MARICOPA ASSOCIATION of GOVERNMENTS

MAG Regional Concept of Transportation Operations

Technical Memorandum No. 3

- Operational Goals and Performance Measures

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ADDENDUM TO TECHNICAL MEMORANDUM NO. 3: GOALS AND PERFORMANCE MEASURES

Development of the Maricopa Association of Governments Regional Concept of Transportation Operations (MAG RCTO) engaged a wide variety of stakeholders from throughout the Maricopa Region. Stakeholder consensus was achieved, early in the project, for operational goals and performance measures. The agreed upon goals and performance measures are presented in Technical Memorandum No 3: Operational Goals and Performance Measures.

However, as the project continued, and in order to garner the support of additional stakeholders, it became necessary to make minor modifications to the earlier agreed-upon goals and the associated performance measures. This section outlines the changes made to the Goals and Performance Measures. Modifications to Tables 1 and 2 of Tech Memo No. 3, as shown in Addendum Table 1 and Addendum Table 2 are shown in bold **(example)** and strikethrough (~~example~~) font.

Addendum Table 1– Summary of Three-Year and Five-Year Goals, and the Associated Performance Measure

Category	Proposed Measure	Three-Year Goals	Five-Year Goals
Freeway Mobility	Peak/non-peak period average travel speed and travel time by freeway segment	Limit the percent increase in average travel time to less than the percent increase in traffic volume	Limit the percent increase in average travel time to less than the percent increase in traffic volume
Arterial Mobility	Peak/non-peak period average travel time by arterial	Limit the percent increase in average **arterial** travel time to less than the percent increase in traffic volume	**Continue to** limit the percent increase in average travel time to less than the percent increase in traffic volume
	~~Percentage of coordinated traffic signals within a city~~ **Percentage of traffic signals optimized within a city**	~~Implement signal coordination within a city on 100 percent of smart corridors~~ **Optimize traffic signal coordination within a city on major arterials, or where appropriate**	Update the traffic signal coordination within cities every two years or when traffic volumes through the intersection change by more than five percent
	~~Percentage of coordinated traffic signals between cities~~ **Percentage of interjurisdictional traffic signals optimized between cities**	~~Implement signal coordination between cities on 100 percent of the smart corridors~~ **Optimize traffic signal coordination between cities on major arterials, or where appropriate**	Update the cross-border traffic signal coordination between cities every two years or when traffic volumes along the arterial change by more than five percent
Freeway Incident Management	Freeway incident response and clearance times	Reduce incident duration by ten percent	Reduce incident duration by 20 percent
Freeway-Arterial Interface Operations	Integrated freeway-arterial operations evaluation study, which includes a measure of travel time	Establish integrated freeway-arterial corridor operations on one corridor	Establish integrated freeway-arterial corridor operations on three corridors
Arterial Incident Management	Arterial incident response and clearance times **(where multi-jurisdictional incident management program is implemented, based on outcomes of feasibility study)**	~~Develop and implement an arterial Incident Management System (IMS)~~ **Conduct a feasibility and planning study for a multi-jurisdictional arterial incident management program**	~~Expand the system to cover one-half of the MAG member agencies~~ **Implement a multi-jurisdictional arterial incident management program (based on outcomes of feasibility study)**

Addendum Table 1– Summary of Three-Year and Five-Year Goals, and the Associated Performance Measure (continued)

Category	Proposed Measure	Three-Year Goals	Five-Year Goals
Arterial Incident Management (continued)	Percentage of traffic signals with emergency vehicle signal preemption that are operating according to the established regional standard	Establish a regional standard for implementation of emergency vehicle signal preemption (EVSP)	~~100 percent of signals with EVSP operating according to the established regional standard~~ **Ensure adoption of the EVSP standard by each of the MAG member agencies, and implement the standard on 100 percent of signals with EVSP**
Transit Mobility	Transit signal priority (TSP) evaluation study, which includes transit trip travel times, **schedule adherence,** and evaluation of impacts on arterial network	Deploy a transit signal priority (TSP) pilot project in the MAG Region	**Where beneficial,** deploy TSP to all Express and BRT routes
~~Maintenance and Reliability~~ **Computer System Reliability**	Percentage of system (including computer system in the TMCs) uptime	Operate the system with up time of 95 percent – no more than 450 hours down time per year	Operate the system with up time of 95 percent – no more than 450 hours down time per year
	Average time to resume service if system failed	Minimize system down time to an average of 1 hour per system failure	Minimize system down time to an average of 1 hour per system failure
Multi-agencies coordination	Number of center to center communication links	• Establish center-to-center communications between 15 agencies in the region. These agencies should include traffic and transportation, enforcement and emergency management, and transit • Facilitate incident and emergency response and between 15 agencies • Facilitate travel information sharing between 15 agencies	• Establish center-to-center communications between 20 agencies in the region. These agencies should include traffic and transportation, enforcement and emergency management, and transit • Facilitate incident and emergency response and between 20 agencies • Facilitate travel information sharing between 20 agencies

Addendum Table 1– Summary of Three-Year and Five-Year Goals, and the Associated Performance Measure (continued)

Category	Proposed Measure	Three-Year Goals	Five-Year Goals
Traveler Information Provision	Usage • Web site – hits per month • 511 telephone service – calls per month • Television broadcast – frequency of broadcast of travel information • Radio broadcast – frequency of broadcast of travel information	• Increase travel information usage (web, 511, television, radio, etc.) by 100 percent, and achieve a 75 percent customer satisfaction rating	• Increase travel information usage (web, 511 television, radio, etc.) by 200 percent
	Information quality • **# of agencies that are participants in Web-Based HCRS** • **% of smart corridors with speed maps** • **# of buses equipped with AVL** • **Customer Satisfaction**	• **Expand Phase 1 of the ADOT/MCDOT/City of Scottsdale web-based HCRS pilot project for local closure and restriction information to include 5 additional MAG member agencies** • **Incorporate transit status information from AVL data from buses into travel information services** • **Develop web-based arterial maps for 100% of instrumented smart corridors** • Achieve a 75 percent customer satisfaction – on a scale of 1 to 10, a score of 7 or higher is desired	• **Evaluate performance capabilities of Phase 2 web based HCRS pilot project for local closure and restriction information and expand to include additional MAG member agencies** • Obtain travel time information on 50% of instrumented arterial roadways and post this information to Web, 511, and variable message signs • Achieve a 75 percent customer satisfaction – on a scale of 1 to 10, a score of 7 or higher is desired

Addendum Table 2 – Proposed Performance Measures, Formula, and Potential Data Sources

Category	Proposed Measure	Proposed Formula and Method	Data Source	Geographical Extent
Freeway Mobility	Peak/non-peak period average travel time by freeway segment	Annual average peak hour travel speed/travel time detected at each sensor station during AM and PM peaks and an off-peak period on Freeway Management System (FMS) instrumented sections of freeway	Annual travel time/travel speed studies, may include data from ADOT Traffic Operations Center (TOC), MAG Bottleneck Study (2003), TTI Urban Mobility Study (Annually)	Route/segment level
Arterial Mobility	Peak/non-peak period average travel time by arterial	Annual average peak hour travel time on selected arterials during AM and PM peaks and an off-peak period Data will be collected on four north/south arterials, and six east/west arterials **North/South** • 59th Avenue • 7th Street • Scottsdale Road • SR87/Arizona Avenue **East/West** • Bell Road/Frank Lloyd Wright Boulevard • Glendale/Lincoln Road • Indian School Road • Baseline Road • Southern Avenue • Chandler Boulevard	Annual travel time studies, may include data from local Traffic Management Centers (TMCs), MAG Congestion Study (1998), MAG Travel Time Study (2003)	Arterial/segment level

Addendum Table 2 – Proposed Performance Measures, Formula, and Potential Data Sources (continued)

