NOCoE
National Operations Center of Excellence

Peer Exchange Report

—

Traffic Signal Systems, Arterial Management, and TSMO Peer Exchange

Summary

The National Operations Center of Excellence (NOCoE) hosted the *Traffic Signal Systems, Arterial Management and TSMO* Virtual Peer Exchange with the participation of transportation agency professionals experienced in developing and implementing in plans, programs, policies, and projects in arterial management to support TSMO in their jurisdictions. This peer exchange benefited from experience shared from state DOTs, MPOs, and local agencies as well as researchers.

Signalized arterial streets carry a significant portion of traffic in urban areas. This peer exchange had presentations and discussion on the potential of integrated TSMO strategies to provide safe, optimal traffic movement on arterial roadways. Topics included innovation, research, and pilot projects funded from grant programs along with a supplemental focus on multimodal and freeway coordination, and use of traffic signal systems and ITS technology to support arterial-based TSMO.

The aim was to share information among participants and to gather feedback on how NOCoE and its partner organizations could better assist in advancing the topic in the community of practice. The summaries that follow and associated videos of presentations will support knowledge sharing around the state of the practice in this core aspect of transportation agency TSMO programs.

Discussion Topics

Session 1 – Let' Be Smart: Innovation and SMART Grants
- *Perception-Based Adaptive Traffic Management*, Dan Sines and Zoami Sosa, City of Colorado Springs
- *Operation Green Light: Integrating Regional Traffic Signal Performance Measures*, Ray Webb, Mid-America Regional Council
- *New Traffic Signal Actuation Concepts using Enhanced Detector Information*, Chris Day, Iowa State University

Session 2 – Coordination of Arterial Operations with Freeways and Transit
- *A Method for Evaluating Transit Signal Priority Using Automated Traffic Signal Performance Measures (ATSPMs)*, Jay Jackson, Massachusetts Bay Transportation Authority (MBTA)
- *RTC FAST: Integrating Arterial, Freeway, and Transit Operations for Seamless Traffic Management*, Joanna Wadsworth, Regional Transportation Commission of Southern Nevada
- *CDOT Region 1 Ramp Metering Program: Existing Conditions, Pilots, and Future Plans*, Alazar Tesfaye, Colorado DOT

Session 3 – Open Discussion
Discussion and identification of current and near future issues in arterial management affecting TSMO.

Session 4– Coordinating and Getting the Most from Arterial-Based TSMO
- *Georgia DOT's Experience with TSMO-focused Arterial Management*, Justin Hatch, Georgia DOT
- *Strategies for Improving Safety and Mobility at Traffic Signals for All Road Users*, Mark Taylor, Utah DOT
- *Oakland County's Experience in ITS and Arterial Management*, Danielle Deneau, Road Commission of Oakland County

Summary

Session 1 – Let' Be Smart: Innovation and SMART Grants

<u>Perception-Based Adaptive Traffic Management</u>

Dan Sines and Zoami Sosa provided information on the US DOT SMART grant project whose goals are built around a forward-looking approach for intelligent infrastructure that integrates people and autonomous vehicles into their traffic management system. Collaborating with partners this work incorporates such key elements as high-resolution telemetry data, a fusion engine, and digital twin of the system, along with connected vehicle applications for preemption and priority treatments that all support the high-resolution adaptive traffic management algorithms that direct the traffic signal controllers. Once the project is complete the intent is to make its resources available in the public domain.
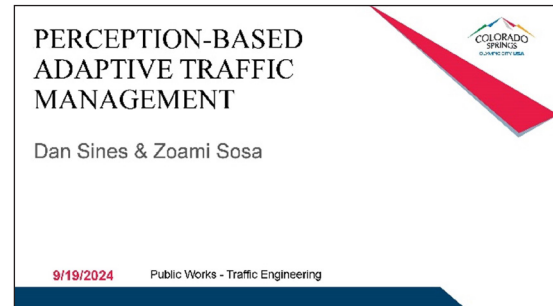
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<u>Operation Green Light: Integrating Regional Traffic Signal Performance Measures</u>

