



# MAG Systems Management and Operations (SM&O) Plan

## Task 1 Report – Best Practices in Urban Transportation SM&O

November 2016

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## LIST OF ACRONYMS

511 DFW – Dallas and Fort Worth Region 511 Traveler Information System	ITS – Intelligent Transportation Systems
AADT – Average Annual Daily Traffic	JPACT – Joint Policy Advisory Committee on Transportation
ADOT – Arizona Department of Transportation	LOS – Level of Service
ARC – Atlanta Regional Commission	LRP – Long-Range Plan
ATCMTD – Advanced Transportation and Congestion Management Technologies Deployment	L RTP – Long Range Transportation Plan
AZDPS – Arizona Department of Public Safety	M&O – Management and Operations
BRTB – Baltimore Regional Transportation Board	MAG – Maricopa Association of Governments
Cap-Main – Capital/Operational Asset Management	MPO – Metropolitan planning organization
CCTV - Closed Circuit Television	MTC – Metropolitan Transportation Commission
CHP – California Highway Patrol	MTP – Metropolitan Transportation Plan
CMAQ – Congestion Mitigation and Air Quality	MTS – Metropolitan Transit System
CMP – Congestion Management Plan	NCHRP – National Cooperative Highway Research Program
CMP – Congestion Management Plan	NCTCOG – North Central Texas Council of Governments
C-TRAN – Clark County Transit	NCTD – North County Transit District
DART – Dallas Area Rapid Transit	NHPP – National Highway Performance Program
DOT – Department of Transportation	NJDOT – New Jersey Department of Transportation
DRCOG – Denver Regional Council of Governments	NTTA – North Texas Tollway Authority
DSS – Decision Support System	NYSDOT – New York State Department of Transportation
DVRPC – Delaware Valley Regional Planning Commission	NYSTA – New York State Thruway Authority
FAST TMC – Freeway and Arterial System of Transportation TMC	ODOT – Oregon Department of Transportation
FDOT – Florida Department of Transportation	OPS – Operational Planning Study
FHWA – Federal Highway Administration	OSA – Operations and Safety Assessments
GDOT – Georgia Department of Transportation	PennDOT – Pennsylvania Department of Transportation
GTC – Genesee Transportation Council	PSRC – Puget Sound Regional Council
HELP – Highway Emergency Local Patrol	PSU – Portland State University
HERO – Highway Emergency Response Operators	RCP – Regional Comprehensive Plan
H-GAC – Houston-Galveston Area Council	RGRTA – Rochester Genesee Regional Transportation Authority
HSIP – Highway Safety Improvement Program	RIMIS – Regional Integrated Multi-Modal Information Sharing
ICM – Integrated Corridor Management	RITIS – Regional Integrated Transportation Information System
IDRuM – Interactive Detour Route Mapping	RITSIP – Regional Intelligent Transportation Systems Implementation Plan
IMTF - Incident Management Task Force	
IPM – Integrated Performance Management	

ROP – Regional Operations Plan  
 RTC – Regional Transportation Council  
 RTCO – Regional Concept of Transportation Operations  
 RTIP – Regional Transportation Improvement Program  
 RTN – Regional Thoroughfare Network  
 RTOC – Regional Traffic Operators Committee  
 RTOP – Regional Traffic Operations Program  
 RTP – Regional Transportation Plan  
 RTR – Regional Toll Revenue  
 RTSRP – Regional Traffic Signal Retiming Program  
 SANDAG – San Diego Association of Governments  
 SEWRPC – Southeastern Wisconsin Regional Planning Commission  
 SINC – Signals in Coordination  
 SM&O – Systems Management and Operations  
 SPC – Southwestern Pennsylvania Commission  
 SRTP - Strategic Regional Thoroughfare Plan  
 STP – Surface Transportation Program  
 STTC – Surface Transportation Technical Committee  
 TAP – Thoroughfare Assessment Program  
 TDM – Transportation Demand Management  
 TIGER – Transportation Investment Generating Economic Recovery  
 TIM – Traffic Incident Management  
 TIMBR – Traffic Incident Management Baltimore Region  
 TIP – Transportation Improvement Program  
 TOC – Traffic Operations Center  
 TOTF – Transportation Operations Task Force  
 TSM – Transportation System Management  
 TSMO – Transportation System Management and Operations  
 TSM&O – Transportation System Management and Operations  
 TSOP – Traffic Signal Optimization Program  
 TxDOT – Texas Department of Transportation  
 USDOT – U.S Department of Transportation  
 VAST – Vancouver Area Smart Trek  
 VMS – Variable Message Sign  
 VMT – Vehicle Miles Traveled  
 VPP – Vehicle Probe Project  
 WSDOT – Washington State Department of Transportation

# 1 INTRODUCTION

## 1.1 Purpose

Given the dynamic nature of transportation management and operations (M&O) it is becoming increasingly important for metropolitan planning organizations (MPOs) to develop and utilize a strategic framework for technology and infrastructure investments. The challenges of aging infrastructure and increasing congestion, together with the opportunities of evolving technology, new data sources, and new approaches to system management have pushed MPOs to re-evaluate transportation system investments. The Maricopa Association of Governments (MAG) recognizes this need and is developing a Systems Management and Operations (SM&O) Plan to help guide their strategic investment decision making process.

As a first step towards the development of the MAG SM&O Plan, this report synthesizes effective practices utilized by comparable MPOs to support the management and operation of their transportation systems. The purpose of the document is to highlight effective SM&O practices – often also called Transportation Systems Management and Operations, or TSM&O – that might have potential application to the MAG region or offer some insights to consider in MAG’s own SM&O Plan.

## 1.2 Process for Identifying Effective Practices

Effective regional practices were identified through a multi-step process:

- 1) **Survey of Experts** – The research team conducted a web-survey of leading experts nationally to gain input on metropolitan areas of the country with leading practices in TSM&O planning, implementation, and assessment. These experts were comprised of key staff from the U.S. Department of Transportation/Federal Highway Administration (USDOT/FHWA); academic institutions; and private consultants in the TSM&O industry.
- 2) **Literature Review** – The research team conducted a review of literature to identify best practices from through the U.S. The literature included a wide array of FHWA guidebooks, case studies, and reference material focused on TSM&O, as well as resources available from the National Cooperative Highway Research Program (NCHRP), and the National Center for Operations Excellence.
- 3) **Identification of Case Study Areas** – From the survey and experience, the team then identified potential case study areas that could provide meaningful lessons for the MAG region
- 4) **Interviews with Leading Regions** -- The team conducted interviews with key staff involved in TSM&O from regions of the country identified as having good practices and somewhat comparable in size and scope of their transportation network to the MAG region.

## 1.3 Summary of Key Findings

Research and interviews with other urban areas identified some innovative practices and programs that MAG might consider as it moves forward with advancing SM&O in the region. A summary of the lessons learned and exemplary practices related to SM&O activities across the country that MAG should consider are described in this section.

**Make the Operations Plan an integrated and living document** – Many MPOs and regional agencies have a TSM&O or operations plan that provides a vision and way forward for TSM&O activities in the region. When looking at the various types and structures of these plans, many agencies view their Regional Concept of Transportation Operations (RCTO) or TSM&O plan as a living document that is frequently revisited and updated. Whether on an annual or 5-year cycle, frequently revisiting such a plan will make sure that it is up-to-date based on the current state of operations as well as current state of technology; it will also make sure that the plan continues to provide a unified direction for TSM&O within the region.

Agencies also cited benefits of having these plans be integrated with or directly linked to a larger regional document, such as the Long-Range Transportation Plan (LRTP) and/or the Congestion Management Plan (CMP). Since the LRTP and the CMP are foundational and driving documents at MAG, making sure that they are informed by the SM&O plan and vice versa will help emphasize operations and management at MAG and make sure that all MAG efforts are aligned and consistent within the region.

**Update and expand regional performance measures** – MAP-21 will necessitate specific mobility and system performance measures. MAG has implemented a performance dashboard that consolidates freeway speed and volume data, archived arterial speed data (from the FHWA National Performance Management Research Data Set), links to transit performance and ridership from Valley Metro and links to bike map. There are some tools on the dashboard and access to an archive. This resource could be improved by linking various datasets to get corridor performance data (freeway, arterial, transit, and non-motorized). Further inclusion of safety data could help to link safety and system operations improvements. Adding incident data collected by Arizona Department of Public Safety (AZDPS) and Arizona Department of Transportation (ADOT) also could enhance this important performance resource.

**Expand allocated funding for Traffic Incident Management** – MAG currently programs funds for the Freeway Service Patrol, and is co-funding the pilot program to house AZDPS officers at the ADOT Traffic Operations Center (TOC). Identify ways to include Traffic Incident Management (TIM) needs in the upcoming long-range plan (LRP, similar to Delaware Valley Regional Planning Commission).

**Expand the Traffic Signal Operations Program** – MAG currently funds the Traffic Signal Optimization Program (TSOP) at approximately \$300,000 per year with planning funds. Consider linking recommendations generated from this program on essential infrastructure improvements and signal system upgrades (such as communications links), to be funded through the Transportation Improvement Program (TIP) programming process. MAG already puts a strong focus on coordination TSOP projects with Integrated Corridor Management (ICM) priorities, and can continue to expand this focus of TSOP for arterials paralleling freeways. MAG also could consider transit signal priority as part of the TSOP program.

**Promote Benefits of the TSOP Improvements** – MAG now requires before and after studies as part of TSOP projects. This information on benefits, cost savings, delay savings, etc. can be an important part of the operations story and business case for investing in operations in the MAG region. This information should be published and shared, and integrated in to outreach and education materials, highlighted in articles, media releases and other features. Several MPOs, including Metropolitan Transportation Commission (MTC) and Pittsburgh, publish the signal timing program benefits and benefit-cost information:

- MTC Summary: <http://mtc.ca.gov/sites/default/files/PASS%20Fact%20Sheets%2014-15%20ALL.pdf>

- Pittsburgh/SPC Summary: <http://www.spcregion.org/pdf/signals/SPCCycle1Summary.pdf>

**Develop Corridor Investment Strategies to guide priorities and implementation** – This review of other areas showed that there are a range of strategies used by MPOs to establish corridor priorities and associated needs and projects. In this region, I-10 and I-17 have been strong focus areas – they are the highest volume freeway corridors in the region, carry a significant amount of truck traffic, and serve as the ‘spine’ of the region’s freeway network. Other corridors could benefit from having a focused plan and set of recommended strategies. Loop 101 has had some ICM planning and implementation, but Loop 202, US 60 and I-10/I-17 beyond the current ICM and system planning boundaries will be beneficial in the future. These corridor investment plans could include operations, transit, safety and other factors, and should consider the parallel arterial network.

## **1.4 Organization**

This document is organized around effective practices identified from the research, in the following categories:

- **Section 2: Institutional Frameworks.** Information on SM&O Plans including who is involved in planning, what roles agencies play and what structures are in place. This also includes discussion on how planning for operations is integrated into metropolitan planning, and how MPOs staff their organizations for SM&O activities as well as what funds are used to support SM&O projects.
- **Section 3: Performance Measures and Data.** Metrics to assess the effectiveness of MPO programs along with information on what data is used and how the data is presented to the public.
- **Section 4: Strategies, Priorities, and Tools to Support SM&O.** Includes the initiatives and strategies being advanced across identified MPOs along with supporting decision support and analytic tools.
- **Section 5: Investment Prioritization and Decision Making.** Provides best practices around MPO decision making and the processes utilized by MPOs in selecting projects
- **Section 6: Case Studies.** Provides a summary of overall highlights from individual regions and their SM&O-related activities.
  1. Atlanta Region
  2. Dallas/Fort Worth Region
  3. Orlando Region
  4. Philadelphia Region
  5. Pittsburgh Region
  6. Portland, OR Region
  7. San Diego Region

## 2 INSTITUTIONAL FRAMEWORKS

Institutional frameworks address the underlying institutional structure for planning for, operating, and managing transportation systems within the region. It addresses issues such as how MPO staff are organized to support coordination across facilities and modes; alternative business models, including public/private partnerships; and how planning for operations is addressed in the metropolitan planning process. Effective practices, and examples, discussed include:

- Development of a regional SM&O plan integrated into metropolitan transportation planning;
- Dedicating MPO staff and planning funds for operations coordination;
- Establishing a regional coordinating group or committee(s); and
- Setting aside dedicated funding for operations.

### ***MAG best practice considerations:***

*Frequent updates to the Operations Plan to capture current priorities and needs, and integrate those needs into programming processes.*

*Explore funding sources that can be combined with Congestion Mitigation and Air Quality (CMAQ) Funds to support operations projects.*

### **2.1 Development of a Regional SM&O Plan Integrated into Metropolitan Transportation Planning**

Several MPOs have worked closely with stakeholders to develop regional SM&O or operations plans. These plans serve to:

- (1) Provide strategic direction on regional goals and objectives for operations,
- (2) Identify priorities for funding that are integrated into the Metropolitan Transportation Plan (MTP) and
- (3) Ultimately help support investments in the TIP.

MAG has already recognized the value of developing such a plan and is in the process of developing one. The practices highlighted below demonstrate an array of different approaches to the development and utilization of these plans, including how the plans are integrated into the long-range planning process and shorter-range TIP development process. They also demonstrate several different approaches for updating the plans, from only periodic (e.g., a 10-year plan) to ones using a regular cycle for updates tied to the TIP. Highlights of contents (performance measures, project prioritization processes, etc.) are discussed further in other sections of this report.

#### **2.1.1 A Strategic TSM&O Plan Providing Direction over a Long-Range Horizon**

In some regions, the plan is long-term (ten or more years) and largely provides strategic direction to operations efforts. For instance:

- In the Portland, Oregon region, the **Portland Metro Regional TSM&O Plan, 2010-2020**<sup>1</sup> identifies four key functional area priorities: multimodal traffic management, traveler information, traffic incident management, and transportation demand management (TDM). For each functional area, the plan identifies strategies and projects that improve operations of the existing infrastructure and manage demand on the transportation system, using a 10-year planning horizon.
- The **Southwest Washington Regional Transportation Council (RTC)**, the MPO for the Vancouver area of Washington State, just north of Portland, also developed a Regional TSM&O Plan in 2011, presenting a 10-year vision and strategy *Regional TSMO Plan for Southwest Washington*.<sup>2</sup> The development of the plan involved steering committee agencies including: Clark County, SWRTC, Washington State DOT (WSDOT), City of Vancouver, Oregon Metro, C-TRAN (Clark County Transit), City of Camas, and the Port of Vancouver.
- In Maryland, the **Baltimore Regional Transportation Board (BRTB)** developed a *Regional Management & Operations Strategic Deployment Plan* (March 2007)<sup>3</sup> to guide planning for operations in the region and identify project priorities. Specifically, the plan focuses on updating the region's ITS Strategic Deployment Plan with a focus on regional M&O project deployment, developing a vision and roadmap for regional M&O deployment, making recommendations for integration of M&O into the region's transportation planning process, and providing updates to the Maryland Intelligent Transportation Systems (ITS) Architecture.
- The **Delaware Valley Regional Planning Commission (DVRPC)**, the MPO for the Philadelphia region, developed a *Transportation Operations Master Plan*,<sup>4</sup> (last updated in July 2009), which outlines a long-range vision of transportation operations for the region and drives operational investments. It presents transportation operations goals, objectives, and operational strategies, including plans and programs to accomplish the regional goals and vision.
- In Central Florida, **MetroPlan Orlando's** TSMO Advisory Committee is guided by the Orlando *M&O Strategic Plan*. Last updated in 2009, the plan includes the process for identifying, allocating, and implementing TSM&O projects. Goals outlined in the plan include: regionalism through stakeholder engagement, identifying M&O champions, enhancing collaboration and communication between partners, supporting resource sharing, assessing regional M&O needs, prioritizing projects, and evaluating performance.

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<sup>1</sup> Regional TSMO Document (June 2010) available at:

[http://www.oregonmetro.gov/sites/default/files/062010\\_regional\\_transportation\\_system\\_management\\_operations\\_plan\\_executive\\_summary.pdf](http://www.oregonmetro.gov/sites/default/files/062010_regional_transportation_system_management_operations_plan_executive_summary.pdf)

<sup>2</sup> Regional TSMO Plan for Southwest Washington (June 2011) available at:

<http://www.rtc.wa.gov/programs/vast/docs/tsmoReport2011.pdf>

<sup>3</sup> Baltimore Regional SMO Strategic Deployment Plan (March 2007) available at:

[http://www.baltometro.org/phocadownload/Publications/Transportation/Plans/MandO\\_StrategicDeploymentPlan\\_2007.pdf](http://www.baltometro.org/phocadownload/Publications/Transportation/Plans/MandO_StrategicDeploymentPlan_2007.pdf)

<sup>4</sup> DVRPC Long Range Plan (July 2009), available at: <http://www.dvrpc.org/reports/09049.pdf>

## 2.1.2 Shorter-Range or More Frequently Updated TSM&O Plans

Other MPOs' operations plans are focused on a shorter multi-year period, such as a four or five-year period, and are intended to be updated on a cycle that aligns with the development of the MTP and/or TIP. These plans often identify specific operational investment priorities. For instance:

- The **Southeastern Wisconsin Regional Planning Commission (SEWRPC)** developed a *Regional Transportation Operations Plan, 2012-2016*,<sup>5</sup> as a short-range plan identifying system operations measures and actions recommended for implementation over a five-year period. The RTOP builds on the recommendations from the region's long-range Regional Transportation Plan (RTP), and identifies the operations measures in the RTP recommended for priority implementation in the five-year period, along with potential funding sources, and the relationship of each measure to the regional ITS architecture. The plan is intended to be updated on a 4-year cycle.
- The **Southwestern Pennsylvania Commission (SPC)**, the MPO for the Pittsburgh region, updates a *Regional Operations Plan (ROP)* each time the MTP is updated, most recently in 2015. This plan came out of efforts initiated by Pennsylvania Department of Transportation (PennDOT). To complement statewide planning efforts, each of the nine transportation operations regions of PennDOT developed a ROP in 2007, which documented each region's approach to operational activities. The plans all used the PennDOT 2005 Transportation Systems Operations Plan as a starting point, but adapted the statewide direction to the region's transportation conditions, values, and priorities. SPC has subsequently mainstreamed the ROP into its regional LRTP process and updates the ROP each time the LRTP is updated.<sup>6</sup> Last updated in 2015, the plan identifies operations goals and objectives, performance measures, focus areas, and key corridors and potential studies.
- In the Denver region, the **Denver Regional Council of Governments (DRCOG)** prepared an RCTO, which describes a collaborative plan to improve regional operations performance across the region over a five-year period. The RCTO presents a unified direction for TSM&O within the region; creates operations objectives and performance measures that can be used in the transportation planning process; and clarifies the roles and responsibilities of partners in the collaborative effort.