Category	Proposed Measure	Proposed Formula and Method	Data Source	Geographical Extent
Arterial Mobility (continued)	~~Percentage of coordinated traffic signals within a city~~ **Percentage of traffic signals optimized within a city**	Number of traffic signals within a city that have been ~~coordinated~~ **optimized** divided by the total number of traffic signals in a city	• Data for this performance measure will be collected through a survey of the local TMCs	Region-wide
	~~Percentage of coordinated traffic signals between cities~~ **Percentage of interjurisdictional traffic signals optimized between cities**	Number of traffic signals ~~coordinated~~ **optimized** with signals in the adjacent city divided by the total number of traffic signals at the city border	Data for this performance measure will be collected through a survey of the local TMCs	Region-wide
Freeway Incident Management	Freeway incident response and clearance times	Annual average freeway incident response and clearance times in minutes	ADOT TOC database, DPS database	Urban freeways
Freeway-Arterial Interface Operations	Integrated freeway-arterial operations evaluation study, which includes a measure of travel time	Average peak travel time on selected origin-destination pairs (including arterial segment and freeway segment) during AM and PM peaks and an off-peak period where integrated freeway-arterial operation have been implemented Pre-deployment data (travel time and delay on selected corridors) is needed to provide a baseline data set	Travel time/travel speed studies, evaluation study of integrated freeway-arterial operations	Urban freeway segment/arterial segment where integrated operations were deployed

Addendum Table 2 – Proposed Performance Measures, Formula, and Potential Data Sources (continued)

Category	Proposed Measure	Proposed Formula and Method	Data Source	Geographical Extent
Arterial Incident Management	Arterial incident response and clearance times **(where multi-jurisdictional incident management program is implemented, based on outcomes of feasibility study)**	Annual average arterial incident response and clearance times in minutes	Local police and emergency services database	Smart corridors
	Percentage of traffic signals with emergency vehicle preemption systems (EVSP) operating according to the established regional standard	Total number of signals in the region with EVSP that operate according to the regional standard divided by the total number of signals in the region with EVSP	Local TMCs plus data processing and aggregation	Region-wide
Transit Mobility	Transit signal priority (TSP) evaluation study, which includes transit trip travel times, **schedule adherence,** and evaluation of impacts on arterial network	Average travel time on Bus Rapid Transit routes where Transit Signal Priority has been implemented Analysis of impacts on arterial network **Schedule adherence analysis**	Valley Metro transit management center Local Traffic Management Centers	Bus Rapid Transit Routes
~~Maintenance and Reliability~~ **Computer System Reliability**	Percentage of system uptime, including FMS and local ATMS	Annual total number of minutes that systems are functioning divided by the total minutes in a year (60x24x365); system shutdown during scheduled maintenance is counted as system downtime	Maintenance logs from system administrative personnel	Region-wide per system
	Average time to resume service if system failed (mean time to repair)	Average number of minutes from the time system failed to the time it resumes functioning	Maintenance logs from system administrative personnel	Region-wide per system
Multi-agencies Coordination	Number of center to center communication links	Total number of center-to-center connections for data sharing and operation coordination	Annual Survey and interview of local TMCs	Region-wide per system

Addendum Table 2 – Proposed Performance Measures, Formula, and Potential Data Sources (continued)

Category	Proposed Measure	Proposed Formula and Method	Data Source	Geographical Extent
Traveler Information Provision	Usage • Web site – hits per month • 511 telephone service – calls per month • Television broadcast – frequency of broadcast of travel information • Radio broadcast – frequency of broadcast of travel information	Annual total number of users of the traveler information system • web site – hits per month • 511 telephone service – calls per month • radio/television stations – – number of stations broadcasting information – frequency of broadcast (hourly, peak-hours only, etc.) – estimated number of listeners	User counts (hits/telephone calls) from regional traveler information applications such as those provided by ISPs, and the 511 web site and telephone service, viewers/listeners from the broadcast industry surveys.	Region-wide
	Information quality			
	• **Number of agencies that are participants in Web-Based HCRS**	**Summation of the number of agencies that are participants in the web-based HCRS**	**Number of agencies that are participants in web-based HCRS to be obtained from HCRS Administrator**	**Region-wide**
	• **Percentage of smart corridors with speed maps**	**Number of smart corridors with speed maps divided by the total number of smart corridors**	**Number of smart corridors to be obtained from AZTech™ Program Manager**	**Region-wide**
	• **Number of buses equipped with AVL**	**Summation of the number of buses equipped with AVL**	**Number of buses equipped with AVL to be obtained from Valley Metro**	**Valley Metro Service Area**
	• **Customer Satisfaction**	Percentage of information users who are satisfied with the system. Satisfaction will be graded on a scale of 1 to 10	Annual Survey and interview. Survey could be incorporated into web site and telephone service	**Region-wide**

Addendum Table 3 – Data Needs and Responsibilites

Category	Proposed Measure	Data Needs	Agency Responsible for Data Collection
MAG will have responsibility for the overall management of the performance measures program. Specific responsibilities will include: • Coordination of data collection • Compilation of data • Data processing and analysis • Data reporting			
Freeway Mobility	Peak/non-peak period average travel time by freeway segment	• Freeway travel speeds for peak periods and non-peak period • Freeway travel time for peak hours and non-peak period • Freeway vehicle volumes	• MAG – travel time studies on freeway segments • ADOT – FMS data including vehicle volumes and travel speeds
Arterial Mobility	Peak/non-peak period average travel time by arterial	• Arterial travel time for peak hours and non-peak hours • Arterial vehicle volumes	• MAG – travel time studies on selected arterials • DOT of – Chandler – Gilbert – Glendale – Goodyear – Mesa – Peoria – Phoenix – Scottsdale – Surprise – Tempe – Maricopa County
	Percentage of traffic signals within a city	• **List of traffic signals and signal locations** • **Timing-plan information indicating whether signal is optimized (within last 2 years)**	
	Percentage of interjurisdictional traffic signals optimized between cities	• **List of traffic signals and signal locations** • **Timing-plan information indicating whether signal is optimized (within last 2 years) with adjacent signals of neighboring city**	
Freeway Incident Management	Freeway incident response and clearance times	Incident duration and clearance times	• ADOT • DPS

Addendum Table 3 – Data Needs and Responsibilites (continued)

Category	Proposed Measure	Data Needs	Agency Responsible for Data Collection
Freeway-Arterial Interface	Integrated freeway-arterial operations evaluation study, which includes a measure of travel time	• Arterial – freeway corridor travel time for peak hours and non-peak hours • Arterial - freeway vehicle volumes • Integrated freeway-arterial pilot project evaluation results	MAG
Arterial Incident Management	Arterial incident response and clearance times **(where multi-jurisdictional incident management program is implemented, based on outcomes of feasibility study)**	Incident duration and clearance times	• MCSO • Police Departments of – Chandler – Gilbert – Glendale – Goodyear – Mesa – Peoria – Phoenix – Scottsdale – Surprise – Tempe
	Percentage of signals with emergency vehicle pre-emption system (EVSP) in which EVSP is implemented according to the established regional standard	Signal inventories • signal location • report of whether signal is equipped with EVSP • report of operating parameters (whether consistent with regional standard)	DOT of • Chandler • Gilbert • Glendale • Goodyear • Mesa • Peoria • Phoenix • Scottsdale • Surprise • Tempe • Maricopa County
Transit Mobility	Transit signal priority (TSP) evaluation study, which includes transit trip travel times, **schedule adherence,** and evaluation of impacts on arterial network	• Bus Rapid Transit Route travel time • Schedule Adherence Data • TSP Pilot project evaluation results	• MAG • Valley Metro

Addendum Table 3 – Data Needs and Responsibilites (continued)

Category	Proposed Measure	Data Needs	Agency Responsible for Data Collection
~~Maintenance and Reliability~~ **Computer System Reliability**	Percentage of system uptime	System operations and maintenance logs	• ADOT • DPS • MCDOT • MCSO • Valley Metro • DOT/Police/Fire Departments of – Chandler – Gilbert – Glendale – Goodyear – Mesa – Peoria – Phoenix – Scottsdale – Surprise – Tempe
	Average time to resume service if system failed	Same as above	Same as above
Multi-Agencies Coordination	Number of center to center communication links	Number of center-to-center communication links established in the MAG region	• ADOT • DPS • MCDOT • MCSO • Valley Metro • DOT/Police/Fire Departments of – Chandler – Gilbert – Glendale – Goodyear – Mesa – Peoria – Phoenix – Scottsdale – Surprise – Tempe – New cities and towns

