goodyear	2014	Install Signal Communications and ITS Components	749,164
PEO13-901C2	Peoria	2013	Install conduit, pull boxes, fiber, and CCTV cameras	29,001
PEO16-401D	Peoria	2016	Design Traffic Signal Communications Deployment	88,642
TMP14-102	Tempe	2014	Fiber Installation and ITS Components	383,333

ITS Projects Currently Programmed in FY2016

Project	Lead Agency	Partner Agencies	Project Description	CMAQ	
CHN16-401	Chandler		Add four-section Flashing Yellow Arrows to 114 signalized intersections currently with Protected-only and protected/permissive left turn signals. This will improve traffic safety and signal efficiency by providing the flexibility to restrict left turns by time-of-day.	$633,281	
GLB16-401	Glibert		This project will install segment#1, 3.5 mile fiber optic cable in new and existing conduit, upgrades traffic controllers and CCTV cameras at intersections to improve communication from Gilbert's TOC to multiple intersections in northwest Gilbert.	$546,072	
GLB16-401	Glibert		This project will install segment#2 , another 3.5 mile fiber optic cable in new and existing conduit, upgrades traffic controllers and installs CCTV cameras at intersections to improve communication from Gilbert's TOC to multiple intersections in northwest Gilbert.	$549,599	same as above
GLN16-401	Glendale		Installation of conduit, fiber optic cable, communications equipment and CCTV cameras at intersections along Olive, Northern and 51st Avenues to expand the capabilities of the signal system. Additionally, 7 new CCTV cameras will be installed to allow for real time traffic monitoring.	$904,728	
GLN16-402	Glendale		Installation of count stations and travel time data collectors at key intersections and locations throughout the city. Additionally, the project will include development of a database and GUI to manage, query, and present the data.	$555,470	
MES16-401	Mesa	Chandler, Gilbert, Tempe	Install 91 ARID Bluetooth devices in traffic signal cabinets throughout the East Valley to monitor traffic speeds and travel times. The data from each agency's devices will be shared via RADS and disseminated via a web map that displays travel times, speed or congestion levels. This project will expand a current City of Mesa project which will deploy 80 ARID sensors.	$655,385	
MES16-402	Mesa	Maricopa County	Develop an electronic means of sharing CAD data with RADS. Develop filters for integrating Mesa 9-1-1 CAD data in RADS and a user interface that Traffic Management Center operators can use to monitor incidents.	$56,580	
PEO16-401	Peoria		Establish communication between the TMC and two traffic signals near the Peoria Sports Complex in order to facilitate timing changes during special events and incidents.	$206,772	
SCT16-401	Scottsdale		Replace standard Signal Cabinets with Advanced Hybrid Cabinets at 60 major intersections	$678,960	

TMP16-403	Tempe		The project will install conduit and fiber in the Rural Road corridor from US 60 north to City Limit. The installation will be based on the overall design of the Rural Road fiber corridor which will be funded locally through the City's CIP.	$983,626

Additional Projects Moved to 2016:

		Original Pgm Yr		
GLN14-101	Glendale	2014	Connect approx. 7 intersections, install 4 CCTV cameras, connect fiber communications infrastructure & add equip. to a public safety bldg.	$904,164

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