In other regions, the M&O or ITS plan is updated even more frequently. For instance:

- The **North Central Texas Council of Governments (NCTCOG)** in the Dallas-Ft. Worth area has an *ITS Strategic Deployment Plan*,<sup>7</sup> which is a living document that the organization seeks to improve continuously. On an annual basis, NCTCOG leads a stakeholder task force in a review of the ITS plan. As part of this process, the task force uses performance measurement data to

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<sup>5</sup> Regional Transportation Operations Plan, 2012-2016, available at:

<http://www.sewrpc.org/SEWRPCFiles/Publications/mr/mr-202-reg-transportation-operations-plan-for-se-wisc.pdf>

<sup>6</sup> 2015 ROP for Southwestern PA, available at: [http://www.spcregion.org/pdf/ROP\\_Final\\_July15.pdf](http://www.spcregion.org/pdf/ROP_Final_July15.pdf)

<sup>7</sup> NCTCOG ITS Strategic Deployment Plan (May 2016), available at:

<http://www.nctcog.org/trans/its/RegITSArch/documents/ITSSDPFINALReportwithAppendix.pdf>

make decisions about whether to add or remove regional ITS projects and proposed deployments from the plan.

### 2.1.3 Regional Priorities Supported by State-Led Operational Planning Efforts

In some regions, the State Department of Transportation (DOT) plays a lead or integral role in regional operations planning, by facilitating stakeholder groups, providing technical expertise, or contributing additional resources. The extent to which a State DOT is involved can vary – from serving as a key stakeholder in regional operations planning activities to spearheading planning efforts. In some regions, the State DOT has played the lead role in developing a regional SM&O Plan. For instance:

- In the **Atlanta** region, the Georgia DOT (GDOT) plays a leading role in operations planning. In 2014, GDOT conducted the Metro Atlanta Operational Planning Study (OPS) to evaluate potential operational improvements to metro Atlanta’s existing transportation system along limited access facilities. The OPS plan identified priorities and ranked projects resulting in a set of recommended projects.<sup>8</sup> GDOT also spearheaded a Regional Managed Lanes Implementation Plan to develop a prioritized list of projects for implementation.<sup>9</sup>

## 2.2 Establishing a Regional Coordinating Group or Committee(s)

In many regions, the MPO serves as the primary convener for committees that meet periodically to focus on specific issues. These committees often play an important role in coordinating regional operations activities and projects. Several areas follow a similar model to the MAG ITS Committee structure. For instance:

- The **Atlanta Regional Commission (ARC)** has formed multiple committees to inform operations planning efforts. TSM&O plays a critical role in metropolitan planning in the Atlanta Region. For the LRP, *PLAN 2040*, ARC convened a Long-Range Operations Committee, comprised of department heads from local planning and public works departments. The LRP allocated \$3.5 billion to address non-recurring congestion by enhancing system operations related to incidents, severe weather, and traffic signal timing. Though not necessarily formed with the intention of being temporary working groups, several committees have turned out to be ad hoc in nature: A Regional Traffic Operations Task Force helped to develop a regional signal retiming program; a Regional Operations Subcommittee served as a technical resource for the development of a regional evacuation plan; and a LRP Operations Committee provided input for the LRP.
- **MetroPlan Orlando** is made up of six advisory committees that support the MPO’s Board in making transportation planning decisions. The TSMO Advisory Committee – consisting of federal, state, regional, and local agency planners and engineers – is focused on safety and technology enhancements along the region’s existing transportation system. Previously titled the “MetroPlan Orlando Management and Operations Subcommittee”, it was elevated to the status of advisory committee and regularly meets throughout the year. The committee is specifically focused on identifying and recommending low-cost improvements to the network

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<sup>8</sup> <http://www.dot.ga.gov/BS/Studies/OPS>

<sup>9</sup> <http://www.dot.ga.gov/BS/Studies/MLIP>

geared towards congestion reduction and air quality improvement. For example, MetroPlan Orlando's annual traffic signal retiming project has been proven to reduce congestion and improve air quality. Committee members are responsible for advising on TSM&O-related updates to the CMP Report, the LRTP, and coordinate TSM&O within the regional ITS Architecture. The group also reviews, revises, and ranks TSM&O Prioritized Projects in the TIP. TSM&O-based projects fall under incident management, TDM, and other similar topics.

- **DVRPC** utilizes Task Forces extensively to support SM&O activities. Its Transportation Operations Task Force (TOTF) consists of numerous regional stakeholders who meet quarterly to discuss a breadth of regional transportation operations activities. These discussions are used to drive DVRPC's transportation operations planning activities. While participants may vary from meeting-to-meeting based on the subject matter, all the major agencies are invited to participate, including but not limited to: state and local DOTs; turnpike, bridge, and port authorities; transit agencies; homeland security; state and local law enforcement agencies; and major city transportation agencies. Topics may include ITS deployments, incident management programs, and federal initiatives. In addition, DVRPC has a TIM Program, which includes the management of eight inter-agency incident management task forces (IMTFs, discussed further in section 4 below).
- **NCTCOG's** Regional ITS Steering Committee is comprised of members from Texas Department of Transportation (TxDOT), transit agencies, the tollway authority, airports, local jurisdictions, research agencies, and the MPO. It meets twice a year (May and November) to guide the development and implementation of ITS infrastructure and services across the region. Topics may include: integration of supporting communication systems, data exchange standards, and updates to the Regional ITS Architecture. The Committee is the first step in the MPO's process for approval. Once a project has gone through the Steering Committee, it is subsequently sent to the Surface Transportation Technical Committee (STTC) or the Regional Transportation Council (RTC) for approval. The STTC - which meets monthly - reviews, comments on, and prepares recommendations regarding surface transportation planning and funding in the region. Similarly, the RTC meets monthly to determine funding, select projects, and guide program development.
- Monthly, there is a **TransPort** meeting that gathers local agency representatives to carry out the TSM&O program in the Portland, Oregon region. TransPort participants include traffic engineers, operators, emergency managers and others involved in transportation management. TransPort develops evaluation criteria and performs an analysis of projects that are submitted by local agencies for TIP or TSM&O Program funding. With oversight by Metro Oregon, TransPort provides prioritized project recommendations to the Joint Advisory Meeting.
- In Southwest Washington State, **Vancouver Area Smart Trek (VAST)** is a coalition of state, regional, and local agencies that focus on collaboration in implementing ITS and operations solutions. VAST is managed by the Regional Transportation Commission and involves regional collaboration on TSM&O and ITS in the region.

### 2.3 Dedicated Funding for Operations

A wide array of funding sources are used by regions to support regional SM&O activities, including funds from the CMAQ Program, the Surface Transportation Program (STP) --- now the Surface Transportation Block Grant Program, the Highway Safety Improvement Program (HSIP), and the National Highway Performance Program (NHPP), as well as state and local funds.<sup>10</sup>

In many urban regions, CMAQ is a primary source of funding for TSM&O projects and programs. CMAQ funds have been used for strategies that meet both air quality and congestion relief objectives, such as traffic signal coordination and TDM programs. Typically, SM&O projects compete for CMAQ funding with other types of CMAQ-eligible activities, such as transit improvements. However, even in regions without CMAQ, other Federal funding programs are being used to support TSM&O activities. For instance:

- The **Puget Sound Regional Council (PSRC)** in the Seattle region uses a variety of funding sources for operations projects, including STP, CMAQ, and HSIP. HSIP funds are used for TSM&O projects that meet both safety and operations goals, and are often used for signal improvements. Project sponsors for ITS projects have found it somewhat difficult to compete for CMAQ funding against transit projects, but have found more success applying for STP funds given different project scoring criteria that are used by PSRC for those funding programs. Large-scale operations projects, such as HOV or high occupancy toll (HOT) lanes, often are funded through a combination of STP, CMAQ, Transportation Investment Generating Economic Recovery (TIGER), and/or state funds.
- **ARC** uses funds from the CMAQ Program and the STP (Urban) to fund TSM&O activities.

Some regions also have regional or local transportation funds raised through taxes. For instance:

- **NCTCOG** projects are supported by the Regional Toll Revenue (RTR) Program created through an inter-local agreement with NCTCOG, TxDOT, and the North Texas Tollway Authority (NTTA). Money is collected from private-sector partners through concessionaire contracts, debt repayment, toll collection, and interest on the RTR pool.

Several MPOs set aside dedicated funding for operations projects, which helps to ensure a consistent stream of projects are implemented. For instance:

- In the Orlando region, **MetroPlan Orlando** has dedicated \$4 million per year from STP funds to M&O/non-capacity projects. In the TIP, M&O is a separate section. Prior to 2008, MetroPlan has about \$2 million for safely, intersection improvements, TMCs, fiber optics, and traffic signals. Then about 2008, the MPO added another \$2 million.
- The **San Diego Association of Governments (SANDAG)** benefits from TransNet, a half-cent countywide sales tax for local transportation projects (similar to the Proposition 400 tax). Of the TransNet funds, 70 percent of revenues are dedicated for congestion reduction, including operations projects. TransNet has funded the traveler information network, the construction of HOV or managed lanes, and traffic signal optimization, along with other operational solutions.

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<sup>10</sup> FHWA, Programming for Operations

### 3 PERFORMANCE MEASURES AND DATA

A key consideration in performance measuring and reporting is required reporting. Under MAP-21, the FHWA established a set of performance measures for state DOTs and MPOs to use. Agencies are required to report on these measures to assess the performance of the Interstate and non-Interstate National Highway System. Performance measures are identified for three categories: Safety, Infrastructure and System Performance. For MPOs, the Safety Performance measures are applicable to all public roads and include:

- Number of fatalities
- Rate of fatalities
- Number of serious injuries
- Rate of serious injuries
- Number of non-motorized fatalities and non-motorized serious injuries

The System Performance measures, which have specific applicability, are shown in Table 1 below.

**Table 1 – MAP-21 Proposed System Performance Measures**

<b>System Performance Measure</b>	<b>Measure Applicability</b>
Percent of the Interstate System providing for reliable travel	The Interstate System
Percent of the non-Interstate NHS providing for reliable travel	The non-Interstate NHS
Percent of the Interstate System where peak hour travel times meet expectations	The Interstate System in urbanized areas with a population over 1 million.
Percent of the non-Interstate NHS where peak hour travel times meet expectations	The non-Interstate NHS in urbanized areas with a population over 1 million.
Percent of the Interstate System mileage providing for reliable truck travel time	The Interstate System.
Percent of the Interstate System mileage uncongested	The Interstate System.
Annual hours of excessive delay per capita	Projects financed with CMAQ funds in all nonattainment and maintenance areas for one or more of the criteria pollutants under the CMAQ program.
Total tons of emissions reduced from CMAQ projects for applicable criteria pollutants and precursors	Projects financed with CMAQ funds in all nonattainment and maintenance areas for one or more of the criteria pollutants under the CMAQ program.

**MAG best practice considerations:**

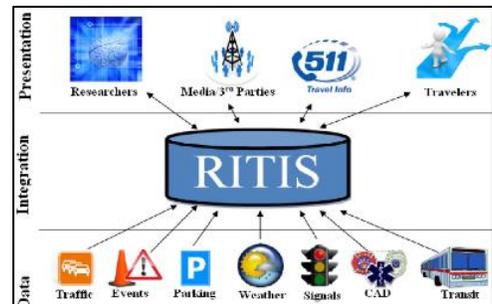
*Establish performance management program that reflects key metrics for the region, and report performance externally (to partner agencies and to the public).*

*Identify strategies for making relevant performance data available to agencies for their use in refining operational strategies.*

*Publish before-and-after results for operational projects, starting with the MAG TSOP which requires before-and-after data analyses.*

**3.1 Collaboration in Collecting and Analyzing Data**

- **MetroPlan Orlando** utilizes standardized data to assess regional operations and translates findings into annual reporting to aid policy makers in pushing legislation that supports regional needs.
- Several agencies that are part of the **I-95 Corridor Coalition** (and an increasing number of states outside of the coalition) are active users of private sector speed data through the Vehicle Probe Project (VPP) data mart. The University of Maryland has developed a tool to help support the I-95 partner agencies by consolidating private sector speed data, as well as data that the agencies specify they want included in the database. The Regional Integrated Transportation Information System (RITIS) automates information sharing and archiving, as well as several analytics functions to support subscriber agencies. Figure 1 shows the RITIS Data Flow Diagram. RITIS helps to support performance measures for congestion/delay, travel times, incident response timelines, and corridor operations analytics, among others. It can also assemble trend information, correlate cost data and support various methods for displaying data (such as map or dashboard). RITIS is used by several DOTs, and is gaining traction with MPOs. MetroPlan Orlando has an agreement with the University of Maryland for central Florida data from RITIS.



**Figure 1 – RITIS Data Flow Diagram**

- The **NCTCOG** in Dallas has an asset management system that consolidates information about system and infrastructure performance to support system analysis and prioritization. The Capital/Operational Asset Management (Cap-Main) is a robust data management system that helps to identify deficiencies, such as pavement/infrastructure deterioration, safety, performance data to help identify early action opportunities and longer term alternates to adding capacity.

**3.2 Using Performance Measures beyond Traditional Congestion Measures**

- **DRCOG** prepared an RCTO, which identifies objectives and performance measures beyond traditional traffic congestion measures. It describes a collaborative plan to improve regional operations performance across the region over a five-year period. A core element of the RCTO

that establishes a unified direction is the identification of three interrelated strategic goals, including associated operations objectives and performance measures, shown in Figure 2.

Objectives	Initiatives	Performance Measures
<b>Goal 1: Provide reliable transportation operations for regional travelers</b>		
<i>Daily Operations</i>	<i>Daily Operations</i>	
<ul style="list-style-type: none"> <li>Increase trip travel time reliability on freeways and arterials for all modes</li> <li>Reduce traveler stops and delay due to signal operations</li> </ul>	<ul style="list-style-type: none"> <li>Continue to coordinate signal timing system management across jurisdictional boundaries</li> <li>Continue to coordinate freeway management</li> <li>Expand freeway management</li> </ul>	<ul style="list-style-type: none"> <li>Travel Time Index (TTI)</li> <li>Planning Time Index (PTI)</li> <li>Transit on-time reliability</li> <li>Arterial Progression Index (API)</li> </ul>
<i>Incident Management</i>	<i>Incident Management</i>	
<ul style="list-style-type: none"> <li>Reduce average incident duration time</li> <li>Reduce the occurrence of secondary incidents</li> </ul>	<ul style="list-style-type: none"> <li>Establish Regional Incident Management Process</li> </ul>	<ul style="list-style-type: none"> <li>Average roadway clearance time</li> <li>Average incident clearance time</li> </ul>
	<i>Work Zones and Special Conditions</i>	
	<ul style="list-style-type: none"> <li>Improve work zone/special event management</li> </ul>	<ul style="list-style-type: none"> <li>Number of secondary incidents</li> </ul>
	<i>Cross-cutting</i>	
	<ul style="list-style-type: none"> <li>Coordinate/integrate multi-modal traveler information</li> <li>Expand traffic monitoring capabilities and infrastructure</li> <li>Establish shared monitoring between jurisdictions</li> <li>Expand a shared communications network</li> <li>Establish a shared data warehouse or data management process</li> </ul>	
<b>Goal 2: Provide safe transportation operations for regional travelers and for public safety and construction/maintenance personnel</b>		
<ul style="list-style-type: none"> <li>Reduce traffic injury rates</li> <li>Reduce traffic fatality rates</li> <li>Reduce public safety and construction/maintenance personnel injury/fatalities</li> </ul>	<ul style="list-style-type: none"> <li>Establish Regional Incident Management Process</li> </ul>	<ul style="list-style-type: none"> <li>Traffic fatality rates</li> <li>Traffic injury rates</li> <li>Number of personnel injuries/fatalities</li> </ul>
<b>Goal 3: Provide transportation operations support for non-auto modes of travel</b>		
<ul style="list-style-type: none"> <li>Reduce SOV mode share</li> <li>Reduce per capita VMT</li> <li>Reduce per capita greenhouse gas emissions</li> </ul>	<ul style="list-style-type: none"> <li>Further coordinate/integrate multi-modal traveler information</li> <li>Define criteria for operations improvements and monitoring for bicycle and pedestrians</li> </ul>	<ul style="list-style-type: none"> <li>Single occupancy vehicles (SOV) mode share</li> <li>Annual per capita VMT</li> <li>Annual per capita greenhouse gas emissions</li> </ul>

**Figure 2 – DRCOG Performance Objectives and Measures**

- SANDAG** in the San Diego region recently transitioned to using vehicle miles traveled (VMT) as a metric rather than level of service (LOS) which is traditionally used to reflect travel delay. Moving to a VMT metric aligns more closely with California’s goal of reducing the carbon footprint the transportation network creates and California has set strict standards for reduction in VMT expected in the San Diego region in the next few years. Activities to support the measurement, reporting, and reducing of VMT are all being developed currently for SANDAG as the change impacts many policy and agency institutional processes.
- SPC** established performance measures to track regional system performance based on the operational objectives put forth in the ROP. SPC focuses on outcome-based measures that evaluate the success of implemented strategies in direct relation to the operational objective. If there is not data available to calculate outcome based measures, an activity-based measure is utilized, which does not measure the direct impact on the operational objective, but instead looks at how successful agencies were at implementing strategies. Figure 3 provides an example of SPCs performance measures based on operational objectives.