Addendum Table 3 – Data Needs and Responsibilites (continued)

Category	Proposed Measure	Data Needs	Agency Responsible for Data Collection
Traveler Information Provision	Usage • Web site – hits per month • 511 telephone service – calls per month • Television broadcast – frequency of broadcast of travel information • Radio broadcast – frequency of broadcast of travel information	• System logs of usage (hits per month, calls per month) • Survey of radio and television broadcast stations	• MAG (surveys) • ADOT
	Information quality • **Number of agencies that are participants in Web-Based HCRS**	**Number of agencies that are participants in the web-based HCRS**	• MAG • ADOT • MCDOT • **Valley Metro**
	• **Percentage of smart corridors with speed maps**	• **Number of smart corridors with speed maps** • **Total number of smart corridors**	
	• **Number of buses equipped with AVL**	• **Number of buses equipped with AVL**	
	• **Customer Satisfaction**	Percentage of information users who are satisfied with the system. Satisfaction will be graded on a scale of 1 to 10	

1. INTRODUCTION

1.1 Purpose

Performance measurement is the use of statistical evidence to determine progress toward specific defined organizational objectives. This includes evidence of both actual fact, such as measurement of pavement surface smoothness, and measurement of customer perception that could be accomplished through a customer satisfaction survey. In transportation, the performance measurement process starts with a definition of the services that the organization promises to provide, including the quality or level of service (e.g., timeliness, reliability) that is to be delivered. Performance measures provide information to policy makers about how well services are being provided. Performance measures should reflect the satisfaction of the transportation service user, the system owner, and the system operator.

The purpose of Technical Memorandum No. 3 is to present the results of Task 4: Identify Operational Goals and Define Performance Measures. In this report, the operational goals and performance measures for transportation systems in the Maricopa Association of Governments (MAG) region are identified. Key transportation systems and their existing operational practices are targeted for improvement through the establishment of realistic goals and performance measures.

Goals and performance measures are identified for:

- the urban freeway;
- arterial;
- regional transit;
- incident management;
- emergency management systems; and
- traveler information provision.

First, operational goals are identified. These are followed by a recommendation of suitable quantitative and qualitative performance measures.

1.2 Report Contents

Specifically, this deliverable contains:

- A review of the MAG Regional Concept of Transportation Operations (RCTO) Vision and Mission statement;
- The methodology of identifying performance measures and the process of performance measure refinement;
- Proposed performance measures and methods of data collection; and
- The performance measurement program that outlines the role and responsibility of each transportation agency, including the full cycle of activities needed for conducting performance measures.

2. VISION AND MISSION STATEMENTS

The Regional Concept of Transportation Operations (RCTO) is a comprehensive set of planning and operational strategies aimed at improving the safety of motorists, the efficiency of the transportation system, and maximizing the resources of the agencies responsible for managing the regional transportation network.

The first stage of the RCTO development was to identify the Vision and Mission Statements. These were presented in Technical Memorandum No. 1. These are:

Vision Statement: A safe, reliable, efficient, and seamless surface transportation system for the MAG Region.

This will be achieved by:

Mission Statements:

- Identifying and securing funding sources;
- Defining and agreeing on appropriate roles and responsibilities;
- Establishing and implementing applicable policies, procedures, and practices;
- Dedicating and training human resources;
- Continuing improvement of performance against customer driven indicators;
- Sharing, integrating, and coordinating information; and
- Actively managing and operating multi-modal transportation systems.

3. METHODOLOGY

3.1 Goals and Performance Measures Selection

Goals for the MAG RCTO were identified based on the real-time operational needs of the transportation system as well as the strategies that agencies need to have in place to effectively support the operational activities. From these goals, the proposed MAG RCTO performance measures were developed.

The RCTO Stakeholders Group suggested that for the performance measure effort to be effective, it needs to be an indicator of transportation operations, but at the same time be practical and pragmatic. To select measures that are very costly or difficult to determine would, in time, lead to them not being measured, and thereby rendering the performance measurement process ineffective. Thus, the selected performance measures are those that can be reasonably implemented by MAG, the Arizona Department of Transportation (ADOT), Department of Public Safety (DPS), Maricopa County, and local cities and towns. Two important observations were raised by the stakeholders, and are summarized as follows:

- Due to the types of roads and the geographic areas for which they are responsible, the role and operational goals of ADOT, DPS, and Maricopa County are different from those of cities and towns in the MAG region. Hence, their performance measures should consider the difference.
- The performance measures should emphasize coordination between multiple agencies across jurisdictional boundaries.

4. OPERATIONAL OBJECTIVES

The first step in defining a set of reasonable and applicable goals and performance measures for transportation agencies in the MAG region is to identify and differentiate each agency's objectives.

4.1 Freeways and State Route System

ADOT and DPS are responsible for freeway and state route operations and incident management. ADOT and DPS envision a safe, efficient, and dependable multi-modal transportation system in which each mode performs its appropriate role and all work together to provide the maximum mobility for people, services, and goods. Improvements to the mobility of passengers and goods will be accomplished through coordination with government entities, and consultation with stakeholders and the general public.

4.2 Arterial System – Cities, Towns, and Unincorporated Areas

Local municipal transportation departments, Maricopa County Department of Transportation, (MCDOT) and the Maricopa County Sheriff's Office (MCSO) are responsible for arterial and local street traffic operations and incident management. A primary responsibility of local cities and agencies transportation departments is the operation and maintenance of local traffic signal systems.

5. PROPOSED OPERATIONAL GOALS AND PERFORMANCE MEASURES

This section presents the three-year and five-year operational goals, the associated performance measures, the method of measure calculation, the data needs for the measuring process, and the geographic extent to which these measures should apply.

The calendar for the three-year and five-year goals will begin in fiscal year 2005, which begins on July 1, 2004. The three-year period ends on July 1, 2007, and the five-year period ends on July 1, 2009. Because the Transportation Improvement Program operates on a five-year cycle, currently, the final two years of the goal period (2008 and 2009) have not yet been programmed. This allows for planning to resume upon completion of the RCTO development, and for necessary funds to be programmed in 2008 and 2009 to achieve the five-year goal.

5.1 Freeway Mobility

Mobility is a key attribute of the transportation system performance. It can be thought of as a measure for ease of movement. According to the Texas Transportation Institute[(1)], approximately 49 percent of travel time delay in the Phoenix area is due to recurring congestion, while 51 percent of delay is due to incidents; therefore, an effective transportation management should direct efforts at reducing recurring congestion, as well as the effect of incidents on travelers.

5.1.1 Three-Year and Five-Year Goals

The goals of improving freeway mobility in the MAG Region are:

Three-Year Goal:

- Limit the percent increase in average travel time to less than the percent increase in traffic volume.

Five-Year Goal:

- The five year goal for freeway mobility is the same as the three year goal.

5.1.2 Performance Measure

Progress toward the three-year and five-year goals will be charted by regularly measuring the:

- Peak and non-peak average travel time and travel speed by freeway segment.

The average travel time from origin to destination is what the traveler perceives in the real world. Travel speeds on freeways, a fundamental measure, is regularly measured by ADOT on the sections of freeway that are covered by the freeway management system. To better understand freeway performance, it is recommended that average travel speeds on selected freeway segments or travel times (by time of day) for a minimum of ten specific origin-destination pairs be regularly collected and analyzed.

Proposed Formula and Method

On the freeway system, detectors automatically collect real-time travel speed. These detectors are usually deployed densely enough (1/3 mile spacing) to provide a meaningful interpretation of freeway mobility; however, traffic patterns change dramatically from non-rush hours to rush hours. Even during rush hours, the in-bound and out-bound traffic volumes could be different. Hence, it is crucial to use different thresholds for mobility measurement.

It is recommended that the travel speed be collected at each detector station three times daily: 6:00 AM to 9:00 AM, 11:00 AM to 1:00 PM, and 3:00 PM to 6:00 PM. To further reduce data volume for easier data analysis, spatial and temporal aggregation may be applied. For instance, speeds detected by adjacent detectors located at a segment of freeway that has similar characteristics could be averaged to produce one travel speed to represent the speed of that segment of freeway.