Ray Webb shared the background and program elements of the Mid-America Regional Council's (MARC) Operation Green Light program in the Kansas City metropolitan area. He highlighted the challenges of integrating performance data in the region, communicating to decision-makers, and the need for collaboration across 30 partner agencies and jurisdictions.
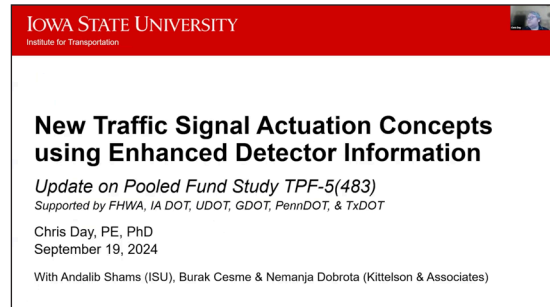
In response to the performance data integration challenges MARC applied for a US DOT SMART grant for systems to collect and share performance measure information based on 60 requirements, system functionality, data types, sources, analytics, outputs, and user experience. Four platforms were selected based on regional requirements and eight vendors submitted applications. MARC is using a two-stage process of evaluation and implementation across six corridors in the metropolitan area. The work is currently in the evaluation process concluding in February 2025 using multiple structured scenarios and test methods along with user feedback assessments.

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<u>New Traffic Signal Actuation Concepts using Enhanced Detector Information</u>

Chris Day from Iowa State University presented research on self-organizing trajectory-based actuated traffic control concepts, including dynamic coordination and instantaneous gap out. There is relatively little study of actuated control in the research literature compared to adaptive control of traffic signals. Initial work was performed in Colorado Springs and current work is part of the Integration of *New Traffic Signal Actuation Concepts using Enhanced Detector Information* transportation pooled fund study [TPF-5(483)]. The study concept has four elements, 1) integrate vehicle trajectory data directly into the traffic signal controller, 2) develop methods that directly access data to make phase termination decisions, 3) directly relate control concepts to operational objectives, and easy configuration of the control methods. The control concepts examined in the study include instantaneous gap, adaptive gap, dilemma zone

protection, queue clearance, and two methods to accommodate traffic platoons.

The simulation studies showed improvements in the number of dilemma zone vehicles, while queue clearance reduces the number of split failures, and increases percent arrival on green. Additionally, the research team sees beneficial results of increased efficiency in phase termination reducing cycle length and delays for minor phase movements and the inclusion of platoon accommodation methods introduces a mechanism for decentralized coordination. Future plans include refinement and testing of benefit/cost relationships and optimization of settings as well as future field study to facilitate live data streams and testing of control concepts with the intent of providing open source resources for their work.

IOWA STATE UNIVERSITY
Institute for Transportation

New Traffic Signal Actuation Concepts using Enhanced Detector Information

Update on Pooled Fund Study TPF-5(483)
Supported by FHWA, IA DOT, UDOT, GDOT, PennDOT, & TxDOT

Chris Day, PE, PhD
September 19, 2024

With Andalib Shams (ISU), Burak Cesme & Nemanja Dobrota (Kittelson & Associates)

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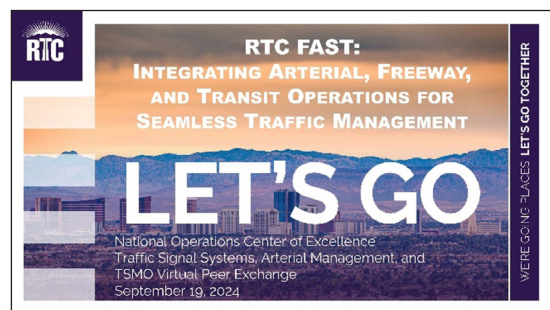*Session 2 – Coordination of Arterial Operations with Freeways and Transit*

A Method for Evaluating Transit Signal Priority Using ATSPMs

Jay Jackson from the MBTA noted that 50 percent of bus operational delays are from signalized intersections and reducing this delay element is directly related to the agency's reliability and travel time goals. The challenges for the transit agency are 50+ jurisdictions with varied infrastructure and uncertainty where they should begin implementation. In addition, data from the agency's AVL systems is not granular enough for transit signal priority (TSP) and traffic signal data is not transit specific. The data collection effort was very labor intensive.

The new approach was to create a bus detection specification to feed the system to determine arrival on green within the ATSPM analysis methodology. This approach then enables accurate arrival time predictions. Next steps include the development of a TSP dashboard to monitor and analyze the performance, functionality, accuracy, delay, and effectiveness of system(s). The agency recently was awarded a $3.7M ATTAIN grant to upgrade traffic signals in three suburbs to add an TSP dashboard and alerting system.

RTC FAST: Integrating Arterial, Freeway, and Transit Operations for Seamless Traffic Management

Joanna Wadsworth from the Regional Transportation Commission of Southern Nevada (RTCSNV) provided an overview of the agency and its core functions of traveler information, traffic management, incident management, archived data, and regional coordination. As an example of coordination in a freeway traffic incident scenario the agency's transportation management center, traffic signal technicians, transit service, and coordination with Nevada DOT and local agencies are all activated. This coordinated incident management on arterial, freeway, and transit operations response results in quicker notification and enhanced communication to partners, earlier incident identification and response, managed impact on traffic operations, reduces potential secondary crashes, and provides travel alerts for all transportation modes.