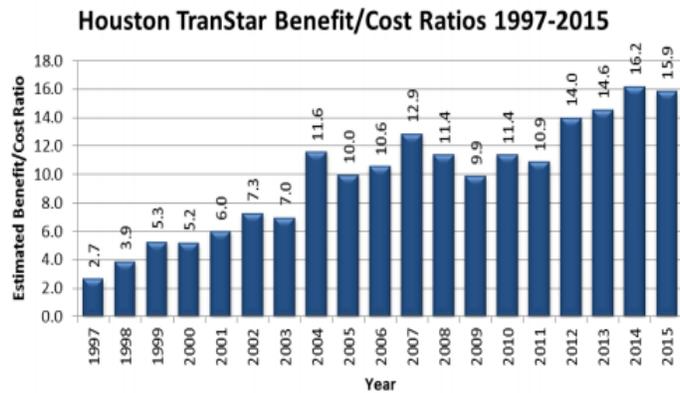
Operational Objective	Performance Measures	Regional Level	Corridor Level	Outcome-Based	Activity-Based
Reduce delays through known bottlenecks	▪ Travel Time		X	X	
	▪ Total Delay (vehicle-hours)		X	X	
Improve the operational efficiency and safety of traffic signals	▪ # of traffic signals upgraded, retimed, replaced and/or removed (if unwarranted) within last 3 years	X			X
	▪ % of traffic signals running in a coordinated, closed-loop or adaptive system	X			X
	▪ % of traffic signals equipped with battery back-up	X			X
	▪ Annual # of crashes at signalized intersections	X		X	
	▪ Travel Time		X	X	
	▪ Fuel consumption		X	X	
	▪ Pollutant emissions		X	X	
	▪ Vehicle stops		X	X	

Figure 3 – SPC Performance Measure Example

### 3.3 Consistent Tracking and Reporting on Performance

- **SEWRPC's** CMP document (also from 2012) provides detailed discussion of congestion on the arterial street network and highways; identifies multimodal, TDM, and TSM&O strategies. (<http://www.sewrpc.org/SEWRPCFiles/Publications/mr/mr-203-congestion-management-process-in-se-wisc.pdf>)
- **Southwest Washington RTC** - As part of the operations program, RTC and VAST agencies have partnered with Portland State University (PSU) and Portland area transportation agencies to maintain and improve the Portal Data Archive hosted by the ITS Lab at PSU. It contains historical and real-time transportation data from agencies in the Vancouver Portland region in a single location. This transportation information warehouse can be used by researchers, planners, traffic engineers, and the public to look at transportation performance.
- The Houston-Galveston Area Council (H-GAC) consolidates information across a variety of categories to assemble an annual report that reflects freeway, arterial, safety, transit operations and incident response metrics. **Both H-GAC and TranStar** produce annual performance reports on a range of metrics, tracking both performance and trends. H-GAC prepares an Annual Mobility Report that compares performance to the previous year, identifies the top 20 project in the region across multiple modes.
- Houston TranStar Annual Report (2015). TranStar is the Houston area transportation and emergency operations center. This facility collocates TxDOT freeway operations, the Harris

County Sheriff and Traffic Management, City of Houston Traffic Operations, and serves as the Emergency Operations Center. TranStar aggregates annual data from its partners to assemble a performance report that captures traffic incident management/response metrics, motorist aid patrol service metrics, and benefit cost information for the overall program. An example of a benefit/cost graph as shown in the annual performance report is provided in Figure 4.



**Figure 4 – TranStar Program Benefit/Cost**

- In 2015, **SPC** executed a Memorandum of Understanding with Carnegie Mellon University's Mobility Analytics Center to ensure the communication, collaboration, and coordination of data necessary to implement transportation research and development projects.

### **3.4 Measuring the Performance of Implemented Strategies**

The implementation of TSM&O activities can be challenging to measure, although many areas are accomplishing this through before and after studies of their signal optimization programs. Publishing the information provides visible justification for investing in that activity. The following are some areas that are successfully measuring the performance of their signal timing strategies:

- **MetroPlan Orlando** conducts a before and after study after each retiming to report on the progress. Then a benefit/cost analysis is completed to show the impact of the program on travel times and air quality. The ability to show the quantitative impact of the program has helped TSM&O programming and support within the organization.
- **SPC in Pittsburgh** publishes signal timing before and after data evaluations on their website. There are also before and after videos that show what traveling the corridor looks like after signal coordination improvements.
- **Oregon DOT** evaluates project-specific data where their project may improve reliability or safety. ITS field equipment is utilized for data capture and translated into performance metrics which Metro then published as part of the regional reporting process.

## 4 STRATEGIES, PRIORITIES, AND TOOLS TO SUPPORT SM&O

Initiatives and strategies are being advanced in areas around the country that requires strategic planning, multi-jurisdictional coordination, and in many cases, multi-modal coordination. Decision support and analytic tools are being used to support SM&O activities.

### ***MAG best practice considerations:***

*Expand visibility of TIM strategies in the RTP.*

*Identify regional TIM needs, such as additional collocation of transportation and public safety/law enforcement that would help advance TIM coordination.*

*Advance the use of Decision Support Systems (DSS) to help balance network capacity and improve operational strategy implementation. ICM provides an opportunity to do this.*

### **4.1 Coordination in Traffic Incident Management**

- **DVRPC's** TIM Program includes the management of eight inter-agency IMTFs across the region. DVRPC provides all administrative and logistical support to the task forces which meet on a quarterly basis to discuss safety issues and traffic management along with inter-agency coordination. Task force members volunteer their time and space, along with their training resources. Funding for the IMTFs includes DVRPC's preparation and conduct of the task forces. Table 2 below highlights strategies, which include projects, policies, programs, and activities designed to reduce traffic congestion through improved incident management and associated objectives.

**Table 2 – DVRPC Objectives and Strategies**

Goal	Reduce Traffic Congestion Through Improved Incident Management			
Objectives	Improve Incident Detection and Verification	Improve Response Times	Improve Interagency Coordination and Cooperation	Improve Incident Clearance
Strategies	<p>Implement and/or upgrade traffic operations centers</p> <p>Construct traffic surveillance systems, fill in missing gaps</p> <p>Share 9-1-1 and state police Computer Aided Dispatch (CAD) information with traffic operations centers</p>	<p>Install reference location signs</p> <p>Construct RIMIS data interfaces with TOC field-to-center software to collect traffic speeds</p> <p>Share traffic surveillance information with emergency responders</p> <p>Incorporate real-time traffic information into CAD systems and emergency vehicle mobile data terminals</p>	<p>Operate and maintain RIMIS</p> <p>Establish and maintain incident management task forces</p> <p>Create incident management response teams (IMRT)</p> <p>Conduct training programs, post-incident reviews</p> <p>Develop regional evacuation plan, and disaster response and recovery plan</p> <p>TOC/County 9-1-1 centers act as a communication hub for emergency/traffic text alerts</p>	<p>Deploy emergency service patrols</p> <p>Pass quick clearance legislation</p> <p>Develop and promote “Move It” policies, erect “Move It” signs</p> <p>Identify and sign pre-arranged detour routes</p> <p>Develop policy and procedures to modify signal timings on detour routes, upgrade traffic controllers/F2C communication systems</p> <p>Pre-deploy traffic control equipment</p> <p>Install ramp gates and barrier gates</p> <p>Develop tow truck incentive program</p>

- **BRTB** has a TIM for the Baltimore Region (TIMBR) Committee, that includes regional representatives of transportation and other emergency response agencies. The focus of TIMBR is enhancing communication, cooperation, and coordination between agencies, jurisdictions, and modes at traffic incidents. Meetings are held bimonthly, or as needed, at various locations throughout the region.

**4.2 Coordination in Incident Response Operations**

- The **Greater Houston Transportation and Emergency Management Center** provides a successful example in leveraging resource from multiple agencies to provide transportation and emergency

services in a large region. Established in 1993, Houston TranStar is a unique partnership of representatives from the City of Houston, Harris County, METRO and TxDOT who share resources and exchange information under one roof to keep motorists informed, roadways clear and lives safe in the fourth most populated city in the United States. Due to the longevity of this partnership, ongoing and consistent performance metrics are reported on which continues to show value and justification for TranStar's effectiveness in being collocated.

- **California Department of Transportation** has established a long term and successful partnership with the California Highway Patrol (CHP) is that all Caltrans District TOCs are collocated with CHP Dispatch centers in one facility. The coordination between the two entities involves linking relevant systems for data sharing, collaboration during incident response and recovery, and ongoing resource support for all functions in the facility (including in some instances dual responsibilities across CHP and Caltrans functions). Although California is segmented on a district-by-district basis and there may be disparate systems across the state, strong collaboration within one region provides a firm foundation from which to manage a regional network.

### **4.3 Traffic Signal Coordination**

- **MetroPlan Orlando's** Traffic Signal Timing Program continues to be successful in mitigating traffic congestion and improving air quality and has helped evolve TSM&O program planning in the region. MetroPlan is given \$800,000 annually for the signal program to provide coordination between the multiple agencies operating signals in the region. The program requires before-and-after data collection and analysis including LOS, travel speeds and travel times. The program results in Travel Time Delay Studies and Benefit/Costs Analyses that provide evaluation of the program.
- In San Diego, disparate signal systems were not achieving any regional cooperation along important corridors in the region, so **SANDAG** instituted and funded a project to implement one signal system for the entire region. Local agencies all manage their own versions of the signal system, however there is one contract through SANDAG that supports the ongoing required updates of those systems out of the regional ITS funding pool.
- The Freeway and Arterial System of Transportation TMC (**FAST TMC**) in Las Vegas, Nevada operates a fully integrated arterial management system for the Las Vegas region. Each City owns and maintains their own traffic signals, but communication throughout the region connects traffic signals to the FAST TMC for operational control. The FAST TMC also manages the freeway ITS network. Therefore, one entity operates the entire region's ITS system.

Providing quantitative impact of program has helped push enhancements in TSM&O programming.

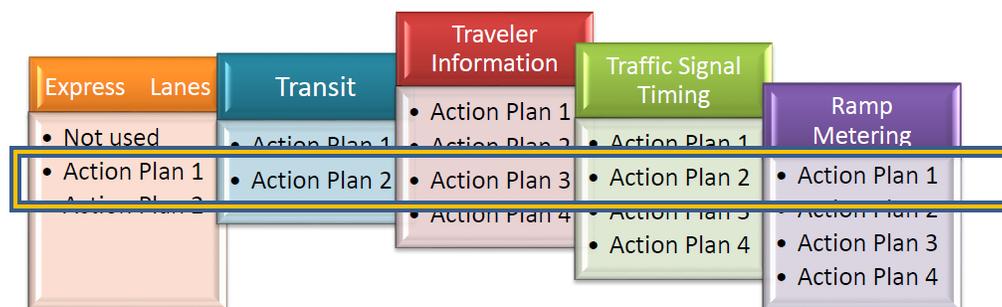
- **BRTB** has a Traffic Signal Subcommittee, which consists of traffic signal engineers/managers from the five regional jurisdictions; State Highway Administration and Federal Highway Administration. The committee also includes representatives from the Metropolitan Washington Council of Governments, Maryland Transit Administration and consultants. Its purpose is to identify and understand projects to improve traffic signal coordination.
- **The NCTCOG's** Thoroughfare Assessment Program (TAP) aims to maximize the effectiveness of arterial traffic signal systems and traffic flow through operational improvements in regional

thoroughfare corridors. The Regional Traffic Signal Retiming Program (RTSRP) implements new signal timing and operational improvements along selected corridors. The latest phase of the program began in April 2014, and a total of 1,315 signalized intersections in the Dallas-Fort Worth Metropolitan Area are expected to be retimed. Selected corridors will be implemented under this phase of the project by December 2017.

- **SPC’s** Regional Traffic Signal Program has been very successful in reducing vehicle delay and congestion and improving travel times along the region’s road network. Since its establishment in 2008, 251 intersections across 23 corridors (1st cycle) have been upgraded with the 2nd cycle of projects scheduled to be completed in 2015. SPC’s Regional Traffic Signal Timing Program, operating since 2008, has resulted in a 64:1 benefit/cost ratio in terms of reduced travel delay, reduced vehicular stops, and reduced fuel consumption and emissions. The program has been conducted phases:
  - Program conducted in phases
  - Phase 1 and 2 complete, Phase 3 on-going
  - Phase 4 and 5 included in TIP
  - \$5 million per cycle allocated to project (80/20 match)
  - 250 signals per cycle (~10% of region’s infrastructure)
  - Includes equipment, assessments, final design, construction, and implementation
  - Signals maintained/operated by municipalities, permitted by PennDOT

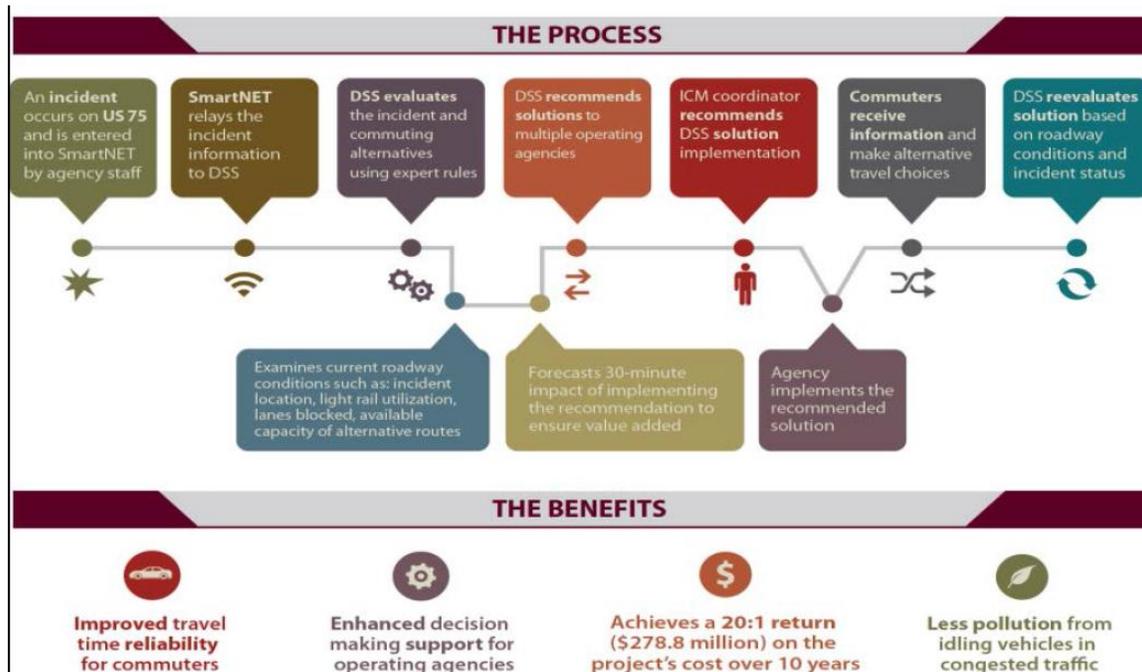
#### 4.4 *Integrated Corridor Management, Active Traffic Management, and Decision Support and Analytical Tools*

- The San Diego ICM project team is led by **SANDAG** and includes partnerships with the USDOT, Caltrans, Metropolitan Transit System (MTS), North County Transit District (NCTD), and the cities of Escondido, Poway, and San Diego. The ICM system allows individual transportation systems to be operated and managed as a unified corridor network. The I-15 ICM project applies predictive algorithms and real-time modeling tools to forecast traffic across multiple networks and recommend response plans to manage anticipated congestion, as shown in Figure 5. For example, the ICM system coordinates the use of freeway ramp meters and arterial traffic signals to improve day-to-day conditions or to route traffic around major incidents.



**Figure 5 – SANDAG Decision Support System Strategy Combination Example**

- ICM was administered by **Dallas Area Rapid Transit (DART)** on US-75 along the Dallas-Plano-Richardson corridor. The multi-modal project focused on traffic congestion and re-timing plans during major incidents and includes pre-planned traffic diversions and alternate timing plans. The daily operation of the corridor is coordinated and information is exchanged through a TXDOT Center-to-Center project along with an information exchange system known as SmartNET, which distributes event information and response plan recommendations for incidents that have occurred within the US-75 Corridor. A comprehensive effort to develop the response plans has been led by the ICM Operations, Decision Support and Arterial Monitoring Systems Committees. After consideration by the group, it was determined that varying event types and locations would require different response scenarios depending on location and transportation impact, as shown in the decision support system process in Figure 6.



**Figure 6 – Dallas Decision Support System Process**

As a result of the project, the Dallas and Fort Worth Region 511 Traveler Information System (511 DFW) was developed. The system is managed by NCTCOG and its operations are co-funded by DART, TxDOT, and NCTCOG.

## 5 INVESTMENT PRIORITIZATION AND DECISION MAKING

The process for selecting projects is unique to each metropolitan area. Examples of innovative ways to approach the decision-making process, prioritization of TSM&O activities, and approval procedures are highlighted in this section.

### ***MAG best practice considerations:***

*Establish specific criteria to be able to identify key routes within the region. Designate specific corridors for investment prioritization.*

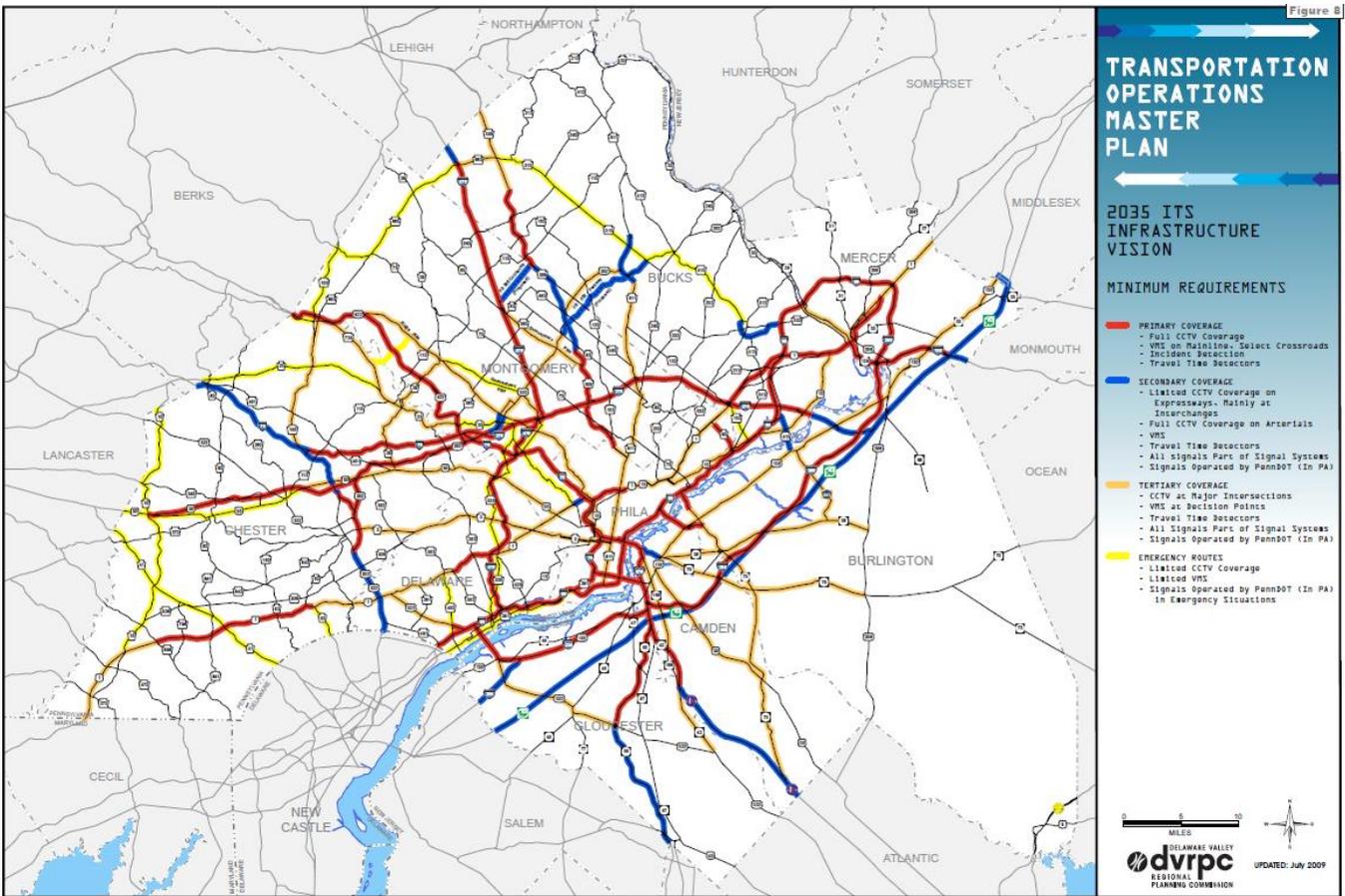
*Identify types of strategies/technologies that can be applied to address specific operational needs and requirements.*

*Establish a process for linking performance to corridor priorities.*

### **5.1 Identification of a Priority Network**

Some MPOs have identified a priority network within the region for ITS deployments and focused operational treatments, based on agreed-upon regional priorities for criticality of the network and its performance.