Data Sources and Data Needs

- **Real-Time Travel Speed and Travel Times:** The freeway travel speed collected by the ADOT TOC should be archived for off-line data analysis. Additionally, annual travel time studies should be conducted for the ten selected origin-destination pairs. Consideration should be given to the variation in seasonal traffic (winter/summer). The MAG Bottleneck Study (2003) and the Texas Transportation Institute (TTI) Urban Mobility Report, could provide useful baseline data.
- **Highway Characteristics:** The freeway geometry and operational characteristics (such as number of lanes and if it is a known bottleneck area) can be used to aggregate instrumented freeway segments together in order to reduce the amount of data to be analyzed. An approach might be to average the data collected between interchanges or a group of interchanges into a single reporting unit. For example, the detector data collected on SR-51 North, from 32nd Street to Bell Road, may be averaged, if the data appeared to exhibit similar speed and travel time characteristics. When deciding upon

which freeway segments would be acceptable to consolidate into a single reporting group, geometric conditions and other factors that may affect travel time and travel speeds should be considered. As-built drawings and other sources of base-mapping may assist in this analysis.

- **Freeway Segment Identification:** A set of routes or freeway segments and origin-destination pairs should be identified for applying the travel time analysis. During the selection process, the availability of speed or travel time on the selected routes should be considered to ensure the measure can be implemented.

Geographic Extent

The geographic extent of this performance measure should cover, at a minimum, the instrumented freeway segments. The performance measure should eventually be expanded to cover the entire urban freeway system in the MAG region.

5.2 Arterial Mobility

Signalized intersections represent the primary capacity constraint on arterials. Thus, optimized signal operations is critical to improving arterial mobility. There are over 2,000 signalized intersections in the MAG Region. The performance of a high percentage of them could be improved easily and inexpensively by simply adjusting the timing.

5.2.1 Three-Year and Five-Year Goals

In order to improve arterial mobility in the MAG Region, the stakeholders have set goals to:

Three-Year Goal:

- Limit the percent increase in average arterial travel time to less than the percent increase in traffic volume.
- Implement traffic signal coordination within cities on 100 percent of the smart corridors.
- Implement signal coordination between cities on 100 percent of the smart corridors.

Five-Year Goal:

- Continue to limit the percent increase in average arterial travel time to less than the percent increase in traffic volume.
- Update the traffic signal coordination within cities every two years or when traffic volumes through the intersection change by more than five percent.
- Update the cross-border traffic signal coordination between cities every two years or when traffic volumes along the arterial change by more than five percent.

5.2.2 Performance Measures

Progress toward achieving improved arterial mobility will be evaluated by:

- Peak and non-peak period average travel times by arterial;
- Percentage of traffic signals coordinated within a city; and
- Percentage of cross-border traffic signals coordinated between cities.

The following sections explain the proposed performance measures in more detail.

5.2.2.1 Peak/Non-Peak Period Average Travel Time by Arterial

The annual average peak hour travel time will be measured on selected arterials during the AM peak, PM peak, and an off-peak period. Four north/south arterials and six east/west arterials will be initially selected. The arterials that have been initially selected also are included in either Phase I or Phase II of the AZTech™ Smart Corridors program. These arterials include:

- 59th Avenue;
- 7th Street;
- Scottsdale Road;
- SR87/Arizona Avenue;
- Bell Road/Frank Lloyd Wright Boulevard;
- Glendale Avenue/Lincoln Road;
- Indian School Road;
- Baseline Road;
- Southern Avenue; and
- Chandler Boulevard.

Proposed Formulas and Methods

It is recommended that during the survey period, travel times be collected three times daily: 6:00 AM to 9:00 AM, 11:00 AM to 1:00 PM, and 3:00 PM to 6:00 PM. Travel speeds may be collected by probe vehicles using commercially available software such as PC Travel or GPS-based software.

Data Sources and Data Needs

- Arterial Travel Time: Unlike freeways, in which speed detector data is available, automatic arterial travel speed and travel time data is unavailable. Annual surveys, such as the MAG Travel Time Study (2003), should be conducted.
- Arterial Selection**:** Though the arterials to be surveyed have been initially outlined above, it may be necessary to reevaluate the selected arterials based upon feedback from the stakeholders.

Geographic Extent

This measure will be applied to four north/south arterials and six east/west arterials in the MAG Region.

5.2.2.2 Percentage of Coordinated Traffic Signals within a City

In order to underscore the importance of traffic signal coordination, the percentage of coordinated traffic signals within a city has been selected as a performance measure. It is recognized that this performance measure is not independent of the arterial travel-time performance measure (section 5.2.2.1). Improvement in this

performance measure, a higher percentage of coordinated signals, will have a positive effect on arterial travel time.

Proposed Formula and Method

Percentage of within-city traffic signal coordination is calculated as the number of traffic signals within a city that have been coordinated divided by the total number of traffic signals in a city.

Data Sources and Data Needs

Data for this performance measure will be collected through a survey of the local TMCs. Data needs include traffic signal inventories of:

- Signal location; and
- Timing-plan information indicating if the signal is coordinated with adjacent signals

Geographic Extent

The geographic extent for this measure should cover each of the smart corridors within each city.

5.2.2.3 Percentage of Cross-Border Traffic Signals Coordinated Between Cities

While city traffic engineers can implement traffic signal coordination within a city, cross-border traffic signal coordination can be achieved only through cooperation between cities.

Proposed Formula and Method

The percentage of cross-border traffic signals coordinated between cities is calculated as the number of traffic signals coordinated with signals in the adjacent city divided by the total number of traffic signals at the city border.

Data Sources and Data Needs

Data for this performance measure will be collected through a survey of the local TMCs. Data needs include traffic signal inventories of:

- Signal location; and
- Timing-plan information indicating if the signal is coordinated with adjacent signals of the neighboring city.

Geographic Extent

The geographic extent for this measure should cover each of the smart corridors that cross multiple jurisdictions.

5.3 Freeway Incident Management

As previously stated, studies have estimated that approximately one-half of travel delay is due to incidents[(1)]. Effective incident management yields significant benefits to the transportation system. These include:

- Reduced vehicle delays;
- Enhanced safety to motorists through the reduction of incident frequency and improved response and clearance times; and
- Reduced vehicle emissions that result from reduced delays and increased travel speeds.

5.3.1 Three-Year and Five-Year Goals

Improvements to incident management in the MAG region will be realized by decreasing the average incident duration and clearance times.

Three-Year Goal:

- Reduce incident duration by 10 percent.

Five-Year Goal:

- Reduce incident duration by 20 percent.

5.3.2 Performance Measure

Improvement in incident management in the MAG region will be charted by measuring the incident duration and clearance times.

Proposed Formula and Method

The incident response and clearance time can be calculated as the time from when an accident occurs to when it is cleared.

Data Sources and Data Needs

Though incident duration and clearance time information may not be readily available, documentation of incident duration times will enable better understanding of incident clearance performance and allow for improvements in the future.

In order to evaluate progress toward the defined goals, baseline data will need to be collected. This may be difficult without a DPS CAD system. A potential data source is the ADOT TOC activity logs. TOC operators should record the time that they are made aware of an incident, and the time that the incident is cleared, as may be viewed from the closed-circuit television (CCTV) monitors and reported by DPS and other emergency management agencies.

Geographic Extent

The geographic extent for this performance measure should cover, at a minimum, the instrumented portions of the urban freeway system. If possible, incident clearance and duration should be documented on the entire freeway system.

5.4 Freeway-Arterial Interface

The freeway-arterial interface refers to the joint operations of freeways and arterials. Because the freeways and arterials are most often operated and maintained by separate agencies, cooperation and communication between arterial systems (traffic signals) and freeway systems (ramp-meters) is limited; however, improving coordination between arterial and freeway operations can improve both freeway mobility and arterial mobility. This can be achieved through the establishment of an integrated freeway-arterial management system.

The objective of an integrated freeway-arterial management system is to minimize the delay incurred by travelers during incidents by jointly maximizing the capacity of the freeways and adjacent arterials.