RTC FAST:
INTEGRATING ARTERIAL, FREEWAY, AND TRANSIT OPERATIONS FOR SEAMLESS TRAFFIC MANAGEMENT

LET'S GO

National Operations Center of Excellence
Traffic Signal Systems, Arterial Management, and TSMO Virtual Peer Exchange
September 19, 2024

WE'RE GOING PLACES. LET'S GO TOGETHER

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CDOT Region 1 Ramp Metering Program: Existing Conditions, Pilots, and Future Plans

Alazar Tesfaye from Colorado DOT discussed their existing legacy ramp metering system, its limitations, and the need for a new, more efficient system. He shared information regarding their current SMART 25 Corridor pilot project that aimed to improve reliability and reduce travel time by 20 percent by using advanced vehicle detection technology, targeted modifications, integration with STREAMS freeway management system and temporary ramp shoulder use. The project resulted in improved travel time reliability, planning time, and overall average

CDOT Region 1 Ramp Metering

Alazar Tesfaye, P.E.,PTOE
NOCoE Peer Exchange - September 19, 2024

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travel time, most notable in the afternoon peak, as well as effective management of wait times and queues with impact to adjacent arterials streets. Stakeholder feedback was generally positive. However, there were challenges due to changing priorities at executive level, contractor capabilities and interest, and implementation/on-going costs relative to conventional ITS projects. Colorado DOT has received a US DOT SMART grant to expand the coordinated adaptive ramp metering system, and the project is in its initial stages.

Session 3 – Open Discussion

Breakout groups to discuss and identify current and near future active issues in arterial management affecting TSMO were facilitated by Douglas Noble (ITE), Jamie Mackey (FHWA), and Kevin Lee (TRB Traffic Signal Systems Committee). A poll of participants showed staff availability and funding as major barriers to implementing advanced practices, while organizational factors were less concerning. Specific points of discussion included:

- Performance measures, data management, and regional collaborations to support transit signal priority and advanced traffic management systems (ATMS):

- Potential collaborations with other states and regions on approaches to freeway and arterial coordination.

- Importance of the FHWA *Traffic Signal Management Handbook* as a resource.

- Discussion of various traffic signal management challenges, including maintenance, staff turnover, and the need for additional staff. High turnover rates and budget cuts are impacting the ability to manage traffic signal systems effectively. It is necessary to acknowledge these ongoing challenges related to staffing and resource constraints.

- There is a need for streamlined processes and tools to optimize resource allocation and Recognition of the importance of aligning procurement timelines with maintenance schedules.

- Exploring the potential of advanced data analytics, such as digital twins and fusion engines, to optimize traffic signal operations. While there is an abundance of data available, it can be overwhelming to analyze and utilize effectively.

- Integrating new technologies like connected vehicles and AI presents both opportunities and challenges.

- It is crucial to select reliable software and hardware to avoid wasting resources.

- There's potential for benefits in regional collaboration, but local agencies may have concerns about losing control.

- The release of the *Manual on Uniform Traffic Control 11th Edition* (MUTCD) and final release of the U.S. Access Board *Public Right-of-Way Accessibility Guidelines* (PROWAG) changes are causing anxiety among many agencies.

- There is a strong interest in developing standardized agreements and protocols for maintenance, operations, and communication between different states and local agencies. This includes establishing common standards for firmware, central systems, and controllers as well as the need for standardized approaches to collecting and processing various types of data, including detection and perception data.

- There is interest in innovative applications of signal control strategies such as using signal preemption for snowplows to improve winter road maintenance.

- Implementing statewide traffic signal platforms and addressing the challenges of transitioning between rural and urban areas as well as integrating traffic signal systems into statewide transportation management centers.

Overall, the group expressed frustration with the lack of easy solutions to these complex challenges. They emphasized the need for guidance, support, and practical strategies to navigate the evolving landscape of traffic signal management.