- In its Transportation Operations Master Plan, the **DVRPC** established a hierarchy for its network establishing different levels of ITS infrastructure deployment for various ITS elements including closed circuit television (CCTV) cameras, variable message signs (VMS), incident detection, travel time detectors, and traffic signals based on the location and function of the road, as shown in Figure 7. Specifically:
  - Primary coverage areas focus on high volume, multi-lane limited access highways, and include many expressways in the region. This network should include full CCTV camera coverage, VMS on mainline and select crossroads, incident detection, and travel time detectors.
  - Secondary coverage areas include expressways at the periphery of the region where traffic volumes and number of incidents do not justify the same level of ITS coverage as expressways in the region's core, as well as arterials that are almost an extension of adjacent expressways and/or arterials with controlled access. On these expressways, CCTV coverage should be limited to interchange areas, high accident locations, while full CCTV camera coverage is recommended on arterials.
  - Tertiary coverage areas represent key arterials in the region, in which a moderate investment in ITS infrastructure is required to ensure they operate properly.
  - Emergency routes are a final category. While recognizing their importance, minimal ITS infrastructure is needed to support these highways, generally limited to major intersections and decision points.



**Figure 7 – DVRPC Infrastructure Planning Map**

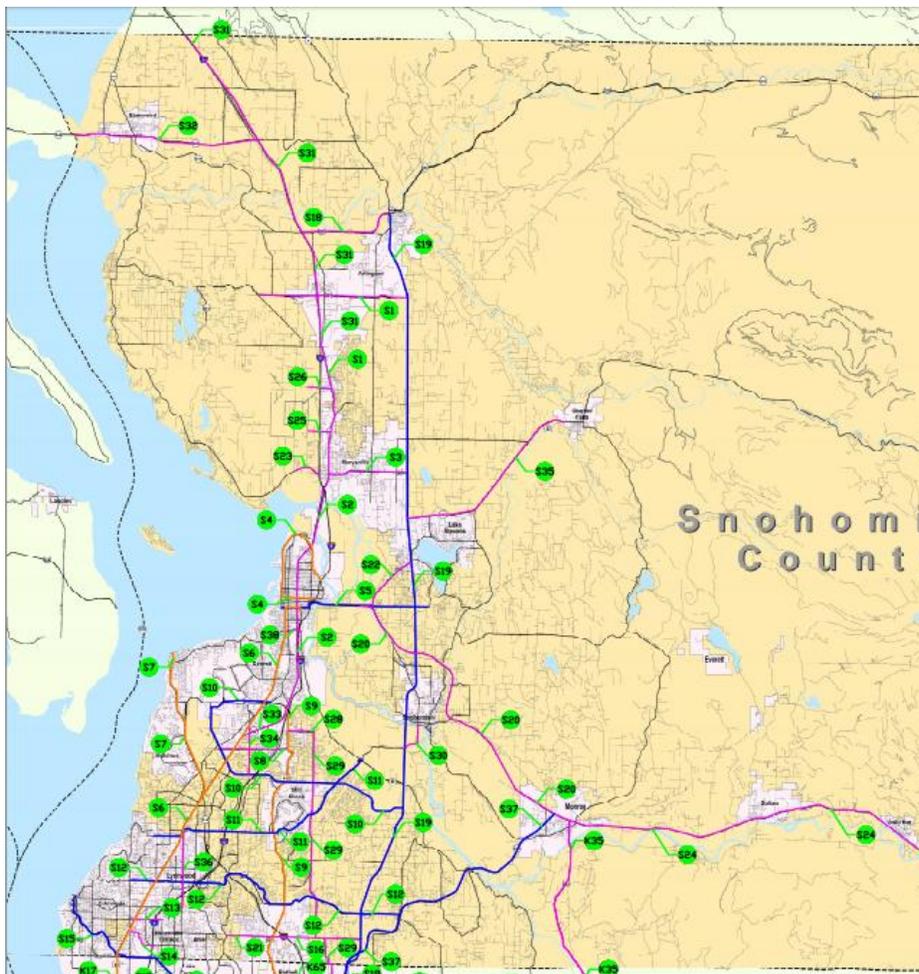
- In the Seattle Region, the **PSRC** developed its Regional ITS Implementation Plan with a focus on 25 key arterial corridors that were identified out of hundreds in the region. The corridors were identified based on an initial list of over 130 principal arterials, with input from freight, transit, and emergency management stakeholders, based on key corridor selection criteria including:
  - Roadway characteristics, including VMT and volume over capacity ratio.
  - Regional significance, including classification as a principal arterial or designated as part of the MTS; whether it has multi-jurisdictional operation; and whether the corridor could be used as an alternate route during construction or an unplanned incident; whether there are alternative options available; and whether the corridor provides connectivity to underserved parts of the region.
  - Stakeholder significance to freight (designated as freight routes), transit (routes for existing/planned BRT service and/or transit signal priority), identified by a jurisdiction as an ITS corridor; and other significance as a congested corridor or key to operations.
  - Criteria used for STP/CMAQ project evaluation, including factors such as whether it traverses two or more Designated Urban Centers or fills gaps in other projects

All 130+ regional arterials were assessed against the criteria using a point scoring. Figure 8 shows one of the resulting maps, for Snohomish County, with corridors color coded as follows:

Tier 1, Orange (met most of all criteria; will be developed into ITS Plan projects); Tier 2, Blue (met a significant number of criteria, some to be included in ITS Plan, to be considered for future deployments); Tier 3, Pink (met the least number of criteria, however, if resources become available investments in ITS and signal improvements could offer regional benefits).

The Regional Intelligent Transportation Systems Implementation Plan (RITSIP) was guided by the Puget Sound Regional Traffic Operators Committee (RTOC), and identifies projects on the ITS corridors for implementation, including:

- New multi-jurisdictional coordinated signal timing plans, including special plans to deal with incidents ranging from construction to emergency evacuations.
- Project deployment of supporting signal infrastructure, including new controllers and cabinets.
- Centralized signal system replacements and upgrades as needed for improved centralized operations.



**Figure 8 – Puget Sound Regional Council Priority Corridors**

- The **ARC** developed a Strategic Regional Thoroughfare Plan (SRTP), which identifies a Regional Thoroughfare Network (RTN), which is a collection of the most critical surface roads in the region. The Thoroughfares were identified based on criteria including:

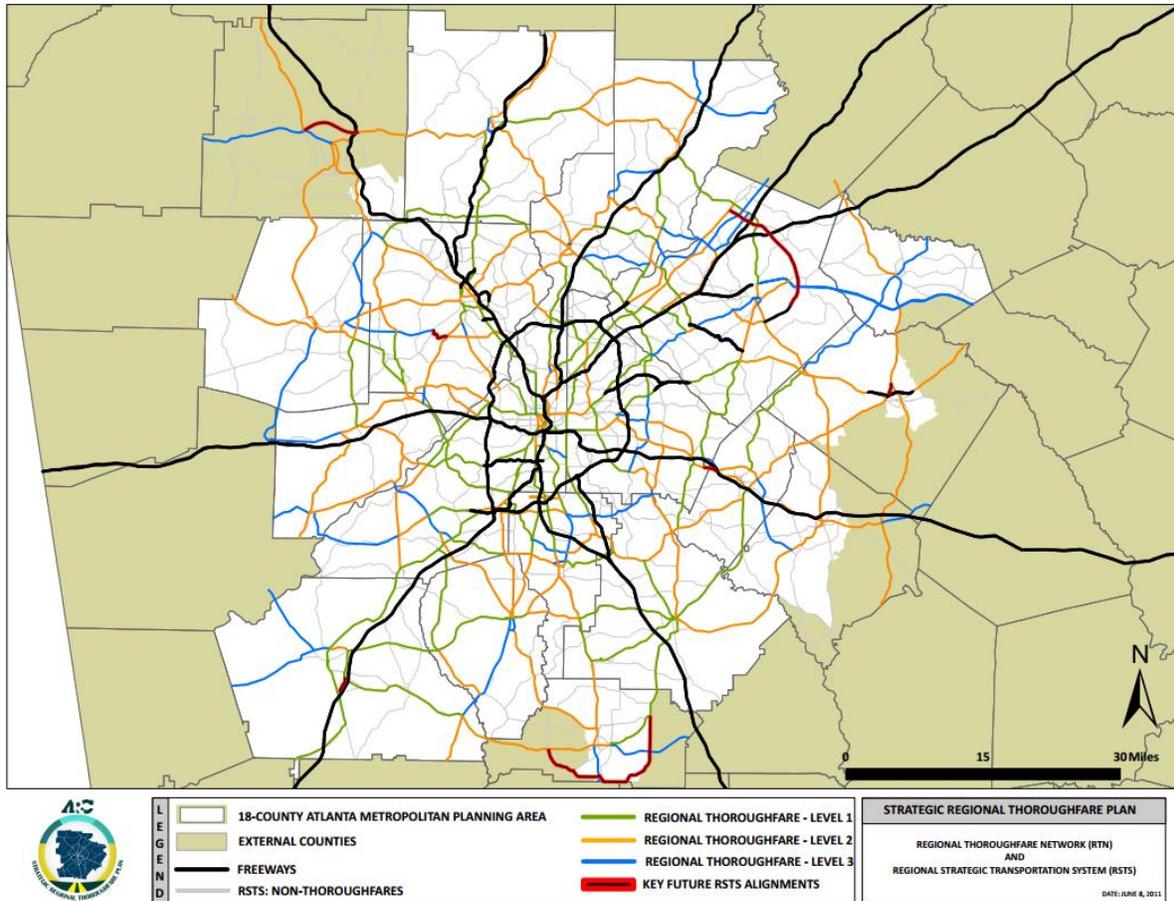
- Connectivity to major employment and residential areas
- Ability to accommodate the most people or users
- Significance to the State of Georgia in addition to Metro-Atlanta
- Capability of supporting emergency evacuation and response
- Existing or planned future accommodations for transit and truck travel
- Identification of roads that are parallel to freeways to improve system redundancy by serving as primary alternative routes

Based on the quantitative analysis using the Metro Atlanta 20-county travel demand model, an initial RTN was identified. Then, meetings were held with representatives from each of the member jurisdictions of ARC, with two draft networks presented based on a combination of policy considerations and performance-based criteria. In addition, briefings were held with several civic, community, and business organizations.

To determine the RTN classification for each roadway segment, a protocol was developed using four thoroughfare classification criteria, with three criteria ratings for each:

- Mobility of people and freight (i.e., high, medium, or low percent of work trips and freight trips)
- Land use connectivity (i.e., primary, intermediate, or basic number of regional attractors, regional areas, town centers, and/or industrial/logistical areas within ¼ mile)
- Network connectivity (i.e., freeway-to-freeway, freeway-to-activity center; freeway-to-other limited access or U.S. route)
- Multimodal functionality (i.e., premium transit service, local transit service, or paratransit or no transit on segment)

As a means of testing the reasonableness of the RTN classification process, the Metro Atlanta region's 20-county travel demand model was run to quantify key statistics relevant to the RTN, including frequency of trip lengths for all vehicles and for work trips. Frequencies were tested for urban, suburban, and exurban facilities. To arrive at an overall RTN classification for each facility segment, the individual criteria rankings for the four core classification criteria were "summed" and averaged to develop a composite classification. The composite segment classification reflects a tiered framework with Tier 1 RTN facilities being considered the highest priority and Tiers 2 and 3 representing mid-level and lower-level priorities as shown in Figure 9.



**Figure 9 – Atlanta Tiered Facilities**

## 5.2 Establishing Consistent Criteria for Prioritizing Project Investment Needs

Several MPOs have developed structured processes for prioritizing TSM&O projects for investment, relying on quantitative and/or qualitative assessment processes using standard criteria. This approach provides the benefit of using a more systematic approach to prioritizing project investments.

- **NCTCOG’s** ITS project selection process is based on criteria that has been reviewed, vetted, approved, and successfully utilized on several projects. Specifically, ITS project funding through the TIP requires assessment using an established set of “Non-Competitive Project Selection Criteria for Traffic Signal and ITS Projects.” These criteria include:
  - Connection to the LRP
  - Project location
  - Expected benefit/cost ratio
  - Expected impact on congestion and air quality
  - Extent of communication and data sharing capabilities
  - Multi-modal and multi-jurisdictional elements
  - Performance metrics
  - Whether the project fills existing ITS Infrastructure gaps

- The **Genesee Transportation Council (GTC)**, the MPO for the Rochester, NY metro area, funds TSM&O through a combination of setting aside funding and a competitive process of allowing TSM&O projects to compete for funding with other types of projects. Recognizing their high levels of cost-effectiveness, GTC dedicates funding directly to two priority TSM&O projects: Implementation of the Highway Emergency Local Patrol (HELP) Program and funding for on-going staffing of the RTOC. These two projects receive dedicated funding due to their recognized high cost-effectiveness and value to the region. Other projects compete for funding in each TIP cycle, and GTC has instituted a performance-based approach with criteria that are used to evaluate project proposals. GTC collaborates with New York State DOT (NYSDOT) Region 4 to solicit project proposals for the TIP from counties, municipalities and other eligible entities, including NYSDOT, New York State Thruway Authority (NYSTA), and the Rochester Genesee Regional Transportation Authority (RGRTA).

GTC and NYSDOT Region 4 staff have established a very structured, performance-based process to evaluate project submissions, using specific criteria to score how well a proposed project supports the region’s goals and objectives, as shown in Figure 10. All projects are ranked using a set of common criteria and mode-specific criteria to select the most beneficial projects for funding. A project can score up to 130 points: up to 100 points on the common criteria and up to 30 points on the mode-specific criteria. Common criteria used for evaluating projects tie directly to the goals and performance measures in the LRTP and include: Safety, Mobility, Community and Economic Development, System Continuity and Optimization, Environment, and Fiscal Responsibility. Mode-specific project evaluation criteria are unique to the following types of projects: highway and bridge, public transportation, bicycle and pedestrian, system management and operations, and goods movement. Below is an example of the scoring used for System Management and Operations projects.

<b><i>System Management and Operations</i></b>						
1. Reduce travel times on major roadways	0	2	4	6	8	10
2. Reduce incident clearance times	0	2	4	6	8	10
3. Increase the productivity of regional transportation agencies/ providers (e.g., cost savings, time savings, etc.)	0	1	2	3	4	5
4. Support or advance existing and/or proposed ITS elements	0	1	2	3	4	5

**Figure 10 – Scoring Criteria for Genesee Transportation Commission SM&O Projects**

- **MetroPlan Orlando** uses an M&O subcommittee, which meets monthly. Before updating TIP, the committee prioritizes the projects and ranks and schedules for programming. The group works to rank projects according to how they are coordinated with the ITS System Architecture, and how they can make it operate more efficiently – balance with equity.

## 6 CASE STUDIES

The project team researched 15 metropolitan areas and interviews were conducted with specific regions to gather best practices that may be applicable to the MAG region. The following regions were interviewed:

- Atlanta
- Dallas/Fort Worth
- Orlando
- Greater Philadelphia
- Pittsburgh
- Portland, Oregon
- San Diego
- Seattle
- Houston

Innovative practices from each of these areas is included in this best practice report. Detailed case studies for seven regions are described in detail in the **Appendix**.

## APPENDIX – CASE STUDIES

### GREATER ATLANTA METRO AREA

Atlanta Regional Commission (ARC) is the regional MPO for 13 full counties and 7 partial counties, as well as the City of Atlanta.<sup>11</sup> The MPO board has 39 members, supported by a staff of 20. Additionally, ARC works closely with GDOT on TSM&O initiatives for the Atlanta region.

#### *Institutional Frameworks*

#### TSM&O Planning Evolved from State and Region Efforts

TSM&O planning in the Atlanta region emerged as a result of the work of three (now defunct) ad hoc committees, dating back to 2004:

- **Regional Traffic Operations Task Force** – Spearheaded by GDOT, the task force was formed to develop a regional signal retiming program. It helped with corridor prioritization and the creation of an implementation strategy. Once development was complete, the task force was no longer needed.
- **Regional Operations Subcommittee** – ARC assembled this subcommittee to serve as a technical resource for its Transportation Coordination Committee (the regional policy group comprised of local practitioners). This subcommittee, active for a year, focused its efforts on supporting the development of regional evacuation plan.
- **LRP Operations Committee** – Formed out of a subset of the Transportation Coordination Committee, ARC convened department heads from local planning and public works departments to provide input for the LRP, PLAN 2040. The group identified projects to increase roadway capacity, and provided technical expertise for the prioritization of operations projects for funding. After the long-range planning process ended, the committee ceased.