5.4.1 Three-Year and Five-Year Goals

Three-Year Goal:

- The three-year goal for improving freeway-arterial interfaces in the MAG region is to establish integrated freeway-arterial corridor operations on one corridor.

Five-Year Goal:

- The five-year goal for improving freeway-arterial interfaces in the MAG region is to establish integrated freeway-arterial corridor operations on three corridors.

5.4.2 Performance Measure

An evaluation, including before and after studies, of the selected corridor will be conducted. The evaluation will indicate the effectiveness of the integrated freeway-arterial operations, and will provide guidance for future deployment. Travel times and delay estimates should be included in the evaluation study.

Proposed Formula and Method

As mentioned, an evaluation will be conducted upon conclusion of the pilot project to determine the efficacy of the system. Expected benefits include a decrease in secondary crashes, reduction in travel time delay, and the resultant decrease in vehicle emissions. In order to provide baseline data for the evaluation, travel time and delay studies should be conducted on the corridors selected corridors prior to deployment.

Data Sources and Data Needs

In order for the three-year and five-year goals to be met, candidate corridors must be identified, the pilot project implemented, and an evaluation conducted.

Geographic Extent

The geographic extent for this measure will cover one corridor within three years and three corridors within five years.

5.5 Arterial Incident Management

Reducing the clearance times of arterial incidents and implementing proper traffic control during incidents can result in increased safety to not only the traveler, but also to emergency management personnel. These objectives can be achieved through the implementation of an arterial incident management system.

5.5.1 Three-Year and Five-Year Goals

Improvements in arterial incident management will be achieved by:

Three-Year Goal:

- Developing and implementing an arterial incident management system.

Five-Year Goal:

- Expand the system to cover one-half of the MAG member agencies.

5.5.2 Performance Measure

Improvement in arterial incident management will be demonstrated by a decrease in arterial incident response and clearance times.

Proposed Formula and Method

Arterial incident response and clearance times will be calculated as the average arterial incident response and clearance times in minutes.

Data Sources and Data Needs

This data will need to be obtained from local police and emergency services databases, such as local police CAD systems.

Geographic Extent

The geographic extent for this measure should cover one-half of MAG member agencies within five years.

5.6 Arterial Operations

While several valley agencies have implemented emergency vehicle signal preemption systems (EVSP), there has not been a coordinated effort to develop a consistent set of operational parameters. While ADOT has developed some guidelines for the implementation of EVSP on ADOT routes, there is no common, agreed upon implementation of the EVSP within the numerous municipalities. For safety reasons, it is important that emergency vehicle driver expectations are consistent across jurisdictional boundaries and throughout the region. This is particularly important because of the high degree of cooperation among fire departments

throughout Maricopa County. Thus, it is not uncommon to see fire response vehicles from Tempe, for example, respond to emergencies in Mesa.

5.6.1 Three-Year and Five-Year Goals

Three-Year Goal:

- The three-year goal in the MAG region is to establish a regional standard for implementation of EVSP.

Five-Year Goal:

- The five-year goal in the MAG region is to ensure the adoption of the EVSP standard by each of the MAG member agencies, and to implement the standard on 100 percent of the traffic signals with EVSP.

5.6.2 Performance Measure

Progress toward the three-year and five-year goals will be measured by evaluating the percentage of signals with emergency vehicle signal-preemption systems operating according to the regional standard.

Proposed Formula and Method

The percentage of traffic signals with EVSP implemented according to the regional standard will be calculated as the total number of signals in the region with EVSP that operate according to the regional standard divided by the total number of signals in the region with EVSP.

Data Sources and Data Needs

Table 3 of Technical Memorandum No. 1 reviews the current status of emergency vehicle signal preemption in the MAG Region. The results of this survey are useful in providing a baseline for this measure.

As the regional standard for EVSP is developed and implemented, the level of deployment can be obtained from a questionnaire to be completed by the local traffic engineers and TMC operators. Required data includes:

- Total number of signals with emergency vehicle signal preemption in the city; and
- Total number of signals that operate emergency vehicle preemption according to the regional standard.

Geographic Extent

The geographic extent for this measure should cover entire MAG region.

5.7 Transit Mobility

Transit operations are a critical link in the transportation system. While several performance measures, such as transit service coverage or transit service frequency, could demonstrate an overall improved transit system, this project focuses on the areas that can be improved through improved cooperation and coordination between transit agencies and local city TMCs.

5.7.1 Three-Year and Five-Year Goals

With the deployment of the Central Phoenix/East Valley Light Rail Transit (LRT) Project, the Phoenix area will soon be the example for leading-edge practice in Transit Signal Priority (TSP) for LRT services. An additional opportunity for improved coordination between transit and traffic engineering disciplines is in the deployment of Bus Rapid Transit (BRT) in mid-2003.

Three-Year Goal:

- The three-year goal in the MAG region is to deploy a TSP pilot project in the MAG Region.

Five-Year Goal:

- The five-year goal in the MAG region is to deploy transit signal priority to all BRT routes in the MAG Region.

Proposed Formula and Method

The effectiveness of Transit Signal Priority will be evaluated by an evaluation study of the TSP pilot project. Measures should include transit trip travel times, transit schedule adherence, and an evaluation of the effects of TSP on the arterial network. Prior to the TSP pilot project, transit trip travel times should be collected on the selected BRT corridors.

Expected benefits include improved schedule reliability, reduced transit travel times, reduced stops, increased rider comfort, and ultimately an increased attractiveness of transit [(2)]. In Los Angeles, deployment results of TSP indicated an average eight percent decrease in overall bus running time, and a 35% reduction in bus delay at signalized intersections[(2)].

Data Sources and Data Needs

Data needs for proposed formula should include:

- Locations of intersections on express bus routes;
- Locations of intersections on bus-rapid transit routes;
- Selection of corridor for TSP pilot project;
- Transit trip travel time on selected BRT routes prior to deployment; and
- TSP evaluation study.

Geographic Extent

The geographic extent for this measure should cover the BRT routes selected for TSP deployment.

5.8 System Reliability

System reliability is a measure of the availability of the system to actively monitor and control the transportation network. System reliability is of particular importance during the peak periods, when congestion levels are high and monitoring and control of the transportation system can provide significant benefits to the traveling public. System reliability is not as crucial during non-peak periods, such as at night or on weekends.

5.8.1 Three-Year and Five-Year Goals

The system may include transportation field devices such as signals, controllers, and detectors, the computer system in the traffic operation center, and the communication infrastructure. The system uptime is a quantitative measure of reliability and maintenance.

Three-Year Goal:

The three-year goals for system reliability is to:

- Operate the system with up time of 95 percent – no more than 450 hours down time per year. This allows for approximately eight hours of system maintenance to be performed per week. Maintenance is preferably conducted during off-peak periods; and
- Minimize system down time to an average of 1 hour per system failure.

Five-Year Goal:

- The five-year goals for system reliability are the same as the three-year goals.

5.8.2 Performance Measure

System reliability will be measured by two performance measures:

- Percentage of system uptime; and
- Average time to resume service if system failed.

5.8.2.1 Percentage of system uptime

Proposed Formula and Method

The calculation of the percentage of system uptime requires the clarification of system downtime. Not all system or field device failures affect transportation operations. Many devices and system components have a redundant design to ensure their continuous operation, in the case that one component is out of service. The system down time, including the time for performing scheduled system maintenance, is defined as the duration of time when a transportation system or device cannot provide its normal function and, consequently, affects motorists' travel decisions or transportation engineers' judgment of traffic operations. The system downtime will be calculated as:

- Percentage of system uptime can be calculated as [1 – (Annual system down time in minutes divided by (60 x 24 x 365) minutes)] x 100%.

Often, the transportation system is a collection of various systems that work harmoniously to provide one or more functions. Accordingly, the system uptime should be measured by categorizing the transportation systems based on their services such as signal control, ramp metering, or detection and computing the uptime for each system individually.

Data Sources and Data Needs

System downtime can be obtained from the system operations and system maintenance logs, from which the percentage of system uptime can be derived. This will be obtained through a survey of local TMCs.

Geographic Extent

The geographic extent for this measure should cover all transportation systems in the entire MAG region.