Session 4– Coordinating and Getting the Most from Arterial-Based TSMO

Georgia DOT's Experience with TSMO-focused Arterial Management

Justin Hatch from the Georgia Department of Transportation DOT discussed the state's signal system and the movement of its arterial management into the Regional Traffic Operations Program (RTOP). With Metro Atlanta fragmented into many counties and cities, there was a need to achieve consistent, standardized operations and maintenance across boundaries, interoperability between systems, and a regional communications network. The RTOP addressed these needs and supported data driven operational decision-making, partnerships, and consultant resources. The success of the RTOP enabled GDOT to expand the approach statewide for traffic signal software, communications, and connected vehicle applications as well as open data resources to support web-based tools for ATSPMs and vehicle probe data. The presentation highlighted the successful handling of significant traffic incidents to smaller daily events like blocked railroad grade crossings, and the challenges faced by pedestrians and bicyclists at a particular intersection.
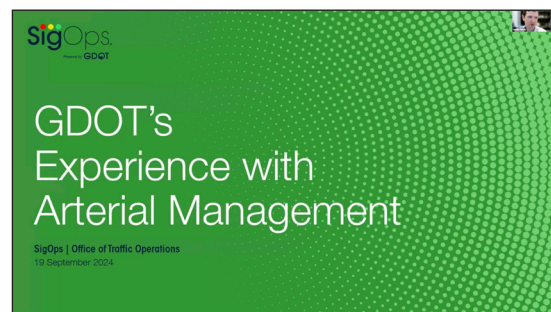
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Strategies for Improving Safety and Mobility at Traffic Signals for All Road Users

Mark Taylor from Utah DOT discussed their strategies intersection focused efforts to improve road safety. These include a wide cross section of staff, physical and technology-based improvements including such items as battery backup systems and generators for traffic signal cabinets, retro-reflective tape applied to traffic signal head back plates to improve visibility, and supplemental intersection lighting mounted on mast arms and from flood lights. Focusing on vulnerable road users, the agency has, near schools, added more WALK time and school

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crossing guards and, more broadly, expanded implementation of accessible pedestrian signals that can be activated through a phone app. The agency is also expanding the use of LiDAR detection of pedestrians and bicyclists to support traffic control strategies and safety outcomes at signalized intersections.

Oakland County's Experience in ITS and Arterial Management

Danielle Deneau from the Road Commission of Oakland County Michigan (RCOC) discussed overseeing traffic signal infrastructure and the procedural approach with county jurisdictions using traffic signal participation agreements the fiscal contributions and decision-making input that cover installations, modernizations, removals, maintenance, and operation of all devices. RCOC has a substantial background and experience connected vehicle technology and V2X elements like roadside unites (RSUs). Looking forward the agency received a US DOT

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SMART grant to build an economically sustainable safety model and prototype deployment of C-V2X technology across six different use cases including such elements as vulnerable road user alerts and snowplow signal priority.
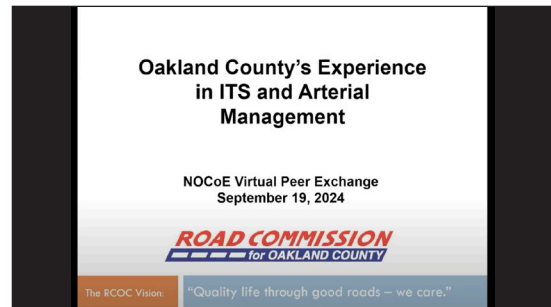
Next Steps

Gaps and Future Actions

This peer exchange focused on traffic signal systems and arterial management with participation from various agencies across the country. NOCoE will meet the AASHTO, ITE, ITS America, and FHWA representatives to review the peer exchange findings and work on next steps as well as potential products. Based on participants' feedback, it is anticipated that the following priority topics and questions need to be further explored:

- **Traffic Signal Agreements:** Develop sample language and templates for agreements between state DOTs and local agencies for traffic signal operations and maintenance.

- **Arterial Management Control Strategies:** Share best practices on systemic screening methods for implementing TSMO strategies on arterials and on data-driven decision making for arterial management using high-resolution controller data and third-party data sources.

- **Webinars:** Low-cost safety improvements for vulnerable road users at signalized intersections and merging technologies like LiDAR for traffic signal performance measurement.

- **Case Studies:** Compile case studies on successful implementations of connected vehicle applications by state and local agencies and on successful regional traffic signal management programs across multiple jurisdictions.

- **Freeway and Arterial Integrated Management:** Share best practices on integrating arterial management with freeway operations and incident management.

- **Combined Safety and Mobility Goals:** Share best practices on integrating safety and mobility goals in arterial management programs.

- **Communications:** Compile best practices for public outreach and communication of arterial management benefits.

- **Staffing and Organizations:** Provide resources on staffing models and strategies to address workforce challenges in traffic signal operations.

- **Grants and Contracting:** Compile information on funding sources and grant opportunities for arterial management and TSMO projects. The Federal Highway Administration to provide guidance on Buy America requirements for ITS and connected vehicle deployments.

- **Transit Signal Priority:** Develop resources on performance measures and evaluation methods for transit signal priority implementations.

- **Asset Management:** Develop resources on asset management practices for traffic signal infrastructure.