#### Regional Operations Planning Documents

There is not one singular document that guides TSM&O investments in the Atlanta region. Instead there are a few influential plans developed by ARC and GDOT that guide operational activities in the region.

- **Regional ITS Architecture** – Atlanta was at the forefront of ITS deployment in the U.S., spurred by the 1996 Summer Olympic Games. ARC developed its long-range Atlanta Regional ITS Architecture, working closely with regional stakeholders (including GDOT, the transit agency, and local municipalities). The plan was developed in three phases:



<sup>11</sup> file:///C:/Users/30418/Downloads/Amended-2016-UPWP--8-24-16.pdf (page 5)

- **Phase I** involved stakeholder identification and engagement, an assessment of current ITS inventory, and the development of an interim Regional ITS Strategic Plan.
- **Phase II** included developing the draft Regional ITS Architecture and Concept of Operations, in collaboration with stakeholders.
- **Phase III** include finalizing the Regional ITS Architecture and Regional ITS Strategic Plan, and developing implementation and maintenance plans.
- **Regional Concept of Operations** – As part of its Regional Traffic Operations Program (see 1.4.2), GDOT developed a Concept of Operations for the Atlanta region to establish program objectives around improving traffic signal operations, and identify the roles and responsibilities of the agency and its partners.
- **Metro Atlanta OPS** – GDOT conducted a study to evaluate potential operational low-cost improvements to the existing transportation system – along limited access facilities – that could be quickly implemented to relieve traffic bottlenecks. ARC served on the steering committee for this planning effort.
- **Regional Managed Lanes Implementation Plan** – This plan was also developed by GDOT, in concert with the Metro Atlanta OPS. This plan identified managed-lane projects that are lower-cost and easier to implement to address significant capacity issues. ARC served on the steering committee for this planning effort as well.

Additionally, TSM&O is a critical component of the RTP, in part due to the cost-effectiveness of such projects (as high as 16-to-1 ratio). The LRP, PLAN 2040 allocates \$3.5 billion to address non-recurring congestion by enhancing system operations related to incidents, severe weather, and traffic signal timing issues. Examples of projects included in the plan include: the Regional Traffic Operations Program’s traffic signal synchronization and communication; variable speed limits on freeways; Highway Emergency Response Operators (HERO); the maintenance and repair of advanced traffic management systems technology; and arterial signal system upgrades at major regional destinations.

## *Staffing and Financing*

### **TSM&O Funding Sources: CMAQ & STP**

ARC has discretion over selecting projects for two Federal funding sources for which TSM&O projects are eligible: CMAQ Improvement and STP (sub-allocation for urban areas). ARC uses this funding for three categories of projects that address the following: 1) roadways operations and safety; 2) projects that address last-mile/first-mile transportation; and 3) freight bottlenecks.

## *Performance Measures and Data*

### **Utilizing Megadata**

ARC evaluates performance at three levels: project level; corridor/system/regional level; and the network level. ARC uses megadata (from providers such as INRIX, etc.) to conduct performance measurement.

## ***Strategies, Priorities, and Tools to Support SM&O***

### **Strategic Thoroughfare Plan**

ARC developed an SRTP in response to growing diversification of uses on streets around the region (pedestrian and bicycle travel, emergency access, economic development, etc.), and the need to more effectively manage corridor improvements. The plan identified an RTN, which is a collection of the most critical roads in the region (includes principal arterials and below; GDOT has a plan for interstate and freeways). With this network of priority roads established, ARC's approach to operations is more comprehensive — there is now more emphasis on developing strategies and guidelines for maximizing the effectiveness of the entire system as a whole rather than focusing on individual segments. The plan guides the funding of projects, and was accompanied by a resolution that Federal funding would be prioritized on the RTN. The plan also informs routine system monitoring (for mobility, accessibility, safety, etc.). Around the same time the SRTP was produced, ARC also developed a Truck Route Master Plan as part of its freight planning efforts; the priority truck routes are incorporated into the RTN.

### **Regional Traffic Operations Program**

GDOT led the development of a Regional Traffic Operations Program (RTOP) a multi-jurisdictional signal timing program – ARC was a key partner in this effort. The objective of RTOP is to actively monitor, manage and maintain traffic signals throughout the Atlanta region to reduce stops and delays due to inefficient signal operations. As part of the program, GDOT developed prioritized routes for RTOP implementation. Once the program is executed, all RTOP corridors will be monitored remotely to address signal repair issues more quickly.

## ***Investment Prioritization and Decision-making***

### **Project Selection**

When scoring projects for the TIP, ARC assigns five additional points to projects on RTN and the regional truck route network.

ARC is currently revamping the project selection process for identifying projects for the TIP. The new process will utilize objective, performance-based criteria to select projects for the TIP, and have a specific funding category for roadway TSM&O projects.

To select projects for CMAQ funding, ARC developed a CMAQ emissions calculator tool to evaluate the potential cost-effectiveness and emissions reduction of potential projects. The tool, based in Microsoft Excel, uses a range of data inputs to calculate the emissions savings and congestion benefits of a project over multiple years. To rank projects, ARC considers the emissions and congestion benefits from the Emissions Calculator, a cost/benefit analysis (amount of emissions benefits per federal dollar spent), and the broader impact to the area within a one-quarter mile buffer of the project location. While the CMAQ program is not focused exclusively on TSM&O strategies, many projects selected are TSM&O in nature.

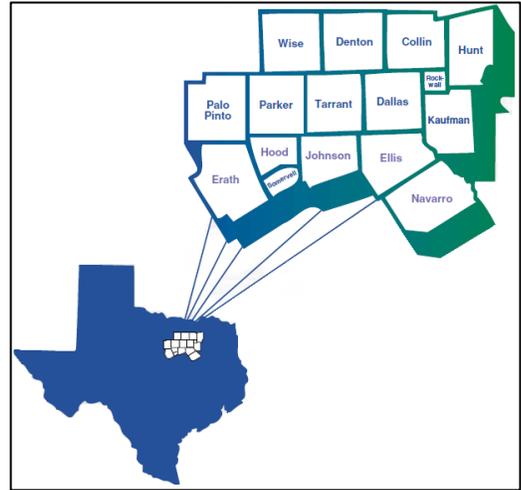
## DALLAS – FORT WORTH METROPOLITAN AREA

The NCTCOG is the regional MPO for the 16-county North Central Texas Region, centered around Dallas and Fort Worth. The region, currently home to seven million residents, is estimated to grow by four million people by 2030. The planning area for this metro area has 16 counties, 168 cities, 22 independent school districts, and 28 special districts.

### *Institutional Frameworks*

#### **North Central Texas Regional ITS Architecture**

NCTCOG’s Regional ITS Architecture (currently the North Central Texas Regional ITS Architecture, previously the Regional ITS Architecture for the North Central Texas Region) was developed using the National ITS Architecture and tailored to best meet the needs of the region. It provides a foundation for planning, designing, and implementing ITS projects and programs across the region. The architecture includes three timeframes: Near-term (within the next three years), medium-term (within the next four to seven years) and long-term (deployed in eight to 12 years). The goal of the document is to enable regional compatibility and operability for ITS integration. It is a living document, updated annually to reflect regional advances in ITS.



#### **Architecture Compliance Statement**

Upon selection, a project is required to complete an architecture compliance statement. This “Statement of National/Regional Architecture Consistency” is reviewed by both TxDOT and NCTCOG before any funding agreements occur. The statement describes how the project is consistent with the standards in the Regional Architecture as well as the Dallas Area-Wide ITS Plan or the Fort Worth Regional ITS Plan.

#### **ITS Strategic Deployment Plan**

The ITS Strategic Deployment Plan (“Plan”) is a companion document for NCTCOG’s Regional ITS Architecture. It supports the Architecture by identifying specific projects and initiatives that stakeholders would like to implement. In turn, the identified projects support the vision for ITS integration and operations in the Architecture. Similar to the architecture, the Plan is updated annually to address the changing needs and priorities of the region.

#### **Data Fiber Sharing Documentation (in progress)**

Recently, NCTCOG completed development of a Regional Network for Data Fiber Sharing document. The guidance, in development for the past decade, was created to unify and standardize criteria for regional data fiber sharing. It includes a Memorandum of Understanding and associated criteria to help share the fiber pipeline. The motivation for this document was the overwhelming nature of fiber optics as the network continues to grow. The document allows for inter-agency agreements for each shared item, helping to document the vast number of different agreements.

## **Regional ITS Steering Committee**

The Regional ITS Steering Committee is comprised of members from TxDOT, transit agencies, the tollway authority, airports, local jurisdictions, research agencies, and the MPO. It meets twice a year (May and November) to guide the development and implementation of ITS infrastructure and services across the region. Topics may include: integration of supporting communication systems, data exchange standards, and updates to the Regional ITS Architecture. The Committee is the first step in the MPO's process for approval. Once a project has gone through the Steering Committee, it is subsequently sent to the STTC or the RTC for approval. The STTC - which meets monthly - reviews, comments on, and prepares recommendations regarding surface transportation planning and funding in the region. Similarly, the RTC meets monthly to determine funding, select projects, and guide program development.

### ***Staffing and Financing***

#### **TSM&O Funding Source: CMAQ**

NCTGOC has seen great success with a Traffic Signal Re-Timing Program funded through CMAQ. The program helps improve both air quality and traffic flow. CMAQ also helps to fund minor non-federal improvement projects such as restriping, field improvements, and installing signage.

### ***Performance Measures and Data***

#### **Developing Performance Metrics**

NCTCOG does not have any solidified performance measures of its own, other than the FHWA speed data that is provided to all MPOs to evaluate speed improvements. NCTGOC, however, recognizes the need for more performance metrics to better evaluate operations and ensure the system is operating at its full potential.

#### **Establishing Partnerships**

NCTCOG will be consulting with partners to establish performance metric criteria that meet stakeholder needs. NCTCOG will also work to expand its partner network to organization such as TxDOT or private sector entities to increase access to performance metrics.

#### **Data Collection**

NCTCOG currently relies on HERE data and TxDOT data. HERE data includes feeds on facilities and TxDOT data generates counts and feeds that help to validate the regional travel model.

### ***Strategies, Priorities, and Tools to Support SM&O***

#### **Multi-Agency Operational Environment**

Traffic signal systems across the region are maintained and operated under different organizational structures. For smaller cities (under 50,000) local agencies operate their own traffic signals (with the exception of state roadways which are operated by TxDOT). For larger cities and for counties, TxDOT is

responsible for operating all signals (on all roadways). Additionally, the toll authority is responsible for operating some signals.

## **Integrated Corridor Management and 511 DFW**

ICM was administered by DART on US-75 along the Dallas-Plano-Richardson corridor. The multi-modal project focused on traffic congestion and re-timing plans during major incidents. It also included pre-planned traffic diversions and alternate timing plans. As a result of the project, 511 DFW was developed. The system is managed by NCTCOG and its operations are co-funded by DART, TxDOT, and NCTCOG. Once enhanced, the success of the system will be marketed for additional private funding sources. The 511 system will also be utilized when looking at planned special events. Such events require additional communications and team work and lessons learned are useful.

## **“Center-to-Center” Traffic Signal System Communication**

The region is currently working on a regional information network (using a three-phase deployment) to share traffic signal system information across traffic management centers (TMCs). The purpose of the system is to create interoperability across jurisdictional signal systems. Under Phase 1 a single vendor will communicate via TMCs across city lines. Under Phase 2, a second vendor will communicate across city lines. By Phase 3 multiple vendors will be communicating across city lines using TMCs.

## ***Investment Prioritization and Decision-making***

### **ITS TSM&O Funding Criteria**

As part of project selection, an agency looking for ITS project funding through the TIP is required to complete the “Non-Competitive Project Selection Criteria for Traffic Signal and ITS Projects”. Projects that receive funding are evaluated based on several non-competitive criteria including (but not limited to): connection to the LRP, project location, expected benefit/cost ratio, expected impact on congestion and air quality, extent of communication and data sharing capabilities, multi-modal and multi-jurisdictional elements, performance metrics, and whether the project fills existing ITS Infrastructure gaps. The identified funding criteria has been reviewed, vetted, approved and successfully utilized on several projects. The criteria are revised as needed.

### **Project Selection**

The Regional ITS Strategic Plan selection criteria helps to prioritize projects in a regional manner. A project does not need to meet all of the criteria in order to progress to TIP. There are certain required criteria that must be met, but also selective criteria where only a certain number of criteria must be met. There may be additional criteria added in some cases to help identify and prioritize projects. This set of flexible criteria allows agencies options in the types of projects they can propose. Agencies are not restricted by local requirements, have flexibility in meeting regional goals, and are not limited by city size or government level.

Once a project request has gone through NCTCOG, NCTCOG meets with the agencies and groups to discuss before sending to TIP. This process helps to eliminate back and forth between groups and to flesh out the details of the projects at an early stage. The TIP team is responsible for knowing whether there is

funding available or if there are alternative funding opportunities as NCTCOG does not always know how much funding they will have or in what form.

## GREATER ORLANDO METRO AREA

The Central Florida Orlando Urban Area is a fast-growing area that includes Orange, Osceola, and Seminole Counties along with 23 municipalities. This area is within the Florida DOT (FDOT) District 5 boundaries. MetroPlan Orlando, the region's MPO, is focused solely on transportation<sup>12</sup>, is governed by a 25-member board and is supported by 17 staff.



### *Institutional Frameworks*

#### **TSMO Advisory Committee**

MetroPlan Orlando is made up of six advisory committees that support the MPO's Board in making transportation planning decisions. The TSMO Advisory Committee – consisting of federal, state, regional, and local agency planners and engineers – is focused on safety and technology enhancements along the region's existing transportation system. Previously titled the "MetroPlan Orlando Management and Operations Subcommittee", it was elevated to the status of advisory committee and regularly meets throughout the year. The committee is specifically focused on identifying and recommending low-cost improvements to the network geared towards congestion reduction and air quality improvement. For example, MetroPlan Orlando's annual traffic signal retiming project has been proven to reduce congestion and improve air quality. Committee members are responsible for advising on TSM&O-related updates to the CMP Report, the LRTP, and coordinate TSM&O within the regional ITS Architecture. The group also reviews, revises, and ranks TSM&O Prioritized Projects in the TIP. TSM&O-based projects fall under incident management, TDM, and other similar topics.

#### **ITS Regional Master Plan (*in development*)**

In addition to Federally mandated transportation planning documents, MetroPlan Orlando is half-way through the development of its *ITS Regional Master Plan* ("Plan").<sup>13</sup> Currently, ITS investments are based on local agency requests. The impetus for the Plan is to create a structure and provide metrics for a performance-based ITS investment decision-making process. While the Plan includes an inventory of current ITS strategies, it will enhance regional ITS resources by providing a framework for strategic investment in future ITS activities. In an effort to ensure the comprehensiveness and usefulness of the document, MetroPlan Orlando has led several workshops to identify regional ITS needs as part of the Plan development process. Once completed, the Plan will guide ITS endeavors as a part of the region's LRTP. The Plan has and continues to be supported by elected officials, creating a positive environment for ITS and TSM&O planning activities. In fact, the success of the Plan, and many other regional TSM&O activities, has been cited in large part to regional intra-agency partnerships.

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<sup>12</sup> Unlike other MPOs, MetroPlan Orlando is not involved in any planning activities related to land use.

<sup>13</sup> The anticipated completion date for the document is January 2017, with final Board presentation and approval in February.

## **M&O Strategic Plan**

While organized as the M&O Subcommittee, the group developed a Strategic Plan to guide the subcommittee on advocating for M&O within the region’s transportation process. The latest document was updated in 2009, predating the change from the M&O Subcommittee to the current TSM&O Advisory Committee. The plan includes the process for identifying, allocating, and implementing TSM&O projects. Goals outlined in the plan include: regionalism through stakeholder engagement, identifying M&O champions, enhancing collaboration and communication between partners, supporting resource sharing, assessing regional M&O needs, prioritizing projects, and evaluating performance. Although the committee structure has changed, the Plan is still considered the guiding document for the TSMO Advisory Committee.

## **Central Florida TSM&O Regional Consortium**

MetroPlan Orlando has and continues to work with a diverse set of agencies and stakeholders to advance regional TSM&O planning activities. Several years ago, the organization worked with FDOT’s District 5 to establish Central Florida’s ITS Consortium. Since its creation, the Consortium has evolved into the Central Florida TSM&O Consortium. Through its partnerships, the Consortium is focused on improving regional TSM&O through Federal funding and responds to Federal opportunities (most recently applying for FHWA’s Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Grant for increased technology on the roadways). The Consortium meets on a quarterly basis to discuss local projects within and outside of the region. Members include traffic engineers and planners from each of the counties, municipalities, transportation planning and operating agencies in FDOT’s District 5.

## **FDOT’s TSM&O Leadership**

As a key regional partner and player, FDOT’s commitment to TSM&O helps support TSM&O as a priority in the Orlando urban area. FDOT has been actively implementing their TSM&O Program since 2010. A TSM&O Leadership Team that includes representatives from District Offices meets on a regular basis and provides direction to the TSM&O Task Team, which includes representation from all relevant offices and is responsible for carrying out regular program activities.

FDOT’s TSM&O Strategic Plan (published in 2013 with an updated version currently in development) presents the high-level structure for establishing and maintaining FDOT’s TSM&O Program and ensures that implementation will occur concurrently through FDOT Operations and Planning, high-level policy recommendations, and the Project Development Cycle. The document describes the activities needed to expand TSM&O—including those affecting operations, planning, project development, construction, and maintenance within the FDOT. Staffing and Financing

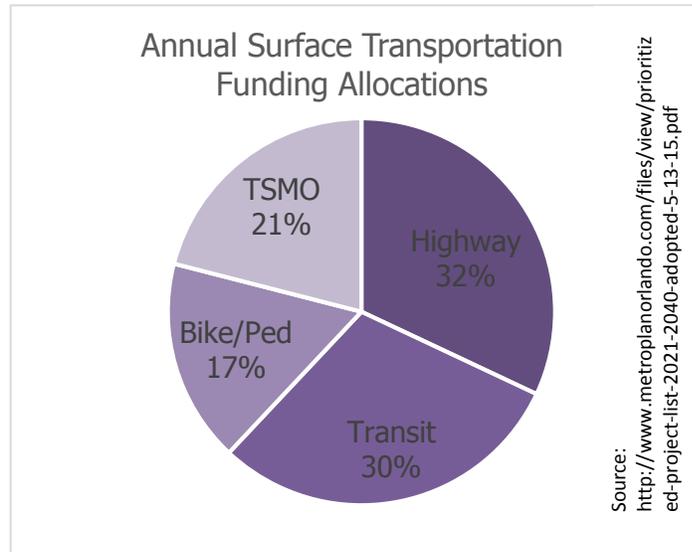
## **SM&O Team**

Within the 17-staff MPO, the SM&O team consists of a Director and two supporting staff members who are responsible for all TSM&O planning activities within the organization. The team noted that its success in pushing the advancement of TSM&O activities within the region relies on having a champion at both the federal and local levels. The organization needs a “spokesperson” to push these issues along through the right channels. Not only is it necessary to have a champion but it is important to be able to make an

effective business case to elected officials to put more emphasis on TSM&O programs. This results in a win-win for both the officials and the organization.