5.8.2.2 Average Time to Resume Service if System Failed

System downtime is inevitable especially when there is a need for scheduled system maintenance. Another means of gauging system performance is to measure how fast the system resumes normal operations, or the mean time to repair the system.

Proposed Formula and Method

The system downtime is equal to the time needed for resuming service. The average time to resume operation can be calculated as

- Average number of minutes from the time that the system failed until the time that it resumes functioning.

Data Sources and Data Needs

The system downtime information can be obtained from system operation and maintenance logs. This will be obtained through a survey of local TMCs.

Geographic Extent

The geographic extent for this measure should cover all transportation systems for in the MAG region.

5.9 Multi-Agencies Coordination

Multi-agency coordination is the first step to establishing a successful regional transportation system. Establishing center-to-center communications will facilitate regional coordination. Center-to-center communication is the key to regional traveler information sharing, incident and emergency management, and signal coordination across jurisdictional boundaries.

5.9.1 Three-Year and Five-Year Goals

The three-year and five-year goals for multi-agency coordination in the MAG region are:

Three-Year:

- Establish center-to-center communications between 15 agencies in the region. These agencies should include traffic and transportation, enforcement, emergency management, and transit.
- Facilitate incident and emergency response between 15 agencies.
- Facilitate travel information sharing between 15 agencies.

Five-Year:

- Establish center-to-center communications between 20 agencies in the region. These agencies should include traffic and transportation, enforcement, emergency management, and transit.
- Facilitate incident and emergency response between 20 agencies.
- Facilitate travel information sharing between 20 agencies.

5.9.2 Performance Measure

Multi-agency coordination will be measured by the number of center-to-center communication links established between agencies in the MAG region.

Proposed Formula and Method

This measure will be calculated as the total number of center-to-center communication connections for data sharing and operation coordination in the MAG region. This data will be obtained through a survey of emergency management, transportation, and transit centers in the MAG region.

Data Sources and Data Needs

Data concerning the availability of center-to-center communications will be obtained by conducting surveys and interviewing transportation agencies in the MAG region.

Geographic Extent

This measure should be applied to all transportation, incident and emergency management, enforcement, and transit agencies in the entire MAG region.

5.10 Travel Information Provision

Traveler information becomes increasingly important to motorists and transit riders because it can help to select departure time, mode of travel, and alternative routes if an incident occurs. The number of traveler information users reveals not only how travelers prefer to receive traveler information but also how efficiently either traffic or non-traffic related information is disseminated to the traveler during an emergency situation.

5.10.1 Three-Year and Five-Year Goals

The three-year and five-year goals of increasing travel information in the MAG region are:

Three-Year Goal:

- Increase travel information usage (web, 511, television, radio, etc.) by 100 percent.
- Achieve a 75 percent customer satisfaction rating. On a scale of 1 to 10, a score of 7 or higher is desired.

Five-Year Goal:

- Increase travel information usage (web, 511, television, radio, etc.) by 200 percent.

- Achieve a 75 percent customer satisfaction rating. On a scale of 1 to 10, a score of 7 or higher is desired.

5.10.2 Performance Measures

The performance measures used to evaluate the increase in travel information provision and usage are:

- Number of users of travel information services; and
- Quality of information being provided to travel information services.

5.10.2.1 Number of Users of Travel Information Services

Proposed Formula and Method

The 511 service and website provide regional traveler information including incident, weather, and construction restrictions. The web log provides detailed daily web usage such as the total number of page hits, number of hits per page, number of visitors, and which page users visit most. This information is useful for traveler information provision enhancement.

The 511 system will be able to provide the number of calls placed to the service in a given month.

It will be necessary to conduct interviews of information service providers (i.e., Westwood One) and local radio and television stations. The purpose of the survey is to determine how many stations broadcast travel information, the frequency of broadcast (every hour, every half-hour, every ten minutes, etc.), source of travel information, and estimated number of listeners. The estimated number of listeners may be estimated by the radio and television stations using established ratings studies. Because some travelers may receive information from the web site, radio, and television, care must be taken to eliminate duplications.

Data Sources and Data Needs

Traveler information usage can be gathered from:

- 511 service – calls per month;
- Website log analysis – hits per month; and
- Conducting interviews with local traveler information service providers and radio and television stations – number of stations broadcasting information, frequency of broadcast, estimated number of listeners.

Geographic Extent

This measure should be applied to all sources of traveler information in the MAG region.

5.10.2.2 Quality of Information Being Provided to Travel Information Services

Whether travelers rely on travel information depends largely on the quality of the information. Quality can be defined in terms of accuracy, reliability, and timeliness.

Accuracy indicates that the information reflects reality. For instance, accuracy reflects whether accident reports are updated when the accident is cleared, or construction is actually occurring at the location as specified in the construction report.

Reliability shows how stable the traveler information system is in providing accurate, accessible traveler information without interruption.

Timeliness represents how often the traveler information is provided to travelers. For instance, how much time elapses after an incident occurs before it is recorded to the incident management database, posted on the 511 service and website, reported to a radio or television station, or displayed on a variable message sign. In addition, this may reflect how often the content is updated for an incident or construction zone.

It is important to understand that there is a correlation among these quality measures. For instance, the delay of information is very likely to result in traveler's receiving inaccurate information. This is especially true with a short duration event such as a minor traffic incident. Although delay is inevitable, improving timeliness can increase the accuracy of traveler information.

If the customer perceives the information to be accurate, reliable, and timely, customer satisfaction with the travel information service is likely to be high. Customer satisfaction will be measured through surveys that are either done independently of the travel information service, or that the traveler can access through an additional menu on the 511-telephone service or webpage link on the az511.com website.

Proposed Formula and Method

A series of questions will be developed for the survey. Customers will be asked to respond to each question using a scale of 1 to 10.

Data Sources and Data Needs

This performance measure will require the development of a customer satisfaction survey.

Geographic Extent

This measure should be applied to all transportation agencies and traveler information providers in the MAG region.

5.11 Summary of Operational Goals and Performance Measure Data Needs

Table 1 summarizes the operational goals for improved transportation operations in the MAG region. **Table 2** summarizes the performance measures selected to evaluate progress toward

achieving the operational goals. Also included in **Table 1** are the formula for calculating each performance measure, and potential data sources.

Table 1 – Summary of Three-Year and Five-Year Goals, and the associated Performance Measure

Category	Proposed Measure	Three-Year Goals	Five-Year Goals
Freeway Mobility	Peak/non-peak period average travel speed and travel time by freeway segment	Limit the percent increase in average travel time to less than the percent increase in traffic volume	Limit the percent increase in average travel time to less than the percent increase in traffic volume
Arterial Mobility	Peak/non-peak period average travel time by arterial	Limit the percent increase in average travel time to less than the percent increase in traffic volume Data will be collected on five north/south arterials and five east/west arterials. Initially, the selected arterials may include: **North/South** • 59th Avenue • 7th Street • Scottsdale Road • SR87/Arizona Avenue **East/West** • Bell Road/Frank Lloyd Wright Boulevard • Glendale/Lincoln Road • Indian School Road • Baseline Road • Southern Avenue • Chandler Boulevard	Limit the percent increase in average travel time to less than the percent increase in traffic volume
	Percentage of coordinated traffic signals within a city	Implement signal coordination within a city on 100 percent of the smart corridors	Update the traffic signal coordination within cities every two years or when traffic volumes through the intersection change by more than five percent
	Percentage of coordinated traffic signals between cities	Implement signal coordination between cities on 100 percent of the smart corridors	Update the cross-border traffic signal coordination between cities every two years or when traffic volumes along the arterial change by more than five percent

Table 1– Summary of Three-Year and Five-Year Goals, and the associated Performance Measure (continued)