### Surface Transportation Program Funds

Traditionally, MetroPlan Orlando TSM&O activities were funded through a set amount of money taken from the total annual MetroPlan Orlando STP Funds. The set amount, approximately \$4 million went to activities such as M&O, ITS, TIM, and transportation management. Recently, the structure of TSM&O funding was changed, moving from a set amount to a set allocation percentage. TSM&O activities now receive approximately 20% of annual funding. This results in about a \$600,000 annual increase. Note, that these funds are for capital investments. Funding for long-term operations and maintenance is the responsibility of the local jurisdiction. There has been discussion regarding the need to update the funding model to better support local jurisdictions operations and maintenance.



### Performance Measures and Data

#### Regional Integrated Transportation Information System

RITIS, run by the University of Maryland CATT Lab, is an automated data sharing, dissemination, and archiving system that provides data, metrics, and communication of transportation related information. The system fuses, translates, and standardizes data from multiple sources to provide an overall view of the transportation network. MetroPlan Orlando has an agreement with the University of Maryland to share Florida-specific RITIS data. The organization is able to use the University’s system to assess regional operations. To date, RITIS has proven to be the most useful source of data to the region. The organization noted that RITIS provides good data and it is cost prohibitive to develop a system to collect, verify, and match data. However, the organization indicated that FDOT is looking to develop such an internal system.

#### Tracking the Trends: A Report on Transportation System Indicators for the Orlando Metro Area

For over a decade, MetroPlan Orlando has been developing an annual report, *Tracking the Trends*, to provide an overview of the area’s transportation systems and the impact of conditions (e.g., population

growth, technology, travel behavior, and funding) on system needs. The report is then used by policymakers to push transportation policy decisions.

### **Strategies, Priorities, and Tools to Support SM&O**

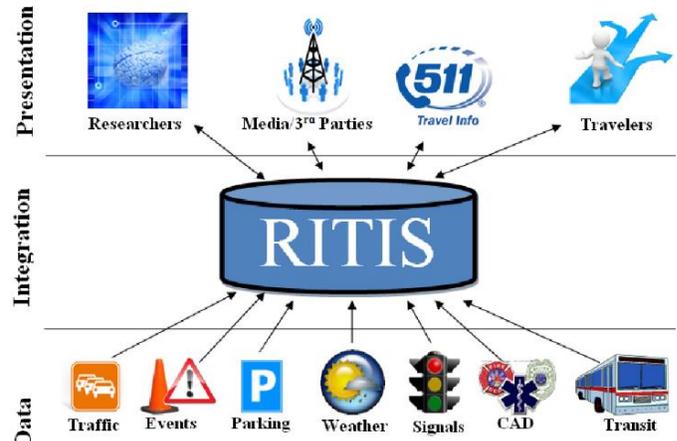
#### **Traffic Signal Retiming Program**

For the past seven years, MetroPlan Orlando has been retiming traffic signals to mitigate traffic congestion and improve air quality. The organization collects before and after data on LOS, travel speeds, and travel times through Travel Time and Delay Studies as well as benefit/cost analyses to show the impact of the program on travel times and air quality. The ability to show the quantitative impact of the program has helped push enhancements in TSM&O programming within the organization. The program requires extensive coordination as multiple agencies are responsible for regional signals. Approximately, \$800,000 in funding is provided annually to program efforts.

#### **Investment Prioritization and Decision-making**

#### **TSM&O Annual Project Selection**

For the past several years, TSM&O Projects have been selected based on collaboration among TSM&O stakeholders. Specifically, stakeholders meet to confer on potential projects, during which time funding and project priority are discussed and updates are made in real time. When making decisions, the group focuses on project significance, support, and equity among the counties and cities within their jurisdiction. For future selection, the TSM&O Team is working to create a performance-based selection process.



## GREATER PHILADELPHIA METRO AREA

The Philadelphia metropolitan area expands over two States, Pennsylvania and New Jersey. The DVRPC is the federally designated MPO for the Greater Philadelphia Metropolitan area. It serves nine counties, 2 DOTs (PennDOT and New Jersey DOT (NJDOT)), and 353 municipalities.



### *Institutional Frameworks*

#### **Transportation Operations Master Plan**

TSM&O principles are integrated into the DVRPC's planning process through three main planning process documents: the region's LRP, its CMP, and its Transportation Operations Master Plan.

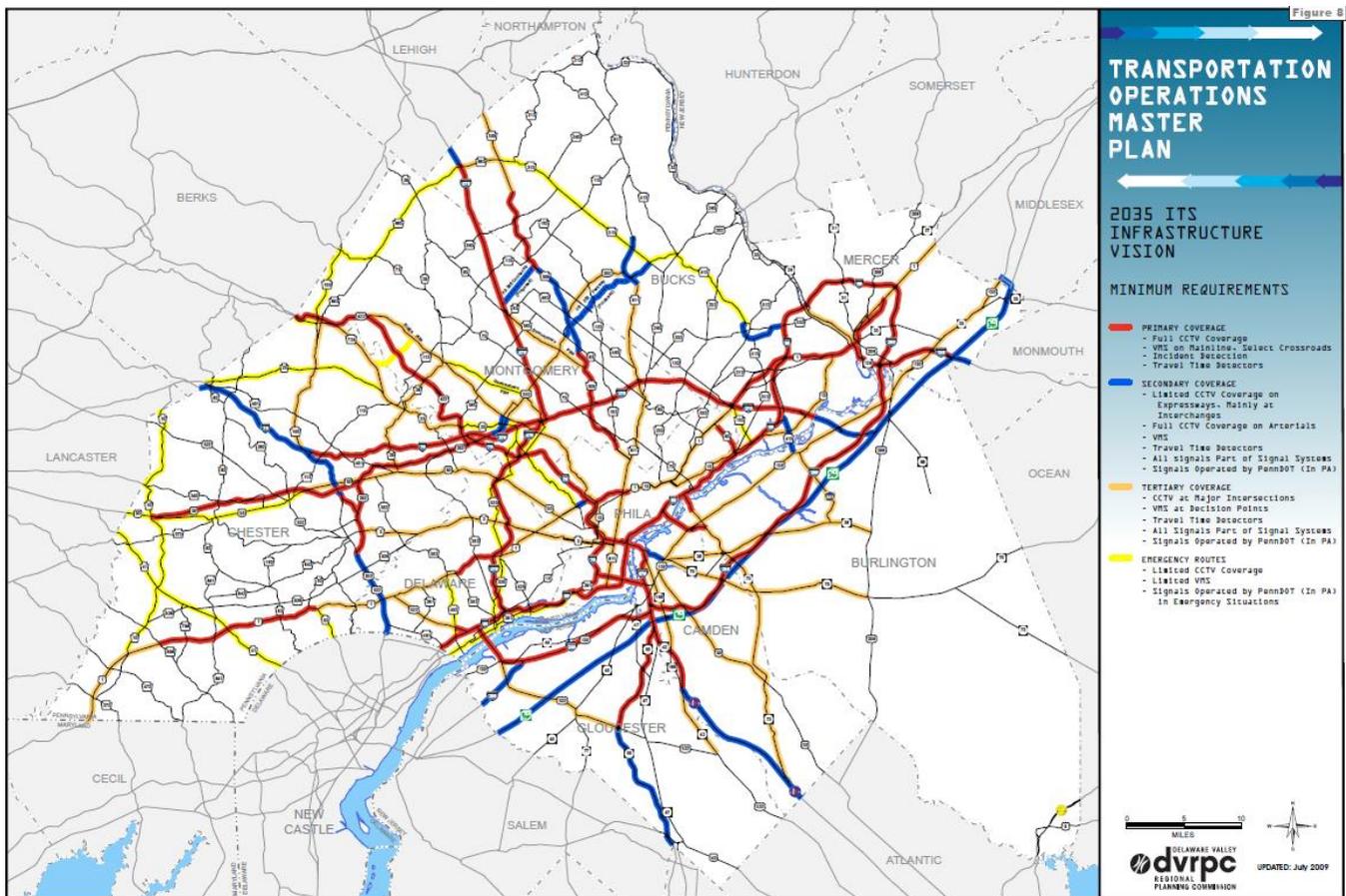
Per Federal mandate, DVRPC maintains and updates the region's LRP, *Connections 2040 Plan for Greater Philadelphia* every four years. A component of the LRP, the *Transportation Operations Master Plan* ("Master Plan") provides direction to the region's transportation agencies and local governments in managing and operating the region's transportation systems. The Plan was developed based on previous planning efforts including PennDOT's ROP and NJDOT's ITS Investment Strategy: 10-Year Program.

The Transportation Operations Master Plan is comprised of four major components: (1) operational goals and cross-cutting objectives; (2) the region's vision for ITS in transportation operations; (3) capital projects and ongoing programs; and (4) the financial investment needed to deploy and operate the named projects and programs.

The Master Plan drives operational transportation investments, as the LRP feeds into the Transportation Improvement Plan (TIP) which provides funding for program improvements consistent with the LRP. DVRPC is currently working to tie the update cycles of the LRP and the Master Plan together so that transportation operations projects may be more effortlessly pushed through the LRP for prioritization and funding through the TIP.

The Master Plan includes an ITS Infrastructure Coverage Map, shown below. Developed through a collaborative process in which DVRPC worked with its partner agencies to determine regional ITS priorities, the map establishes different levels of ITS Infrastructure deployment for various ITS elements. As part of its initial development, ITS infrastructure information was gathered for the region's detour routes, National Highway Routes, and freight routes among others. Once initially developed, the DVRPC has continued to work with its partners to review and update the map periodically.

Figure 6



## PennDOT Regional Operations Plan

PennDOT District 6 has an ROP that was developed in 2007. This document was developed through collaboration between D6, transportation planning partners and other key regional stakeholders and documents the regions approach to operational activities.

One consideration within this plan was looking at signals from both an investment and maintenance perspective since approximately 50% of all of the traffic signal in Pennsylvania reside in the Philadelphia metro region within the District 6 boundaries<sup>14</sup>. The designation of a strategic set of corridor for which to invest in future traffic signal systems was identified as a priority in this document; from that DVRPC developed a “Strategic Corridor Investment Plan” to help prioritize regional signalized corridors.

The plan also considers ICM in the region, beginning with the Schuylkill Expressway Corridor Transportation System Management (TSM) Plan. This plan focuses on improving the utilization of existing transportation facilities along I-76 and its parallel routes as a regional ICM pilot. The results of this pilot set the foundation for evaluating projects at the corridor-level.

A set of project priorities and implementation timelines were identified in the ROP. Short term project, which included items like ITS device deployments, incident management programs, and communications

<sup>14</sup> <http://www.dot.state.pa.us/public/Bureaus/Cpdm/District%206-0%20Regional%20Operations%20Plan.pdf>

projects, were earmarked to be implemented within two-years. Long-term priorities, those to be implemented beyond two years out, including large deployments, construction of new operations centers and programs for parking management. With PennDOT being a major player for priority identification in the regional TIP assembled by DVRPC, the priorities in this document likely inform TIP project identification.

## Regional ITS Architecture

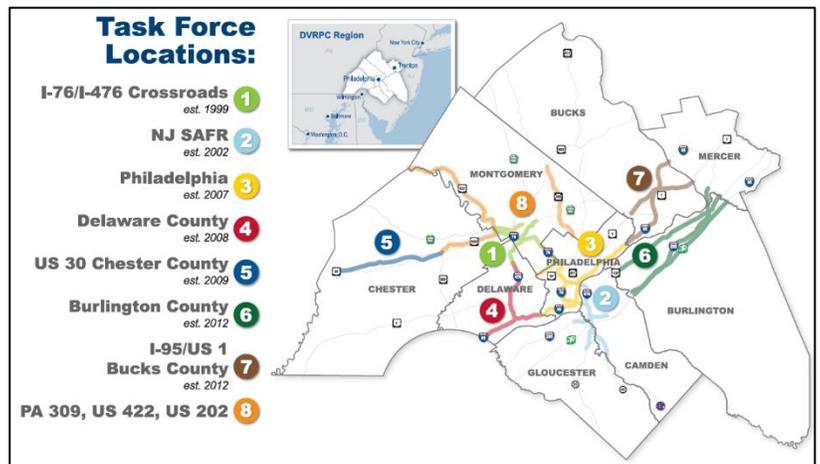
First issued in March 2001, DVRPC’s Regional ITS Architecture was the result of an extensive outreach campaign by the commission with a diverse group of stakeholders. The architecture - structured after, and consistent with the National ITS Architecture developed by US DOT - is the framework for all transportation operations planning within the region. For over 17 years, a core group of transportation operations DVRPC personnel have supported the standup and modification of the architecture. The stability of personnel has allowed for the extensive continuity and evolution of the architecture. The latest version of the architecture is currently being developed.

## Transportation Operations Task Force

The DVRPC TOTF consists of numerous regional stakeholders who meet quarterly to discuss a breadth of regional transportation operations activities. These discussions are used to drive DVRPC’s transportation operations planning activities. While participants may vary from meeting-to-meeting based on the subject matter, all the major agencies are invited to participate, including but not limited to: state and local DOTs; turnpike, bridge, and port authorities; transit agencies; homeland security; state and local law enforcement agencies; and major city transportation agencies. Topics may include ITS deployments, incident management programs, and federal initiatives.

## Incident Management Task Forces

DVRPC’s TIM Program includes the management of eight inter-agency IMTFs across the region (figure to the right). DVRPC provides all administrative and logistical support to the task forces which meet on a quarterly basis to discuss safety issues and traffic management along with inter-agency coordination. Task force members volunteer their time and space, along with their training resources. Funding for the IMTFs includes DVRPC’s preparation and conduct of the task forces.



## Staffing and Financing

### Transportation Operations Group

TSM&O planning activities are conducted through the DVRPC’s Transportation Operations Group. The group, consisting of four full-time staff members, initially focused on ITS, but has since evolved to include many more operational strategies and activities under the TSM&O umbrella. It was noted that unlike many MPOs, DVRPC’s TSM&O responsibilities and CMP activities fall under two separate groups.

### Transportation Operations Funding Sources

Transportation operations planning activities are primarily funded through two mechanisms: DVRPC’s Planning Work Program and the DVRPC’s TIP.

#### **FY Planning Work Program (Transportation Operations).**

Every fiscal year, the DVRPC Board and its planning partners develop an annual Planning Work Program (in effect from July to June of the following year) that reflects the region’s short-range planning needs. Funding is set for regional planning activities to be carried out by member governments and transit operating agencies. Within the larger Work Program, the Transportation Operations Program provides funding specifically for strategies which employ technology and interagency coordination to address recurring congestion and incident management.

FY	Incident management task forces	Traffic Signals	Trans Ops/ Technical Assistance	Trans Ops outreach to municipalities outside of IMTE corridors	Roundabout Feasibility	Structurally deficient bridge detour route identification
2017	X	X	X	X	X	
2016	X	X	X	X		X
2015	X	X	X			X

Funding may be regionally applicable or state/county specific. Focus areas alter each year as shown in **Error! Reference source not found.** Examples of funding include administrative activities for conducting Task Forces as well as planning and conducting regional conferences.

**Transportation Improvement Program (TIP).** Per Federal regulations, the TIP provides an agreed-upon prioritized list of transportation projects across the region. The DVRPC TIP includes TIP subcommittees which submit projects on an annual basis. All submitted projects are vetted through the appropriate DVRPC Unit. For operations projects, the Transportation Operations Unit is responsible for review and approval.

## Performance Measures and Data

### Incident Management Data Collection and Analysis

Performance measurement data collection and analysis varies between Pennsylvania and New Jersey. Therefore, there is currently no regional metric in place. However, many of the metrics collected by DVRPC, are focused on incident management:

- Roadway Clearance Times. Pennsylvania’s IMTFs collect roadway clearance times and provide the information in a quarterly report to DVRPC.
- TIM Self-Assessment. While the region does not currently have measures in place to gather information on incident clearance time, information on incident management is generally received on a regional basis through the TIM Self-Assessment.

## **I-95 Corridor Coalition Data Collection**

DVRPC is an affiliate member of the I-95 Corridor Coalition. As such, the agency has partnerships with universities and private third party data providers. Through this membership, the agency receives INRIX and HERE data.

### ***Strategies, Priorities, and Tools to Support SM&O***

## **Regional Integrated Multi-Modal Information Sharing**

DVRPC uses Regional Integrated Multi-Modal Information Sharing (RIMIS), a software application developed in-house, to connect highway operations centers, transit control centers, and first responders across the Delaware Valley. Information includes incident notifications and situational transportation information through videos and maps. The tool is financed through the TIP (approximately \$750,000 annually). The funding is utilized to hire contractors to maintain and operate the software.