Category	Proposed Measure	Three-Year Goals	Five-Year Goals
Freeway Incident Management	Freeway incident response and clearance times	Reduce incident duration by ten percent	Reduce incident duration by 20 percent
Freeway-Arterial Interface Operations	Integrated freeway-arterial operations evaluation study, which includes a measure of travel time	Establish integrated freeway-arterial corridor operations on one corridor	Establish integrated freeway-arterial corridor operations on three corridors
Arterial Incident Management	Arterial incident response and clearance times	Develop and implement an arterial Incident Management System (IMS)	Expand the system to cover one-half of the MAG member agencies
	Percentage of emergency vehicle preemption signals operating according to the established regional standard	Establish a regional standard for implementation of EVSP	100 percent of signals with EVSP operating according to the established regional standard
Transit Mobility	Transit Signal Priority evaluation study, which includes transit trip travel times on Bus Rapid Transit Routes, and evaluation of impacts on arterial network	Deploy a TSP pilot project in the MAG Region	Deploy TSP to all Express and BRT routes
Maintenance and Reliability	Percentage of system (including computer system in the TMCs) uptime	Operate the system with up time of 95 percent – no more than 450 hours down time per year	Operate the system with up time of 95 percent – no more than 450 hours down time per year
	Average time to resume service if system failed	Minimize system down time to an average of 1 hour per system failure	Minimize system down time to an average of 1 hour per system failure
Multi-agencies coordination	Number of center to center communication links	• Establish center-to-center communications between 15 agencies (including traffic, enforcement and emergency management) in the region • Facilitate incident and emergency response between 15 agencies • Facilitate travel information sharing between 15 agencies	• Establish center-to-center communications between 20 agencies (including traffic, enforcement and emergency management) in the region • Facilitate incident and emergency response between 20 agencies • Facilitate travel information sharing between 20 agencies

Table 1– Summary of Three-Year and Five-Year Goals, and the associated Performance Measure (continued)

Category	Proposed Measure	Three-Year Goals	Five-Year Goals
Traveler Information Provision	Usage • Web site – hits per month • 511 telephone service – calls per month • Television broadcast – frequency of broadcast of travel information • Radio broadcast – frequency of broadcast of travel information	Increase usage (web, 511 television, radio, etc.) by 100 percent	Increase usage (web, 511 television, radio, etc.) by 200 percent
	Information quality	75 percent Customer satisfaction – on a scale of 1 to 10, 7 or higher scores	75 percent Customer satisfaction – on a scale of 1 to 10, 7 or higher scores

Table 2 – Proposed Performance Measures, Formula, and Potential Data Sources

Category	Proposed Measure	Proposed Formula and Method	Data Source	Geographical Extent
Freeway Mobility	Peak/non-peak period average travel time by freeway segment	Annual average peak hour travel speed/travel time detected at each sensor station during AM and PM peaks and an off-peak period on Freeway Management System (FMS) instrumented sections of freeway	Annual travel time/travel speed studies, may include data from ADOT Traffic Operations Center (TOC), MAG Bottleneck Study (2003), TTI Urban Mobility Study (Annually)	Route/segment level
Arterial Mobility	Peak/non-peak period average travel time by arterial	Annual average peak hour travel time on selected arterials during AM and PM peaks and an off-peak period Data will be collected on four north/south arterials, and six east/west arterials **North/South** • 59th Avenue • 7th Street • Scottsdale Road • SR87/Arizona Avenue **East/West** • Bell Road/Frank Lloyd Wright Boulevard • Glendale/Lincoln Road • Indian School Road • Baseline Road • Southern Avenue • Chandler Boulevard	Annual travel time studies, may include data from local Traffic Management Centers (TMCs), MAG Congestion Study (1998), MAG Travel Time Study (2003)	Arterial/segment level

Table 2– Proposed Performance Measures, Formula, and Potential Data Sources (continued)

Category	Proposed Measure	Proposed Formula and Method	Data Source	Geographical Extent
Arterial Mobility (continued)	Percentage of traffic signals coordinated within a city	Number of traffic signals within a city that have been coordinated divided by the total number of traffic signals in a city	Data for this performance measure will be collected through a survey of the local TMCs; data needs include: • Signal location • Timing-plan information indicating whether signal is coordinated with adjacent signals of neighboring city	Region-wide
	Percentage of cross-border traffic signals coordinated between cities	Number of traffic signals coordinated with signals in the adjacent city divided by the total number of traffic signals at the city border	Data for this performance measure will be collected through a survey of the local TMCs; data needs include: • Signal location • Timing-plan information indicating whether signal is coordinated with adjacent signals of neighboring city	Region-wide
Freeway Incident Management	Freeway incident response and clearance times	Annual average freeway incident response and clearance times in minutes	ADOT TOC database, DPS database	Urban freeways
Freeway-Arterial Interface Operations	Coordinated freeway-arterial operations evaluation study, which includes a measure of travel time	Average peak travel time on selected origin-destination pairs (including arterial segment and freeway segment) during AM and PM peaks and an off-peak period where integrated freeway-arterial operation have been implemented Pre-deployment data (travel time and delay on selected corridors) is needed to provide a baseline data set	Travel time/travel speed studies, evaluation study of integrated freeway-arterial operations	Urban freeway segment/arterial segment where coordinated operations were deployed

Category	Proposed Measure	Proposed Formula and Method	Data Source	Geographical Extent
Arterial Incident Management	Arterial incident response and clearance times	Annual average arterial incident response and clearance times in minutes	Local police and emergency services database	Smart corridors
	Percentage of traffic signals with emergency vehicle preemption systems (EVSP) operating according to the established regional standard	Total number of signals in the region with EVSP that operate according to the regional standard divided by the total number of signals in the region with EVSP	Local TMCs plus data processing and aggregation	Region-wide
Transit Mobility	Transit Signal Priority evaluation study, which includes transit trip travel times on Bus Rapid Transit Routes, and evaluation of impacts on arterial network	Average travel time on Bus Rapid Transit routes where Transit Signal Priority has been implemented Analysis of impacts on arterial network	Valley Metro transit management center Local Traffic Management Centers	Bus Rapid Transit Routes
Maintenance and Reliability	Percentage of system uptime, including FMS and local ATMS	Annual total number of minutes that systems are functioning divided by the total minutes in a year (60 x 24 x 365); system shutdown during scheduled maintenance is counted as system downtime	Maintenance logs from system administrative personnel	Region-wide per system
	Average time to resume service if system failed (mean time to repair)	Average number of minutes from the time system failed to the time it resumes functioning	Maintenance logs from system administrative personnel	Region-wide per system
Multi-agencies Coordination	Number of center to center communications links	Total number of center-to-center connections for data sharing and operation coordination	Annual Survey and interview of local TMCs	Region-wide per system

Table 2– Proposed Performance Measures, Formula, and Potential Data Sources (continued)

Category	Proposed Measure	Proposed Formula and Method	Data Source	Geographical Extent
Traveler Information Provision	Usage • Web site – hits per month • 511 telephone service – calls per month • Television broadcast – frequency of broadcast of travel information • Radio broadcast – frequency of broadcast of travel information	Annual total number of users of the traveler information system • web site – hits per month • 511 telephone service – calls per month • radio/television stations – – number of stations broadcasting information – frequency of broadcast (hourly, peak-hours only, etc.) – estimated number of listeners	User counts (hits/telephone calls) from regional traveler information applications such as those provided by ISPs, and the 511 web site and telephone service, viewers/listeners from the broadcast industry surveys.	Region-wide
	Information quality	Percentage of information users who are satisfied with the system. Satisfaction will be graded on a scale of 1 to 10.	Annual Survey and interview. Survey could be incorporated into web site and telephone service	Region-wide

6. PERFORMANCE MEASURE PROGRAM

The performance measures, method of implementation, data needs and data sources have been identified in previous sections of this report. This section provides a description of the responsibilities, the data collection needs of each agency.

6.1 Roles and Responsibilities

6.1.1 Arizona Department of Transportation

ADOT is responsible for the monitoring and control of freeways and state route operations. The ADOT TOC, located in Phoenix, is the hub of ADOT's freeway operations and incident management center. Through its vehicle detectors, CCTV cameras, and VMS, the TOC not only regulates and monitors traffic flow but also provides traveler information to travelers via multiple means such as the Internet, video feeds to other media, and the 511 service. The TOC hosts the state's Highway Condition Reporting System (HCRS) and serves as the incident detection and response coordination center.

The objectives of the ADOT TOC are to:

- Support optimum utilization of the freeway system;
- Provide a safe and efficient environment for users; and
- Ensure efficient utilization of ADOT resources.

6.1.2 Maricopa Association of Governments

MAG is the metropolitan planning organization for the region and assumes responsibility for transportation operations planning.

- Provide guidelines and standards for regional transportation operations;
- Provide funding and resources to facilitate regional transportation coordination; and
- Coordinating municipalities to identify alternative routes for traffic diversion in case incident and emergency occurs.

6.1.3 Municipal Agencies and Maricopa County

Municipal agencies manage the majority of the roadways and traffic signals in the MAG Region. The roles of municipal agencies are to:

- Implement signal control and signal coordination strategies for improved traffic movement;
- Plan for road maintenance and construction; and
- Ensure travelers' safety, and protect against property damage.

While an efficient and safe transportation system within a city is important, a regional transportation system relies on coordination among agencies in different cities to ensure that a high level of transportation service does not stop at the city boundary. Only through the coordination between municipal agencies can the transportation system in the MAG region become more efficient.

6.1.4 Data Needs for Performance Measure

Through data collection and statistical analysis, performance can help to determine progress toward defined operational objectives. Performance measures help to:

- Set goals and standards;
- Detect and correct problems;
- Manage, describe, and improve processes; and
- Document accomplishments.

A successful performance measure relies on a clear data collection plan. The plan should:

- Identify how much data needs to be collected, the population from which the data will be collected, and the length of time to collect the data;
- Identify the charts and graphs to be used, the charting frequency, the type of comparison to make, and the calculation methodology; and
- Identify the characteristics of the data to be collected.

A variety of data needs to be collected by each agency in order to execute the performance measures. **Table 3** lists the proposed performance measures, their data needs, and each agency's responsibility for data collection.

6.2 Performance Measure Execution, Agency Roles, and Responsibilities

Each agency in the MAG region is responsible for traffic operations and emergency management not only within its own boundaries, but also in the entire region. Performance measure examines the degree of achievement that has been reached as well as identifies the problems that need to be solved. While the roles, responsibilities, and data needs have been clearly identified for each agency, the full cycle of performance measure execution requires funding, careful planning, data collection, data analysis, performance review, problem identification, and agency coordination. MAG should take the coordinating role in the Performance Measurement Program.

6.2.1 Budgeting

Funding is always an issue to transportation agencies. Besides system design and planning, and installation, the transportation budget is allocated to operations and maintenance. Performance measure also requires human resources and funding to conduct data collection and analysis. The first step of performance measure execution is to allocate funding and resources for this special purpose.

6.2.2 Planning

After funding and resources have been identified, agencies in the MAG region should prioritize the performance measures based on the available resources and timeline, and reach a consensus for selected measures. Stakeholders from the state, county, and cities should meet to discuss the time frame for data collection and the schedule for the entire performance measures process.

6.2.3 Execution

In-house or contract resources could conduct the performance measurement. During the planning and execution period, the in-house or contract resources will need to interview agencies to obtain feedback and assess data availability required by the measures.

6.2.4 Review

The output of data analysis should be reviewed by each agency before drawing the final conclusions. The in-house or contract resources should detail where, how, and what data has been collected and for how long it should be collected. The agency's duty is to verify the correctness of the data and to confirm the performance measure methodology.

6.2.5 Problem Identification

After the review process, a conclusion of performance measures will be presented to stakeholders along with the problems identified. Recommendations to resolve these problems should be proposed to the stakeholders for operational considerations.

6.2.6 Coordination

Agency coordination is the key to creating an integrated regional transportation system. For years, city policy makers and traffic engineers have focused on the improvement of transportation services in the city; however, city boundaries are becoming blurred, as travelers demand continuous and consistent services irrespective of what city they are in. Through careful planning and coordination, transportation professionals from cities, county, and the state should focus on the problems identified by the performance measures and diligently assess the feasibility of proposed solutions. After problems are identified, and solutions implemented, another round of performance measure begins. Budget should be allocated for additional performance measure and analysis. The performance measure objectives and goals may need to be modified as regional conditions change, or as existing goals and objectives are met.

Table 3 – Data Needs and Responsibilites

Category	Proposed Measure	Data Needs	Agency Responsible for Data Collection
MAG will have responsibility for the overall management of the performance measures program. Specific responsibilities will include: • Coordination of data collection • Compilation of data • Data processing and analysis • Data reporting			
Freeway Mobility	Peak/non-peak period average travel time by freeway segment	• Freeway travel speeds for peak periods and non-peak period • Freeway travel time for peak hours and non-peak period • Freeway vehicle volumes	• MAG – travel time studies on freeway segments • ADOT – FMS data including vehicle volumes and travel speeds
Arterial Mobility	Peak/non-peak period average travel time by arterial	• Arterial travel time for peak hours and non-peak hours • Arterial vehicle volumes	• MAG – travel time studies on selected arterials • DOT of – Chandler – Gilbert – Glendale – Goodyear – Mesa – Peoria – Phoenix – Scottsdale – Surprise – Tempe – Maricopa County
Freeway Incident Management	Freeway incident response and clearance times	Incident duration and clearance times	• ADOT • DPS
Freeway-Arterial Interface	Coordinated freeway-arterial operations evaluation study, which includes a measure of travel time	• Arterial – freeway corridor travel time for peak hours and non-peak hours • Arterial - freeway vehicle volumes • Integrated freeway-arterial pilot project evaluation results	MAG

Table 3 – Data Needs and Responsibilites (continued)

Category	Proposed Measure	Data Needs	Agency Responsible for Data Collection
Arterial Incident Management	Arterial incident response and clearance times	Incident duration and clearance times	• MCSO • Police Departments of – Chandler – Gilbert – Glendale – Goodyear – Mesa – Peoria – Phoenix – Scottsdale – Surprise – Tempe
	Percentage of signals with emergency vehicle pre-emption system (EVSP) in which EVSP is implemented according to the established regional standard	Signal inventories • signal location • report of whether signal is equipped with EVSP • report of operating parameters (whether consistent with regional standard)	DOT of • Chandler • Gilbert • Glendale • Goodyear • Mesa • Peoria • Phoenix • Scottsdale • Surprise • Tempe • Maricopa County
Transit Mobility	Transit Signal Priority evaluation study, which includes transit trip travel times on Bus Rapid Transit Routes, and evaluation of impacts on arterial network	• Bus Rapid Transit Route travel time • TSP Pilot project evaluation results	• MAG • Valley Metro

Table 3 – Data Needs and Responsibilites (continued)

Category	Proposed Measure	Data Needs	Agency Responsible for Data Collection
Maintenance and Reliability	Percentage of system uptime	System operations and maintenance logs	• ADOT • DPS • MCDOT • MCSO • Valley Metro • DOT/Police/Fire Departments of – Chandler – Gilbert – Glendale – Goodyear – Mesa – Peoria – Phoenix – Scottsdale – Surprise – Tempe
	Average time to resume service if system failed	Same as above	Same as above
Multi-Agencies Coordination	Number of center to center communication links	Number of center-to-center communication established in the MAG region	• ADOT • DPS • MCDOT • MCSO • Valley Metro • DOT/Police/Fire Departments of – Chandler – Gilbert – Glendale – Goodyear – Mesa – Peoria – Phoenix – Scottsdale – Surprise – Tempe – New cities and towns

Table 3 – Data Needs and Responsibilites (continued)

Category	Proposed Measure	Data Needs	Agency Responsible for Data Collection
Traveler Information Provision	Usage • Web site – hits per month • 511 telephone service – calls per month • Television broadcast – frequency of broadcast of travel information • Radio broadcast – frequency of broadcast of travel information	• System logs of usage (hits per month, calls per month) • Survey of radio and television broadcast stations	• MAG (surveys) • ADOT
	Information quality	Customer satisfaction survey	• MAG • ADOT • MCDOT

7. WORKS CITED

1. 2002 Urban Mobility Study. Mobility Data for Phoenix, Arizona. Texas Transportation Institute. Available online (1/2003) at: http://mobility.tamu.edu/ums/study/mobility_data/tables/phoenix.pdf

2. An Overview of Transit Signal Priority, Advanced Traffic Management Systems Committee and Advanced Public Transportation Systems Committee of the Intelligent Transportation Society of America, 2002.