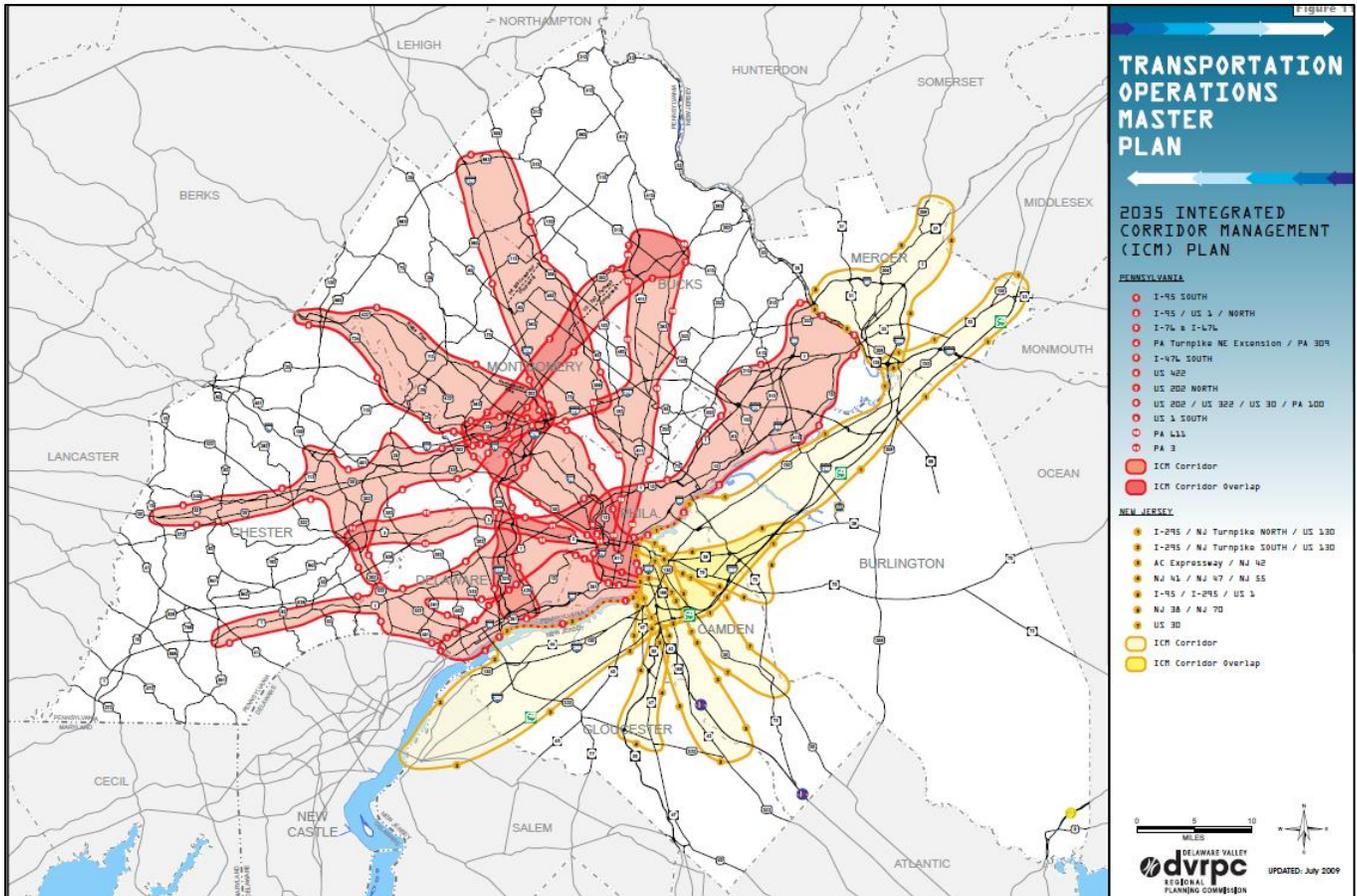
## **Interactive Detour Route Mapping**

Interactive Detour Route Mapping (IDRuM) was developed in partnership with DVRPC and PennDOT District 6 to provide detour routes across 13 counties within Pennsylvania and New Jersey (five and eight, respectively). The software takes the detour information and translates it into a “point-and-click” application.

## **Integrated Corridor Management and Active Traffic Management**

Within the DVRPC Master Plan is a 2035 ICM Plan, shown below. The ICM plan identifies corridors within the planning region that are the best candidates for the deployment of ICM. For each of these corridors, a comprehensive vision will be developed that identifies closed loop systems, arterial CCTV and DMS locations, priority bus treatment needs, smart bus stops and communication links to local policy and municipal TOCs. These visions will guide project implementation.

This ICM initiative was based on the I-76 TSM project, which was led by PennDOT and described in greater detail in a previous section.



## Regional Traffic Signal Optimization

DVRPC continues to operate its RTSRP to evaluate and improve traffic signal operations along multiple corridors. Corridors are selected based on greatest need. Since its inception, the program has resulted in several successfully retimed corridors across the region. The program has had to account for the varying division of operational responsibility between states. For example, PennDOT does not own, operate, or maintain any signals; only the counties have this responsibility. However, PennDOT is responsible for approving all county plans. Therefore, the counties and state DOTs must work together. Alternatively, in New Jersey, NJ DOT owns and operates signals along its state routes while counties own and maintain their own signals.

Five transportation operations centers (TOCs) across the region have active signal system operations: NJDOT TOC, PennDOT TOC, Philadelphia TOC, Burlington County, NJ TOC and some municipalities which run their signals through Public Works. These active systems allow for active and dynamic operations. For instance, PennDOT TOC is piloting a project with connected fiber in which the fiber will allow the Department to take over signals along a corridor during emergency operations to enable faster incident and response management.

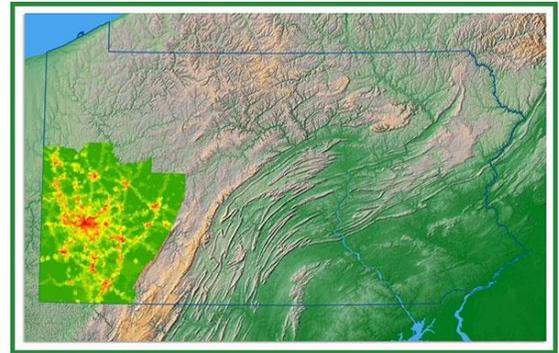
### ***Investment Prioritization and Decision Making***

When prioritizing and determining where to invest, DVRPC works closely with Federal, state, and local DOTs and planning agencies to get a complete understanding of what is and is not working across the region. The agency gathers information on upcoming projects and areas within the region that need operational support and looks at the existing inter-agency relationships within each potential location to determine the “probability of success”. In essence, how impactful will the project be to the area? The commission includes this information in their decision-making process. However, the ultimate priorities for TSM&O project funding is dictated by PennDOT and NJDOT.

DVRPC’s decision-making also includes keeping an eye to the future – once capital funding is expended, the agency considers where the funding will come from to maintain and operate the project as well as what will happen once the technology becomes obsolete.

## GREATER PITTSBURGH METRO AREA

The City of Pittsburgh and its surrounding metro is within the planning area for the SPC. The SPC has over 60 members from 10 counties, the City of Pittsburgh, and PennDOT Districts 10, 11 and 12. There are over 500 municipalities in the 10-county region



### *Institutional Frameworks*

#### **Regional ITS Architecture**

The SPC *Regional ITS Architecture* is a detailed inventory of all of the ITS stakeholders and the communication flows between stakeholders and between ITS devices and services. FHWA pushed the architecture plan in 2004 and meetings with local stakeholders were conducted to discuss ITS capabilities, planned projects, and aspiring projects. From that information, SPC was able to gather stakeholders together to create a comprehensive Strategic ITS Plan for the next 5-10 years.

#### **Regional Operations Plan**

The ROP is a living document updated about every 4 years in preparation for completing the LRP. The Traffic Signal Program (see 1.4.1) was one of SPC's major focuses to come out of the 2007 ROP, and has continued to be a focus in the subsequent Plans.

The ROP is a chapter of the LRP. It outlines goals and objectives and identifies specific performance measures at the regional and corridor levels. It outlines specific performance measures in 15 categories, and will be updated to include the MAP-21 performance reporting requirements.



#### **Operations and Safety**

The SPC is structured similar to MAG in that ITS/Operations and Safety are the responsibility of the same team. This group established Operations and Safety Assessments (OSA), which essentially combines corridor studies and Road Safety Assessments. This allows operations and safety to be considered together, and provide for a more holistic set of improvements.

#### **PennDOT's Intelligent Transportation Program**

The PennDOT Intelligent Transportation Program began in 2009 with the goals of providing communication and collaboration for ITS projects and providing centralized management of the ITS project portfolio at PennDOT. The mission of the program is to "Cultivate PennDOT's intelligent transportation infrastructure via the coordinated implementation of key and complimentary projects

within a structured and managed Program”<sup>15</sup>. The TIP focuses on identifying intelligent transportation needs, providing oversight and approval of projects, and improving communication and collaboration of efforts between the various PennDOT districts and bureaus involved with intelligent transportation.

Within the program document, key TSM&O projects are documented, including background information, expected benefits, estimated completion and other notes.

### *Performance Measures and Data*

#### **Data Sources**

SPC currently conducts manual data collection and analysis using excel sheets and graphs, and has plans to move to an automated collection process. SPC collects data from its partnership with the Maryland RITIS lab and utilizes third party speed data to support performance measures and before and after studies of traffic signal improvements.

### *Strategies, Priorities, and Tools to Support SM&O*

#### **Traffic Signal Program**

In Pennsylvania, traffic signals are almost all owned and maintained by local municipalities. Of the 500+ municipalities in the Southwest Pennsylvania Region, approximately 250 own and operate traffic signals. The challenge is that each municipality has varying levels of resources and expertise and many are not actively managed. Additionally, there is no network of traffic signals in place across municipalities, although there is increased focus on signal coordination projects for multijurisdictional corridors

SPC’s traffic signal program funds the Traffic Signal Program by applying for CMAQ funds in the TIP programming cycle (approximately every two years). Local agencies submit project applications which are reviewed by the Operations Committee and scored. There is double the demand for signal improvement projects than there is available funding. A fourth and fifth cycle are already programmed for future TIPs.

SPC has completed two cycles of signal program funding and typically will address 250 traffic signals in each cycle. Given that there are approximately 2,800 traffic signals in the region, SPC can only reach about

## Intelligent Transportation Program

### *511 Pennsylvania*

#### BACKGROUND

- 511 Pennsylvania is a scalable service that provides travelers in Pennsylvania with quality, timely, reliable, and relevant traffic, weather and intermodal information.
- The service is provided via telephone and web to improve safety, reduce congestion, and increase mobility.
- 511 Pennsylvania will provide traveler information to customers on three layers:
  - Statewide
  - Corridor Based
  - Metropolitan Areas

#### EXPECTED BENEFITS

- A safer, more reliable and efficient system. If users know of congestion, construction, incidents, and weather conditions in advance of approaching the condition, decisions can be made to possibly alter or modify their trips. These decisions may make travel for users more efficient and therefore should make the overall network function more effectively.
- Reliable, real-time traveler information disseminated consistently throughout the commonwealth. This is accomplished by using a “one-stop shop” of information provided by multiple transportation and emergency management agencies, along with third-party vendors.
- Consistent and coordinated information provided to motorists in a seamless and independent manner, regardless of agency, jurisdiction or geographic boundaries.



Estimated Completion: November 2013

Percent Complete: Task A – 100 percent  
Task B – 95 percent  
Task C – Start Pending

<sup>15</sup> <https://www.dot.state.pa.us/Internet/Bureaus/PennDOTROP.nsf/defaultPAITS?OpenPage>

9-10% of signals per funding cycle. However, for those traffic signals that have been improved in the last two cycles, SPC has seen a benefit to cost ratio of 64:1 for reduced emissions and signal coordination.

There are two types of subtypes within the traffic signal program – Signals in Coordination (SINC) projects and SINC with upgrades projects. SINC projects involve the signal retiming for signals that have already been updated. SINC with upgrades projects alternatively include optimizing operations, equipment upgrades, signal controller updates, coordinated communications between signals or a GPS device, and vehicle and pedestrian signals.

The SPC website posts the results of the before and after traffic signal evaluations. There also are some before and after videos that show what traveling the corridor looks like, from the driver perspective, after traffic signal coordination improvements. Agencies have found this to be a valuable outreach tool to promote the benefits of investing in operations improvements.

## **Partnerships**

SPC credits partnerships as one of the biggest drivers of program success such as commissioners strongly supporting and advocating for the regional traffic signal program. Additionally, the Mayor of Pittsburgh and a few commissioners have been recently advocating for technology exploration in the transportation field. Universities are also strong partners for research.

## ***Investment Prioritization and Decision-making***

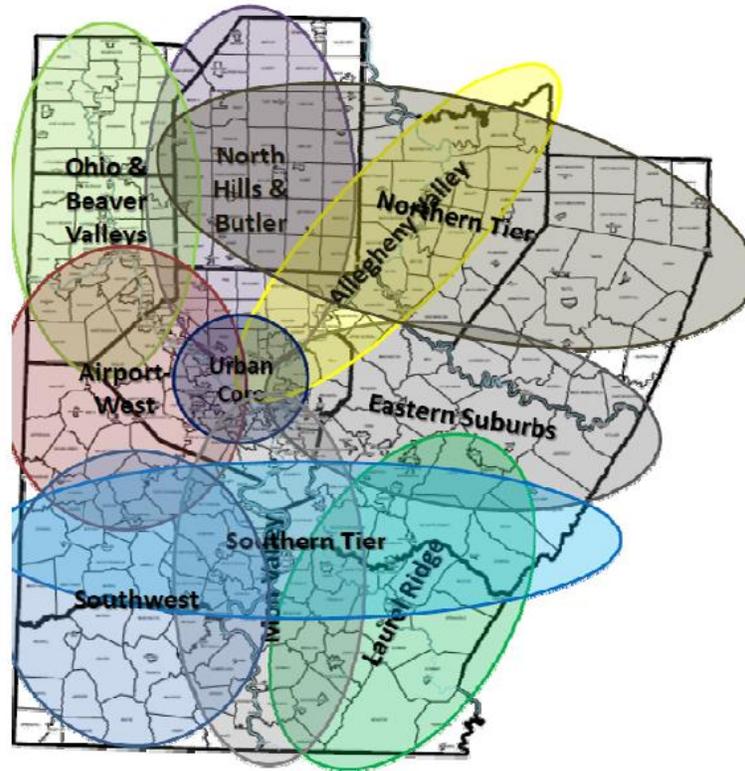
The ROP identifies seven priority areas including: traffic signals; incident and emergency management; traveler information; operational teamwork; intermodal connectivity; freeway and arterial operations; and freight management. For each of these priority areas, a set of projects were identified. These projects were each designated a priority level (high, normal or low), a champion/responsible party was identified and a timeline.

## **Operations and Safety Assessments**

OSA provide an approach that focuses on operations and safety collectively rather than independently. This type of assessment results in the identification of short- and long-term alternatives, and these are incorporated into the long-range transportation plan, TIP and maintenance planning activities.

## **Regional Travelsheds and Key Corridors**

SPC's regional Transportation Operations and Safety Committee, which includes participants from SPC, City of Pittsburgh, PennDOT, Port Authority, County planners and others, identified eleven 'travelsheds' within the Pittsburgh metro area. Travelsheds were identified based on major transportation networks that had similar characteristics and travel patterns throughout the region. A map of the designated travel sheds is shown below.



A list of key corridors in the region have been identified that highlight need for specific studies that have been identified. The studies identified include need for road safety assessments (RSA), OSAs, corridor studies, and traffic studies. Studies are not immediately programmed for completed but instead area scheduled and conducted by various planning partners as time and resources allow.

## ITS Project Selection

ITS projects are funded by maintenance dollars, mapped into highway projects, or funded by CMAQ. The ITS project process is dependent on the source of funding. SPC relies mostly on CMAQ for ITS funding, but the funding is competitive. Projects are ranked based on CMAQ criteria and other local process criteria. Construction ITS projects go through TIP coordination meetings.

PennDOT's Green Light-Go Program identifies designated and critical corridors in relation to traffic signals. The goal of the Green-Light-Go Program is to improve efficiency of existing traffic signals on state highways. The program identified a Local Grant Element and a PennDOT Project Element. Funds from Act 89 motor license fund, which is, \$25 in 2015-16 and up to \$40 million in 2016-17, are being used in the Local Grant Element for *Designated Corridors*, identified as state highways with average annual daily traffic (AADT) of less than 10,000 vehicles. PennDOT *Critical Corridors*, which are funding through Program funds, are defined as state highways with AADT greater than 10,000 vehicles or traffic signals at the end of limited access ramps<sup>16</sup>.

<sup>16</sup> [http://spcregion.org/pdf/ROP\\_Final\\_July15.pdf](http://spcregion.org/pdf/ROP_Final_July15.pdf)

## **ITS Project Vision**

Pittsburgh in particular is reinvigorating ITS efforts. Research and development are a big focus due to the efforts of Carnegie Mellon University and other nearby universities. Furthermore, Pittsburgh and many companies within Pittsburgh are interested in advancing Connected and Autonomous Vehicles. SPC actively participates in a statewide connected and autonomous vehicle working group on emerging technologies. Recently, the Uber ride-sharing service deployed self-driving cars on the streets of Pittsburgh. The fleet included 14 cars and was the first deployment of a fleet of autonomous vehicles in the country. As such, the Pittsburgh metro area has a favorable environment for deploying ITS and advanced operations infrastructure and systems.

## PORTLAND, OREGON AREA

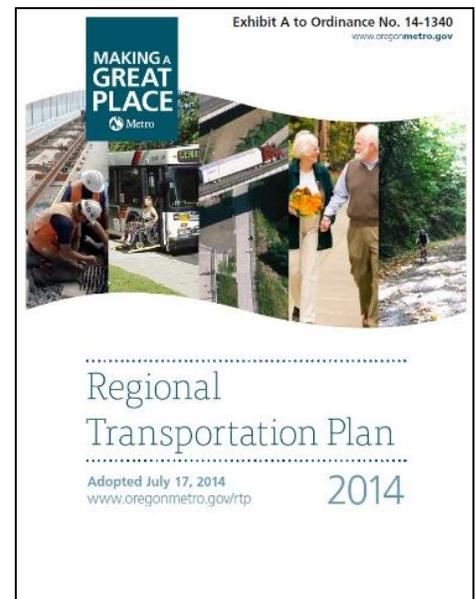
Metro is the federally designated MPO for the Portland metropolitan area serving the transportation system for 24 cities in three counties: Clackamas, Multnomah and Washington. Metro’s jurisdiction covers almost 403 square miles and is governed by a 7-member council.

### *Institutional Frameworks*

#### **Regional Transportation Plan**

Metro updates this plan every four years as a guide for future investments in the region’s transportation system. From the plan come specific plans and projects and the funding to complete them. In between full updates about every ten years, the plan can be amended to respond to changing local conditions and newly adopted plans. Six local jurisdictions propose projects each year that are amended into the RTP to be eligible to build the project with federal funds.

A part of the RTP is the Regional TSM&O Plan, which guides operations investments through 2020. The TSM&O Plan which identifies \$1.5 million per year to use for prioritized projects. The TSM&O program looks at a 3-year horizon of planned projects in the region.



#### **TSM&O Program**

The TSM&O Program for Metro is defined by two components:

1. Transportation system management – includes strategies that focus on making the infrastructure better serve the users by improving efficiency, safety and capacity of the system.
2. Transportation demand management – includes programs and strategies seeking to modify travel behavior to make more efficient use of transportation infrastructure and services and enable the users to take advantage of everything the system has to offer.

The TSM&O funding is allocated for regional projects and cross-jurisdictional projects, although there is a special allotment of the funding that is currently going toward updating an outdated regional signal system and will go toward a data warehouse update in the near future. TSM&O projects are largely applied to corridor mobility strategies that may span multiple jurisdictions, although there is recognition of local projects, safety projects, or freight programs/corridors. There is no set aside funding specifically for signal timing optimization projects out of the TSM&O funds.

Approximately half of the funding goes toward regional projects and the other half is allocated to local or cross-jurisdictional projects. Projects range from adaptive signal timing projects, travel time sign installations, improvement in port corridor area, and studying ICM for I-205, SR-212, and SR-224. Projects are mapped using categories such as adaptive signal timing, arterial surveillance, freeway management, and ICM.

When the TSM&O program was initially completed, funds were already set aside to get projects going, which provided much needed leverage to institutionalize TSM&O within the RTP. There have been other projects carried out involving ITS investments outside of the TSM&O program such as freight projects and a TIGER grant.

Local transportation system plans (TSPs), mobility corridor strategies and corridor refinement plans are required to

include TSM&O strategies and projects consistent with the regional TSM&O plan. The development of the Regional Active Transportation Work Program that occurs every year is coordinated with other Metro transportation planning activities, including TSM&O.



## Mobility Corridors

Some projects are organized under the mobility corridor concept where 24 unique, multimodal corridors have been identified in the Portland region. Each corridor includes a combination of freeways/highways, parallel networks of arterial streets, regional multi-use paths, high capacity transit, and frequent bus service that connect major activity centers, as defined by the regional growth concept. Mobility corridors are those that serve a key transportation function within an area. Key functions might include:

- Provide/create critical access to other cities, regional centers, transportation modes and attractions;
- Serve as a key freight route; and
- Is a key statewide travel route or provides statewide access.

Mobility corridors are documented in a Mobility Corridor Atlas, which serves as a tool for transportation and land-use planners and is used to during the project programming process. Corridor-specific projects receive approximately two-thirds of TSM&O funds.

## Formalized Partnerships

On a monthly basis there is a TransPort meeting that gathers local agency representatives in order to carry out the TSM&O program. The attendees at the meeting include traffic engineers, operators, emergency managers and others involved in transportation management. This Transport meeting was formalized in 2003 into a regional meeting that provides prioritized recommendations to the Joint Advisory Meeting with a Metro Council overseeing all approvals. Typically requests for funding total

double what the annual budget capacity allows which requires prioritizing projects through the Transport meeting. The process for prioritizing projects as part of the TSM&O program usually is carried out over the course of a few meetings and then a total recommendation package is sent to Council for approval.

## ***Staffing and Financing***

### **Transportation Operations Funding Sources**

Operations projects are funded by a variety of sources, including local dedicated funds, State funds and dedicated Metro TSM&O funds. Since 2009, the Portland region has set aside funding from Metro's Regional Flexible Fund program to support implementation of TSM&O. About 4% of federal funding and 12% of state funds are going toward TSM&O/TDM programs.

Every two years, the Joint Policy Advisory Committee on Transportation (JPACT) and Metro Council decide how to allocate Regional Flexible Funds (STP, CMAQ, and Transportation Alternative grant funds). Funding levels are established for regional programs, including the TSM&O Program. The TSM&O Program funds are divided into two pools, with one-third of the funding going to projects that benefit the entire region and two-thirds of the funding going to corridor-based projects<sup>17</sup>. Metro will work with TransPort, the regional operations group managed by Metro, to evaluate and select projects to be funded by the Program funds.

A second funding stream is a competitive process in which local agencies submit project applications. Operations projects can be funded through the competitive process as well as through the TSM&O Program funding allocation.

The TSM&O program is funded by bonds and federal funds. There is no gas tax that can be used and no sales tax in the state of Oregon. Oregon DOT is piloting road-user charge based on vehicle-miles traveled. A small sample group that has opted into the pilot program is being tested. There is no tolling mechanism in the state to support funding. Investing in a regional disincentive program such as Metropia is of interest to Metro which would provide incentives to use off-peak travel hours or lesser used routes during peak travel hours.

## ***Performance Measures and Data***

### **RTP System Monitoring and Reporting**

The RTP system monitoring is an important element in the region's CMP process. With advancements of ITS in the region, Metro can collect data more efficiently and effectively to process performance metrics for ongoing evaluation purposes. The RTP system monitoring program reports out current conditions using observed data for each of the 24 mobility corridors. A system performance report is prepared every two years in advance of the allocation process for regional flexible funds and future RTP updates.

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<sup>17</sup> <http://www.ops.fhwa.dot.gov/publications/fhwahop13050/s11.htm>

## Intra-Agency Data Collection and Performance Measurement

The Metro Data Portal is a server warehouse that collects freeway loop detector information including speeds and volumes and is linked directly to the planning model. This kind of direct link of data to support planning is unique for an MPO. The Data Portal is taking vehicle counts and speeds to calculate travel times that are then posted on the freeway message signs in the region. The planning model is leveraged to forecast a myriad of data sets including population forecasts, employment densities, and traffic projections. Metro acknowledges that for the planning model to support investment decisions, a historical observation data set would be more reliable of a metric to rely upon.

Metro also receives project-specific data from Oregon DOT (ODOT) where their project may improve reliability or safety. An example of this is the SR-217 where data is actively measured using ITS field equipment and is reported on as a project-specific data set to the Data Portal.

The Portland region has developed comprehensive guidance for multimodal arterial performance measures, and provides implementation guidance for specific measures for autos, bicycles, pedestrians, transit and agency performance (such as detectors and other equipment). It identifies high, medium and low priority measures. Another important component was identifying corridor 'readiness' for measures; that is, where would there be low or significant effort to get data, is the data able to be split by lane, etc.



## Strategies, Priorities, and Tools to Support SM&O

### Focus on Mobility as a Service

Metro is attuned to federal opportunities for funding including the Smart City Challenge, TIGER grants, and other programs that could support regional improvements. In partnership with TriMet, the regional public transportation provider, Metro pursued Smart City Challenge funding. Although not receiving funding for that program, the partnership between Metro, TriMet, local agencies, and Oregon DOT provides a foundation with which to invest in corridor projects that will make a solid impact on travelers.

Metro recognizes mobility is a service that needs to be provided to the traveling public and to demonstrate this effectively, they need to bring down the cost of transportation for travelers. An example is that by bringing down travel time, Metro would help bring down the cost of living.

**Integrated Corridor Management**

The region has received a federal grant for development of an ICM Concept of Operations and are currently underway with its development.

**Investment Prioritization and Decision Making**

As previously mentioned, there is a competitive call for projects where metro agencies submit projects (both TSM&O and non-TSM&O) for funding. For the corridor-level projects, TransPort develops evaluation criteria and performs an analysis of projects that are submitted by local agencies. Projects submitted by multiple sponsors are given additional points in the project evaluation process.

Metro had identified four areas that guide their investment strategy for M&O. The four categories and example projects within each is shown below.

Investment Area	Example project types
Multimodal Traffic Management	Signal timing project; transit priority; communications projects
Traffic Incident Management	Incident response programs
Traveler Information	511 systems; transit information; trip planning applications
Traffic Demand Management	Public education campaigns; employer transportation programs

For the most recent project selection process, regional flexible funds were allocated using a collaborative project nomination process and new focus areas were identified. The new focus areas that were established, the percentage of funds allocated, and the priority selection criteria associated with that area are shown below.

Focus Area	Funding Allocation	Priority Selection Criteria <sup>1</sup>
Active Transportation and Complete Streets	75% of available funds	<ul style="list-style-type: none"> <li>• Improving access to and from priority destinations</li> <li>• Improving safety</li> <li>• Improving user experience</li> <li>• Increasing use of and serving high growth areas</li> </ul>
Green Economy and Freight Initiatives	25% of available funds	<ul style="list-style-type: none"> <li>• Reducing freight delay</li> <li>• Increasing freight access to industrial and employment centers</li> <li>• Greening the economy</li> <li>• Improving safety</li> <li>• Reducing air toxins</li> <li>• Reducing impacts to underserved communities</li> <li>• Improving freight mobility</li> </ul>

## SAN DIEGO AREA

SANDAG is the regional MPO for the 19 cities and counties surrounding the San Diego metropolitan area. SANDAG is governed by a Board of Directors composed of mayors, councilmembers, and county supervisors from each of the region's 19 local governments. The region encompasses over 4,000 square miles. SANDAG is governed by a 19-member board and is supported by 80 staff. An additional 1.25 million residents will be part of SANDAG's jurisdiction by 2050.

### *Institutional Frameworks*

#### **Regional Transportation Plan: San Diego Forward**

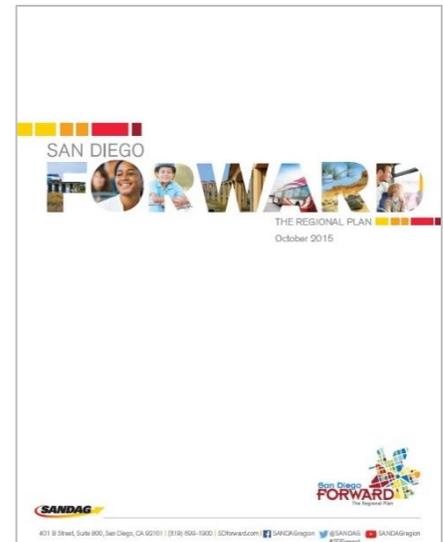
There is a TSM chapter (7) in the RTP which focuses on expanding traveler information services, improvements to the timing of traffic signals, ramp metering, management of arterials/freeways/transit, auxiliary lane projects, and incident management strategies. SANDAG does an annual check in with the RTP on project development and to plan what is next in the coming two years. An integrated performance management (IPM) strategy is identified to bring together freeways, arterial, and public transit systems toward becoming managed as one network rather than disparate networks.

The San Diego Forward Regional Plan combines the region's two most important existing planning documents: the Regional Comprehensive Plan (RCP) and the RTP. The San Diego Forward Regional Plan allocates \$258 million over the next 35 years to help fund the regional transportation system, including major transit systems and highways, and up to 20 mobility hubs.

Mobility hubs will locate transportation services and amenities in one location which will offer travelers different mode options. Real-time traveler information and transit support systems (such as mobile applications, smart intersections, autonomous and connected vehicles, and a universal payment system) will all be incorporated into mobility hubs. Mobility hubs are being funded by an Emerging Priorities Program grant from Caltrans and is being led by SANDAG in conjunction with the Imperial County Transportation Commission.

#### **Regional Transportation Improvement Program (RTIP)**

The 2016 RTIP is a prioritized program designed to implement the region's overall strategy for providing mobility and improving the efficiency and safety of the transportation system, while reducing transportation-related air pollution in support of efforts to attain federal and state air quality standards for the region. The 2016 RTIP also incrementally implements San Diego Forward Regional Plan. Transportation Systems/Demand Management for ITS and traffic signal projects as well as TDM projects totaled \$184.5 million for the five-year program.



## Regional ITS Plan and ITS Architecture

SANDAG has been working on updating the Regional ITS Strategic Plan with a ten-year forward look at developing and implementing new technology strategies for TSM. Whereas the 2050 RTP has a 40-year horizon, the ITS Strategic Plan looks at a shorter horizon and focuses on system improvements in the coming decade. The ITS Strategic Plan was developed through the active participation of the regional stakeholders, including the 18 cities, the County of San Diego, Caltrans District 11, MTS, and the NCTD. The Plan documents the region's priorities for TSM investments and measures for evaluating the value of ITS projects. The ITS Strategic Plan focuses on multi-modal performance-based management of the region's transportation system and sets priorities and focus areas toward those goals.

SANDAG completed a regional ITS plan in 2012 that helps identify focus areas in more detail. During development of that plan, input was gathered from agency stakeholders. SANDAG anticipates to continue using the project-by-project and corridor project model for ITS implementation as well as stakeholder input/consensus that the regional ITS plan is reflecting the needs and goals of the region.

There is a regional ITS architecture that is updated when the regional ITS plan is updated that captures the ITS functions that are currently happening in the region as well as identifies what is planning or upcoming as identified in the regional ITS plan.

## Regional Transportation Committee

The Transportation Committee provides oversight for the preparation and implementation of San Diego Forward and the projects under the RTIP, including the *TransNet* Program of Projects.

## Staffing and Financing

### TSM&O Staff

Although there is not a defined TSM&O program within SANDAG, there are transportation planning staff that are focused on TSM&O-related transportation planning within the organization. The team supports the region's agencies with existing ITS deployments, ITS project planning and criteria, and ITS deployment. The team is working with Caltrans that just initiated an I-805 project-specific TSM&O. SANDAG acknowledges that they need to develop a TSM&O plan.

### TSM&O Funding Source: Sales Tax

*TransNet* is the half-cent sales tax for local transportation projects that was originally approved by voters in 1987 and was extended in 2004. Each time *TransNet* goes up for ballot, there is a list of specific projects with funding priority that restrict what the funding may be used on. The detailed funding strategy for ongoing use of the *TransNet* funds is identified in the San Diego Forward Regional Plan. Each year, SANDAG adopts an overall work program and budget with federal, state, and local funds to carry out its regional projects. In fiscal year 2016, \$1 billion was allocated toward capital projects and \$283.5 million was for *TransNet* program.

## ***Performance Measures and Data***

### **Performance Metrics**

The 2050 RTP identifies TSM performance measures as well as actions and responsible parties for implementing TSM strategies. There are performance metrics defined for the San Diego Forward Regional Plan, however, they do not explicitly relate to TSM&O programs or goals. These metrics are reported on an annual basis.

Over the past few years, SANDAG has been developing new analytic tools and capabilities. Two of the most significant additions to SANDAG's analysis tool kit include the development and implementation of a CT-RAMP activity-based model system and the development and implementation of a PECAS land-use model.

### **Data Collection**

SANDAG maintains traffic count data for significant roadways and all Caltrans routes in the San Diego region, collects data to generate transit operator performance reports, counts transit passenger boardings and alightings, and generates transportation forecasts.

The regional transportation model uses inputs from TSM data sources including freeway detection data and the arterial signal system to forecast for transportation planning purposes.

The I-15 ICM DSS collects freeway and arterial data sources and makes forecasted decisions based on thresholds defined for that data if a strategy implementation is warranted. For example, if there is a queue forming on the freeway, the DSS would be able to capture that data and forecast the anticipated impacts from that queue on the freeway network as well as arterial network. These DSS systems are used to forecast traffic patterns, and then analyze and recommend operational changes to minimize or reduce traffic congestion. The DSS can initiate strategies to mitigate in a combination of freeway, arterial, and transit implementation plans that have been agreed by all stakeholders that would work best to alleviate the impacts of the queuing on the freeway. The IPM approach cited in the RTP TSM chapter is being used in this ICM project to demonstrate the benefits of an IPM approach.

## ***Strategies, Priorities, and Tools to Support SM&O***

### **Integrated Corridor Management on I-15**

In 2010, the I-15 corridor in the San Diego region was selected as one of two pilot sites in the nation to develop, implement, and operate an ICM system. The San Diego ICM project team is led by SANDAG and includes partnerships with the USDOT, Caltrans, MTS, NCTD, and the cities of Escondido, Poway, and San Diego. The ICM system allows individual transportation systems to be operated and managed as a unified corridor network. The ICM system went live in early 2013. The I-15 ICM project applies predictive algorithms and real-time modeling tools to forecast traffic across multiple networks and recommend response plans to manage anticipated congestion. For example, the ICM system coordinates the use of freeway ramp meters and arterial traffic signals to improve day-to-day conditions or to route traffic around major incidents. As part of the ongoing ICM project, a coordinated detour messaging system was activated in April, 2016 with 40 alternate route signs installed on surface streets along the I-15 corridor

in the cities of Escondido, Poway, and San Diego. The free 511 San Diego mobile application was developed as part of the ICM project and features corridor specific innovations such as predictive travel times on I-15; maps with current traffic conditions; customized incident and construction notifications throughout the region; NCTD bus routes, fares, and arrival times; real-time MTS information; and real-time dynamic toll rates for the I-15 Express Lanes.

## **Regional Arterial System**

Regional arterial management is a focus for SANDAG. Investments in arterial infrastructure has been limited in the past because initiatives to measure and manage the performance of arterial roadways were not cost-effective. However, recent advances in wireless technology are making new investments in collecting traffic data along arterial roadways more economical. A Regional Arterial System has been included as part of the RTP since 1989 and deployments of ITS infrastructure continues to support the robust network of data sources. Local agencies own and manage ITS infrastructure. The Regional Arterial System includes 1,038 miles of roads.

This one traffic control platform that is used for all local jurisdictions and continues to be funded to maintain through a regional maintenance contract through a cost sharing model. The local agencies and SANDAG review the contract on an annual basis and SANDAG continues to manage the contract. Regional arterials are longer continuous routes that provide accessibility between communities within the region and which also may allow subregional trips to avoid freeway travel. To qualify for the updated RAS, arterials must meet at least one of four approved criteria as identified in the RTP.

## **Adoption of Vehicle-Miles Traveled Metric**

California Senate Bill (SB743) was adopted in 2013 which removes automobile delay (LOS) as a significant environmental impact, and directs the selection of a new measurement that better addresses the state's goals on climate change and multimodal transportation: VMT. This change requires SANDAG to implement strategies within the next two years and requires specific measurement for TSM and TDM initiatives in order to show results. The target that has been set is to reduce greenhouse gas emissions in the San Diego region by 13% by 2035. The measurement, allocation, and application of funding and resources in the state will need to be altered to account for this new VMT metric rather than the LOS metric, although the outcomes will be more in line with the goals of the state.

## ***Investment Prioritization and Decision-making***

While there is no formal committee to review projects on an annual basis, the regional ITS plan is planned to be updated regularly to garner consensus from area stakeholders. Projects that come out of the regional ITS plan, such as the I-805 Concept of Operations involves stakeholders in the development process.

Adoption of the San Diego Forward Regional Plan follows a similar process as other metropolitan areas. SANDAG anticipates to continue using the project-by-project and corridor project model for project prioritization that the regional ITS plan is reflecting the needs and goals of the region.